

The Proceedings of Nineteenth Wuhan International Conference on E-Business



Wuhan, P. R. China

July 5, 2020

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International Journal of Networking and Virtual Organizations (EI & Scopus index),

Journal of Systems and Information Technology (EI & Scopus index),

International Journal of Services Technology and Management (EI & Scopus index).

Preface

The annual Wuhan International Conference on E-Business (WHICEB) is an AIS affiliated conference. WHICEB 2020 is held in Wuhan, P R China on 5 July, 2020. WHICEB promotes intellectual research and facilitates academic and corporate networking in e-business and related fields. The intent is to encourage academic research and business development through exchanging ideas about the e-business, global and corporate financial issues, and necessity for continuous innovation. The conference aims at presenting innovative research findings, solutions and approaches to make the Internet a productive and efficient vehicle for global commerce. Whether running an e-business or transforming a business into e-business, we constantly encounter challenges ranging from technological to behavioral issues, from marketing to data analysis issues, and from effectiveness to security issues. The past years all over the world initiatives have been started for the next step of development. Some people have already talked about the fourth industrial revolution. After consumer oriented mass production we focus nowadays on personalized products and services, which demands cyber physical systems, cloud computing and big data. There are integration issues for management of technology, management of supply chains, management of human resources and management of knowledge and intelligence that are being resolved in an e-business environment. Organizations, regardless of its locations and sizes, should consider having a strategic decentralized planning effort that includes e-business as a pillar for sustainable competitive advantage.

Proceedings of the Nineteenth WHICEB document the breadth and depth of research from different aspects of business and from different disciplines that have major implications for e-business. There are twelve tracks in the proceedings and the proceedings will be listed in the appropriate indexes. The selected best papers from the proceedings will be recommended to international academic journals including but not limited to the following: Electronic Commerce Research and Applications (SSCI), Electronic Commerce Research (SSCI), International Journal of Networking and Virtual Organizations (EI), and International Journal of Services Technology and Management (EI).

The research papers in the proceedings went through a double blind peer review process. Papers are accepted based upon a clear research methodology and contributions to the knowledge of e-business including but not limited to case study, experiment, simulation or survey. The efforts made by our track chairs in reviewing submissions are really appreciated, which ensures the quality of the proceedings. I personally thank them for their professional diligence. They are: Yaobin Lu and Ling Zhao, Artificial intelligence and new IS research; John Qi Dong and Rohit Nishant, Big Data and Analytics; Shangui Hu and Jinnan Wu, Cross-cultural E-commerce; Xiaobo (Bob) Xu and Weiyong Zhang, Digital Technologies, Digital Transformation, and Business Value; Xiaoling Li and Lu Wang, E-business Strategy & Online Marketing; Zhongyun (Phil) Zhou, Xiao-Liang Shen, Yongqiang Sun, and Xiao-Ling Jin, Emerging Issues in E-Business; Nannan Xi, Juho Hamari and Hongxiu Li, Engaging Technologies; Yi Wang, Yuan Sun and Si Shi, Enterprise Social Media; Zhaohua Deng, Tailai Wu, Dongxiao Gu and Jia Li, Information Management and Health Outcomes; Hefu Liu, Cai Zhao and Meng Chen, Information Systems and Operations Management; Dehua He, Deyi Zhou, Amar Razzaq and Muhammad Rizwan, Practice and Theory in Cross-border E-commerce; Jiang Wu, Ling Zhao, Zhongyi Hu and Zhao Pan, Social Network and Commerce.



Yiliu (Paul) Tu

Editor, Proceedings of Eighteenth Wuhan International Conference on E-Business
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Welcome Message from the President of China University of Geosciences

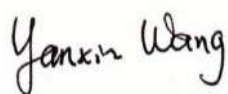
The world today is in the wave of economic globalization and informatization. The Internet and Information Technology (IT) have provided new opportunities to the world economy with tremendous achievements. In this globalizing information era, IT and the Internet are silently changing the way people work, live and learn. In recent years, many scholars have conducted research on e-business from many different disciplines such as computer science, telecommunications, economics, management, human resources, law and sociology. As a result of these efforts, e-business has created a bright perspective for further development in the world and is expected to continue to contribute to global growth and stability.

The Wuhan International Conference on E-business is jointly organized by the International Cooperation Center for E-business and the College of Economy and Management, China University of Geosciences (Wuhan), and by the College of Business, Alfred University in the United States and Baden-Wuerttemberg Cooperative State University Heidenheim, Heidenheim, Germany, and by the School of Management, Research center of Enterprise Decision Support(Key Research Institute of Humanities and Social Sciences in Universities of HuBei Province) ,Wuhan Textile University.

This conference has become an AIS Affiliated Conference In 2011, and the Proceedings of the Nineteenth Wuhan International Conference on E-Business (WHICEB 2020) will be included into AIS library. The focus of this conference is related to realizing the full potential of technology in the globalization era. The conference will demonstrate the latest achievement in the fields of Internet economy and organizations. Conference tracks include Artificial intelligence and new IS research; Big Data and Analytics; Cross-cultural E-commerce; Digital Technologies, Digital Transformation, and Business Value; E-business Strategy & Online Marketing; Emerging Issues in E-Business; Engaging Technologies; Enterprise Social Media; Information Management and Health Outcomes; Information Systems and Operations Management; Practice and Theory in Cross-border E-commerce; Social Network and Commerce. It will providing scholars from home and abroad an academic exchange platform for the promotion of technological innovation and international cooperation, and hence the healthy development of e-business in the world.

CUG, a state key university in China with geosciences as its world-famous academic programs, always attaches great importance to the studies of the interaction among population, economy, society, resources and the environment, in an attempt to promote the harmonious development of both human and nature, and pays great attention to the development of international academic exchange platforms for promoting the international collaboration, and facilitating the process of internationalization of the university.

In recent years, great progress has been made on e-business and the development of management science, which not only promotes the development of management science in CUG, but also provides an important support for the construction of a complete disciplinary system based on geosciences for CUG. The prodigious economic growth in China will provide essentials and supports for the studies of e-business and related fields. E-business will have a major impact on our future prosperity in all facets of life, business and government. Let us work together to strive for a more dynamic e-environment and a more enjoyable life for mankind in this magic e-era!



Yanxin Wang

PhD, Professor

President

China University of Geosciences, Wuhan, China

Welcome Message from the AIS President

Greetings to all WHICEB Delegates! I am delighted to welcome you to the 19th year of the conference. The conference provides an exciting platform for faculty and students to build friendships and share creative ideas and findings. Local conferences are an important part of our community because they provide opportunities for faculty and students to come together, form friendships, and exchange ideas. By fostering such relationships and ideas, WHICEB cultivates high quality scholarship in China, in Asia, and around the globe.

On behalf of the Association for Information Systems (AIS), I would like to thank the conference organizers, Jing Zhao, from the China University of Geosciences, Juergen Seitz from Baden-Wuerttemberg Cooperative State University in Heidenheim, Germany, and Doug Vogel from Harbin Institute of Technology for their service to the conference and to the Information Systems community. I would like to extend a special thanks to Wilfred V. Huang, honorary conference chair, for his many years of service. The conference organizers have assembled a world-class conference committee, attracted a strong set of globally recognized journal outlets, and attracted significant global sponsorship to ensure that the conference, and its delegates is an ongoing success.

The AIS is honored to count WHICEB as an affiliated conference. This year has been a very different year for the conference, and the world as whole. The conference provides an exemplary example of how a group of scholars can come together and have a lasting impact on the quality of research and networking that is necessary to advance the Information Systems discipline.

As AIS President, I personally invite each of you to familiarize yourself with the Association. We offer a growing set of digital services, such as the eLibrary, where the WHICEB conference proceedings will be available to download, webinars on research methods and career management, and access to workshops that can help develop your skills for research and teaching. For members and non-members alike, I urge you to visit www.aisnet.org to learn more about the benefits of membership. I cordially invite you to join the WHICEB 2020, and look forward to seeing you at future conferences such as the International Conference on Information Systems (ICIS) and the Pacific Asia Conference on Information Systems (PACIS).



Alan R. Dennis

President, Association for Information Systems

Professor of Information Systems and John T. Chambers Chair of Internet Systems

Indiana University

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Prediction of Freight Volume Based on Grey Correlation and Improved Grey Neural Network

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Abstract: Freight volume prediction not only plays an important role in the rational allocation of logistics resources, but also has an important impact on the formulation of related policies. This paper first determines the key factors that affect the freight volume through gray correlation analysis, takes the key factors as the input of the grey neural network model, and improves the weights and thresholds of the gray neural network through genetic algorithms to avoid the model from falling into a local optimum. The prediction results of three different models show that the gray neural network based on genetic algorithm optimization has higher prediction accuracy, which proves that the model is reasonable and reliable and can provide a reference for freight volume prediction. The model can also be applied to prediction in other fields, and it also proves the advantages of the combined model.

Keywords: grey neural network, grey correlation analysis, freight volume, forecast, genetic algorithm

1. INTRODUCTION

The actual quantity of goods transported within a specified time is called freight volume. Freight volume can reflect the actual transportation results of a region, and it is also an important indicator of the strength of a region. Freight volume forecasting, as a prerequisite for the rational allocation of logistics resources, plays an important role in logistics system planning. The forecast results can also be used as a reference for the formulation and reform of related policies. This article collects relevant data on China's freight volume and its influencing factors from 1999 to 2018, screens out key factors through gray correlation analysis, combines the gray system with neural networks, and improves the gray neural network through genetic algorithms to achieve freight volume prediction.

2. LITERATURE REVIEW

Many experts and scholars have used various models to forecast freight volume and logistics demand, and have achieved good results. For example, Li Xu optimized the traditional gray model to improve the accuracy of model prediction and predict the railway freight volume in China ^[1]. Naqing Zhao fitted the ARIMA model through Eviews software to predict the railway freight volume in China ^[2]. Pingyao Wang used multiple linear regression and GM (1,1) to make joint predictions ^[3]. Li Duan et al combined data selection and fuzzy clustering for feature selection, and then input the selected data into a prediction model based on generalized regression neural network ^[4]. The gray system, time series analysis, and neural network are currently mainly used in freight volume forecasting methods. However, these gray systems and time series analysis have no self-learning and self-adaptation capabilities, resulting in large errors in calculation results. However, neural network prediction requires a lot of data support, and it is difficult to make actual predictions.

Grey neural network combines grey system theory and BP neural network algorithm. It can better predict the overall trend of the sample through a small amount of sample data. It also has the ability of self-learning and self-adaptation. It can continuously modify errors and improve prediction accuracy. The gray correlation score is

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a quantitative analysis method to measure the degree of correlation between factors, which can identify the key factors that affect the freight volume.

3. GREY RELATIONAL ANALYSIS AND IMPROVED GREY NEURAL NETWORK

3.1 Grey relational analysis

Grey correlation analysis is a method of judging the degree of correlation between factors based on the similarity of the shape of the curve set of the factors^[5]. This method analyzes the dynamic relationship and development trend of the comparison sequence and the reference sequence, and performs quantitative analysis to obtain the gray correlation between the reference sequence and each comparison sequence. The greater the correlation between the comparison sequence and the reference sequence, the closer the development direction and rate of the comparison sequence to the reference sequence, and the closer the relationship with the reference sequence. Under the condition that the sample size is small or the correlation between the samples is not strong, the grey correlation analysis method is very suitable. The calculation amount is small, so it is very convenient^[6]. Due to space limitations, this article does not prove the derivation here.

3.2 Genetic algorithm improved grey neural network

The gray system theory is different from the white system where all the information is known and the black box system where all the information is unknown. The gray system refers to an uncertain, insufficient data system where "a part of the information is known and a part of the information is unknown. The gray system is a new method to study the problem of insufficient sample data and information uncertainty. It can better predict the overall trend of the sample through a small amount of sample data^[7]. However, the grey prediction method is not suitable for approximating complex nonlinear functions. The BP neural network model is a model that mimics the working mode of biological neurons. It has the characteristics of sufficient sample data, self-learning ability, self-adaptation ability, and strong ability to solve nonlinear problems^[8]. The combination of the gray system model and the BP neural network model can make up for each other's deficiencies and enhance the ability to solve problems. Combining the gray system model with the BP neural network model and using their respective characteristics, a gray neural network prediction model with stronger stability, higher prediction accuracy, and faster problem processing speed is established.

When using gray neural network for prediction, the traditional method uses a random method to initialize the network weight threshold. It is very easy to fall into the local optimal value and the prediction result is extremely unstable. Therefore, the network is improved by using genetic algorithm, and the individual code of genetic algorithm, Initialize the population, use selection, mutation, crossover and other operations to find the best initial parameters of the neural network, and obtain the optimal neural network weights and thresholds. Train the gray neural network and use the trained network to predict China's freight volume.

4. PREDICTION OF CHINA FREIGHT VOLUME

Both BP neural network and gray neural network models can be used for cargo transportation volume prediction, but both models have shortcomings. Therefore, an improved gray neural network model based on genetic algorithm is established, and the key influencing factors are determined through gray correlation analysis. In order to verify the accuracy of this model, the above three models are used to forecast the freight volume, and finally the prediction results are compared. This article selects data on China's cargo transportation volume and its influencing factors from 1999 to 2018. All data are from the National Bureau of Statistics.

4.1 Grey relation analysis

The specific calculation steps are as follows:

- (1) Determine the reference sequence and comparison sequence

A series of data that reflects the behavioral characteristics of the system, called a reference sequence, written as

$$X_0 = \{x_0(k)\}, k = 1, 2, \dots, n \quad (1)$$

A series of data consisting of factors affecting system behavior, called a comparison sequence, written as

$$X_i = \{x_i(k)\}, k = 1, 2, \dots, m \quad (2)$$

(2) Dimensionless

Because the physical meaning of each factor in the system is different, the dimensions of the data are not necessarily the same, which is not good for comparison. Therefore, it is generally necessary to perform dimensionless processing. In this paper, the data is averaged. The averaged formula is as follows:

$$\bar{x}_j = \frac{1}{n} \sum_{k=1}^n x_j(k) \quad (3)$$

$$x_j(k) = x_j(k) / \bar{x}_j \quad (4)$$

(3) Find the correlation coefficient

The correlation coefficient $\gamma_i(k)$ of the reference sequence X_0 and the comparison sequence X_i is calculated as follows:

$$\gamma_i(k) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|} \quad (5)$$

In the formula (5), $\min_i \min_k |x_0(k) - x_i(k)|$ is the two-stage minimum difference; $\max_i \max_k |x_0(k) - x_i(k)|$ is the two-stage maximum difference; ρ is the resolution coefficient, $\rho \in [0, 1]$, the smaller ρ , the higher the resolution. ρ is generally taken as 0.5^[9].

(4) Calculate relevance

The calculation formula for the correlation between the reference sequence X_0 and the comparison sequence X_i is as follows:

$$r_i = \frac{1}{n} \sum_{k=1}^n \gamma_i(k) \quad (6)$$

There are many factors that affect China's freight volume Y. Heng Zhang^[10] believes that factors that may affect freight volume include: GDP, output value of primary industry, output value of secondary industry, output value of tertiary industry, population, and total retail sales of consumer goods. After consulting relevant information, in this paper, the factors affecting freight volume include the value added of the primary industry (100 million yuan) X_1 , added value of the secondary industry (100 million yuan) X_2 , added value of the tertiary industry (100 million yuan) X_3 , gross domestic product (100 million yuan) X_4 , consumer consumption level (yuan) X_5 , total population at the end of the year (10,000 people) X_6 , Total retail sales of social consumer goods (100 million yuan) X_7 , the number of corporate entities in the wholesale and retail industry X_8 , sales of wholesale and retail goods (100 million yuan) X_9 . The specific data is shown in Table 1.

Table 1. Data on freight volume and influencing factors

Year	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
1999	1293008	14549	41080.9	34934.5	90564.4	3346	125786	35647.9	27115	27448.3
2000	1358682	14717.4	45664.8	39897.9	100280.1	3721	126743	39105.7	25567	32265.47
2001	1401786	15502.5	49660.7	45700	110863.1	3987	127627	43055.4	25543	35153.3
2002	1483447	16190.2	54105.5	51421.7	121717.4	4301	128453	48135.9	26605	40090.3
2003	1564492	16970.2	62697.4	57754.4	137422	4606	129227	52516.3	27340	48613.2
2004	1706412	20904.3	74286.9	66648.9	161840.2	5138	129988	59501	52448	86928.6

2005	1862066	21806.7	88084.4	77427.8	187318.9	5771	130756	68352.6	47698	93151.3
2006	2037060	23317	104361.8	91759.7	219438.5	6416	131448	79145.2	51788	110054.8
2007	2275822	27674.1	126633.6	115784.6	270092.3	7572	132129	93571.6	55737	132740.8
2008	2585937	32464.1	149956.6	136823.9	319244.6	8707	132802	114830.1	100935	208229.8
2009	2825222	33583.8	160171.7	154762.2	348517.7	9514	133450	133048.2	95468	201166.2
2010	3241807	38430.8	191629.8	182058.6	412119.3	10919	134091	158008	111770	276635.7
2011	3696961	44781.4	227038.8	216120	487940.2	13134	134735	187205.8	125223	360525.9
2012	4100436	49084.5	244643.3	244852.2	538580	14699	135404	214432.7	138865	410532.7
2013	4098900	53028.1	261956.1	277979.1	592963.2	16190	136072	242842.8	171973	496603.8
2014	4167296	55626.3	277571.8	308082.5	641280.6	17778	136782	271896.1	181612	541319.8
2015	4175886	57774.6	282040.3	346178	685992.9	19397	137462	300930.8	183077	515567.5
2016	4386763	60139.2	296547.7	383373.9	740060.8	21285	138271	332316.3	193371	558877.6
2017	4804850	62099.5	332742.7	425912.1	820754.3	22935	139008	366261.6	200170	630181.3
2018	5152732	64734	366000.9	469574.6	900309.5	25002	139538	380986.9	211540	650253.8

Taking the freight volume in Table 1 as the reference number series and analyze it by grey correlation., the results are shown in Table 2.

Table 2. Influencing factors and their correlation

Influencing factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
Correlation	0.9760	0.8504	0.7977	0.8432	0.9080	0.8985	0.8390	0.8734	0.6564

Factors with correlation coefficients greater than 0.8 were taken as the main influencing factors, including the value added of the first industry (100 million yuan) X_1 , the value added of the second industry (100 million yuan) X_2 , GDP (100 million yuan) X_4 , and the level of household consumption (Yuan) X_5 , year-end total population (10,000 people) X_6 , total retail sales of social consumer goods (100 million yuan) X_7 , the number of corporate entities in the wholesale and retail industry X_8 .

4.2 Genetic Algorithm Improves Grey Neural Network

4.2.1 Data preparation

Seven key influencing factors can be obtained from grey correlation analysis. These seven key influencing factors are used as the model input, the freight volume forecast value is the model output, and the data from 1999 to 2013 are used as the training data of the neural network, and the data from the five years from 2014 to 2018 are used to test the accuracy of the model. In order to eliminate the differences between different orders of magnitude, data on China's freight volume and its influencing factors from 1999 to 2018 need to be normalized. Use formula (7) to normalize the data so that the normalized data is between [0,1].

$$x_i = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \quad (7)$$

4.2.2 Establishment of Grey Neural Network Model

In order to reduce the influence of random interference in the process of model building, sequences are often generated by accumulation, and the generated sequences have a monotonic increase. Therefore, the input data can be processed by using a graying layer before the neural network, and then the output data can be restored by using a whitening layer. In this way, the gray system can be combined with the neural network to form a gray neural network prediction model.

The algorithm flow of forecasting freight volume using gray neural network is as follows:

(1) Carry out "accumulation generation " operation on the normalized data sequence of the freight volume and its influencing factors to obtain the accumulation sequence. This can reduce the randomness existing in the original data and make the accumulation data sequence show a monotonous growth law, which is convenient for the BP neural network to carry out Approaching. Considering that there are x_1, x_1, \dots, x_n n variables, that is

$$x_i^{(0)} = [x_i^{(0)}(1), x_i^{(0)}(2), \dots, x_i^{(0)}(n)] \quad (i = 1, 2, \dots, n) \quad (8)$$

Accumulate $x_i^{(0)}$, that is

$$x_i^{(1)} = [x_i^{(1)}(1), x_i^{(1)}(2), \dots, x_i^{(1)}(n)] \quad (9)$$

$$x_i^{(1)}(k) = \sum_{m=1}^k x_i^{(0)}(m) \quad (k = 1, 2, \dots, p) \quad (i = 1, 2, \dots, n) \quad (10)$$

(2) Since the accumulation sequence does not necessarily have an exponential growth law, the BP neural network can be used to fit any function, and the BP neural network is trained to approximate the accumulation data sequence. Since the BP neural network is already quite popular, its principle and calculation process will not be described again. The topological structure of the gray neural network forecast freight volume model is shown in Figure 2.

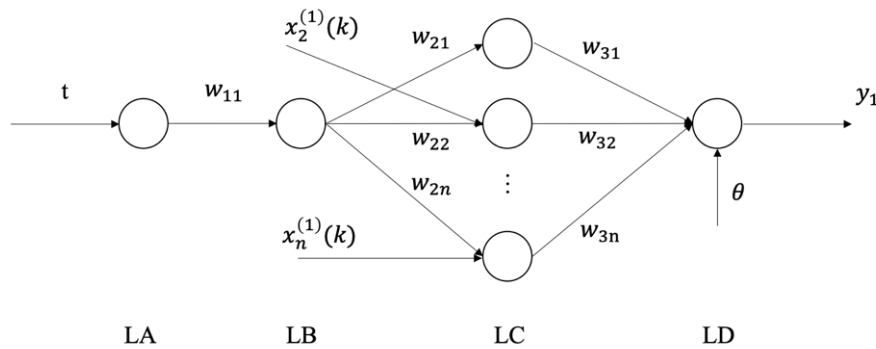


Figure 2. The topological structure of the gray neural network

(3) Use the trained BP neural network to make predictions and output the predicted value of the accumulated sequence

(4) Carry out the "accumulated reduction" operation on the predicted value of the accumulated data to obtain the predicted value of the freight volume:

The gray neural network not only retains the "cumulative generation" method in the gray prediction theory, which can reduce the random component in the freight volume, but also completely avoids the various shortcomings of the gray prediction method in solving the prediction formula. At the same time, the neural network can accurately realize the fitting and prediction of data sequences with arbitrary changes. Therefore, the gray neural network combines the advantages of the artificial neural network and the gray prediction method, which is conducive to improving the accuracy of freight volume prediction.

4.2.3 Genetic Algorithm Improves Grey Neural Network

Although the gray neural network improves the accuracy of the prediction, due to the random initialization of the weights and thresholds, the network is easy to fall into the local optimum, and the prediction results are different each time, and the deviation is large. Therefore, in this paper, the genetic algorithm can better adjust

the balance between global and local search capabilities, which can solve the shortcomings of the traditional gray neural network. The steps to improve the gray neural network using genetic algorithms are as follows:

- (1) Determine the network structure and genetically encode the initial weights.
- (2) Calculate the difference between the predicted output and the expected output based on the output value of the output layer, and optimize the fitness value of the individuals in the population based on the difference.
- (3) Determine whether the termination conditions are met, if yes, terminate, otherwise continue with the following operations.
- (4) Select the population according to the fitness value and perform operations such as crossover and mutation, and then return to step 3).
- (5) The initial parameters optimized by the genetic algorithm are used in the gray neural combination model, and the optimized output values are obtained after training.

The genetic algorithm toolbox in MATLAB contains a wealth of functions related to genetic algorithms. Using the genetic algorithm toolbox can easily implement the optimization of neural network weights and thresholds by genetic algorithm^[11]. In this article, we will also use the genetic algorithm to optimize the gray neural network based on MATLAB software to predict China's freight volume. The grey neural network process improved by genetic algorithm is shown in Figure 2.

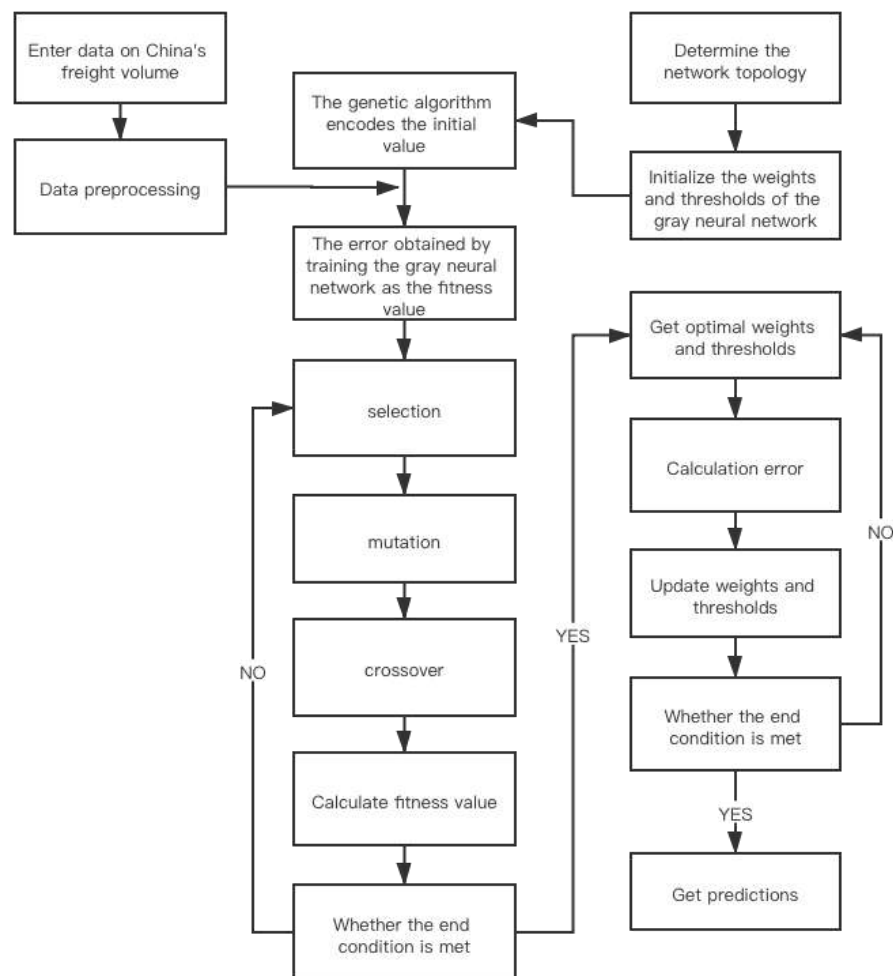


Figure 2. The grey neural network process improved by genetic algorithm

4.2.4 Model parameter settings

It is found through a lot of experiments that the number of hidden layer neurons is the most accurate when the number of hidden neurons is 5, so the number of hidden layer nodes is 5. The number of nodes in the input layer is 8, and the number of nodes in the output layer is 1. The number of iterations of the gray neural network is 300, and the initialization parameters of the network parameters a, b_1, b_2, \dots, b_n are $0.3 + rand(1)/4$. Learning rate $u_1 = u_2 = u_3 = \dots = u_7 = 0.0015$. The genetic algorithm was used to optimize the seven network parameters of the gray neural network. The individuals of the genetic algorithm were coded in real numbers, and each individual was a real number string. The individual's prediction error on the gray neural network was used as the value of individual fitness. Set cross probability $cp = 0.4$, mutation probability $mp = 0.1$, population size $M = 15$, number of evolutions $G_{max} = 300$. The change of the optimal individual fitness value after each iteration of the genetic algorithm is shown in Figure 3. The best initial parameter values obtained by genetic algorithm optimization is shown in Table 3.

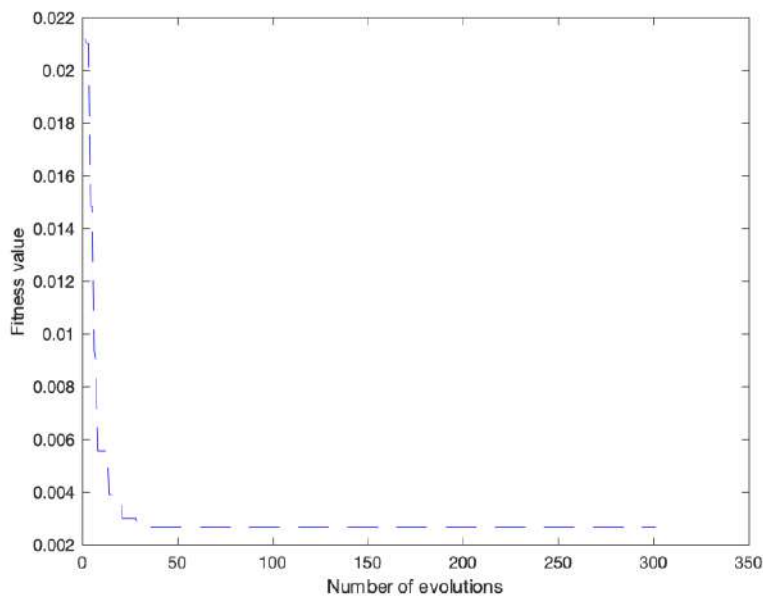


Figure 3. Fitness curve

Table 3. Best initial parameters

Parameter	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Parameter value	0.3623	0.4247	0.3673	0.3456	0.4226	0.4543	0.4501	0.3806

4.2.5 Result analysis

The optimal parameter values are assigned to the gray neural network, which is solved by programming using Matlab. After 300 iterations, the error curve is obtained as shown in Figure 4.

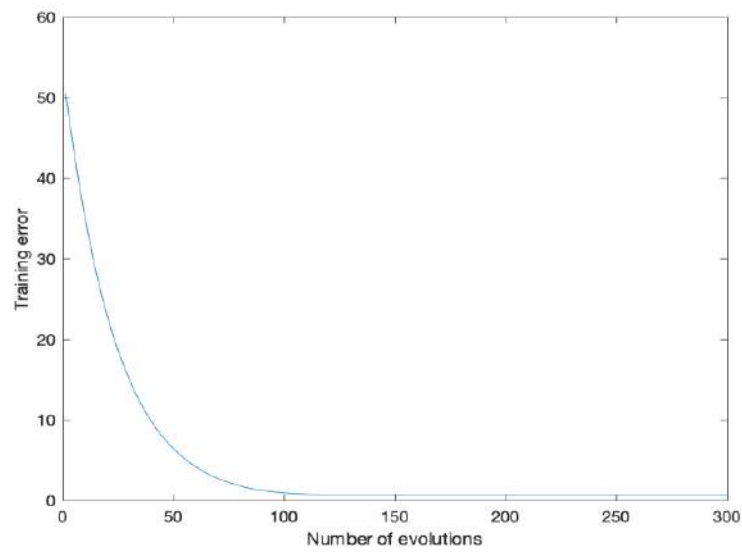


Figure 4. Training error curve

It can be seen that the network is basically close to 0 when the number of evolutions is 100, which meets the accuracy requirements and can be used for the prediction of cargo transportation volume. The grey neural network model trained by the genetic algorithm improved grey neural network model test 2014-2018 China cargo transportation volume prediction value and actual value fitting results are shown in the Figure 5.

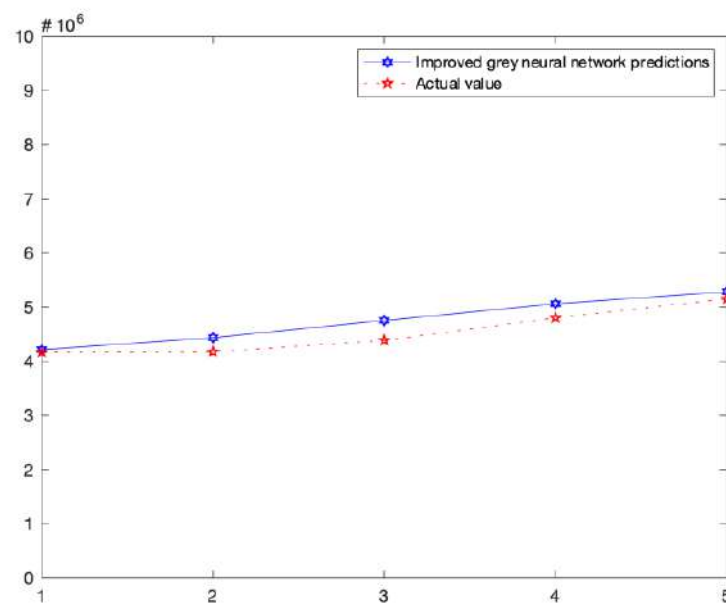


Figure 5. Comparison of predicted and actual values

In order to verify the accuracy of the improved gray neural network of the genetic algorithm, the prediction results were compared with the BP neural network and the gray neural network. The results show that the gray neural network improved by the genetic algorithm has better prediction accuracy than the BP neural network and gray neural network Better and better forecasted freight volume. The prediction results of the three models are shown in Figure 6.

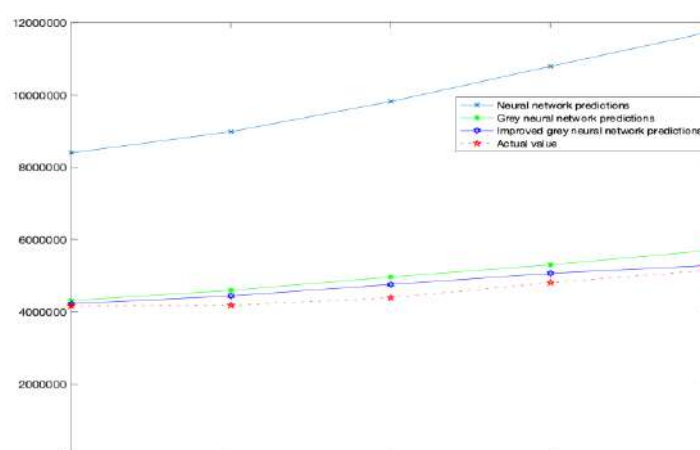


Figure 6. Comparison of predicted and true values of three different models

5. CONCLUSIONS

The forecasting accuracy of freight volume based on grey correlation analysis and improved grey neural network is higher than that of BP neural network and grey neural network, and it can be used as a reference model for forecasting freight volume. The model has higher prediction accuracy, and the model's prediction range is not limited to freight volume. The influencing factors can be adjusted according to different forecast needs, which provides a reference for the prediction method. At the same time, this paper also validates the advantages of the combined model in prediction. In addition, because the amount of experimental data is small, it will inevitably have an impact on the prediction results. In the next step, consider using a larger amount of data for training and testing.

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Applying Big Data Technology to University Libraries: A

Perspective Based on Service Context

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Abstract: In the era of big data, the construction of university libraries cannot be separated from the support of big data technology. The collection and analysis of data can improve the management efficiency and service quality of university libraries. On the basis of explaining the characteristics of big data and big data related technologies, our study puts forward the application framework of big data technology in university libraries based on the characteristics of university libraries. Based on the perspective of the context, we explore the effects of the application form of big data technology in university libraries on students' perception of the context, and establish a theoretical model of how it will affect students' perceived service quality, perceived value and satisfaction the library. Our research can give suggestions to the service innovation practice of university libraries.

Keywords: Big Data Technology; Libraries; Satisfaction; Service Context

1. INTRODUCTION

In the era of big data, Cloud Computing, Internet of Things, Artificial Intelligence and other technologies have penetrated into all walks of life in society. Big data technology and libraries have a natural fit, which can empower the digital transformation of university libraries, but at the same time, university libraries also face new challenges^[1]. The application of big data technology in university libraries can provide students with better information resource services and non-information resource services, such as providing students with a better learning environment and richer learning tools. In different application context, the services that big data technology can provide to students are also different. However, at present, there is still a lack of research on how the characteristics of services in different context will impact students' satisfaction. We analyzed the impact of big data technology in different service context, and the impact on university students' perceived service quality, perceived value and satisfaction, with a view to providing reference for the service practice of university libraries.

2. THEORETICAL BACKGROUND

University libraries are closely related to social and public cultural services, and are also an important carrier of university information services. Information and communication technology improved the digitization of university libraries, and also changed the service model of university libraries. User satisfaction is the key outcome for measuring marketing process. In the library context, we take the change in user satisfaction with the library as an indicator of the application of big data technology. User satisfaction is closely related to users' perceived service quality and perceived value, perceived service quality and perceived value are two antecedents of user satisfaction^[2].

In our research, because the library's main function is to provide users with information services, we divided the use contexts of the library into two categories: information resource service contexts and non-information resource service contexts.

There are two specific contexts for information resource services, namely the electronic resource service context and the physical resource service context^[3]. Electronic resource service refers to providing users with

bibliographic and newspaper retrieval and reading services on the Internet. Physical resource services refer to the information services of physical books and periodicals of libraries. In non-information resource services, we also divide it into two contexts, namely, instrumental service contexts and humanistic service contexts. In the field of information management, there is research on the potential of instrumentality as a way to improve practical capabilities. In our research, we use instrumentality as the ability to assist user activities. And humanistic services refer to education, consultation, lectures and other humanistic services provided by libraries.

Based on the application context of big data technology, we propose a user satisfaction model for big data library applications. We classify electronic resource services and physical resource services as perceived information service contexts, instrumental services and humanistic services are attributed to the perceived non-information service contexts. Figure 1 shows our model.

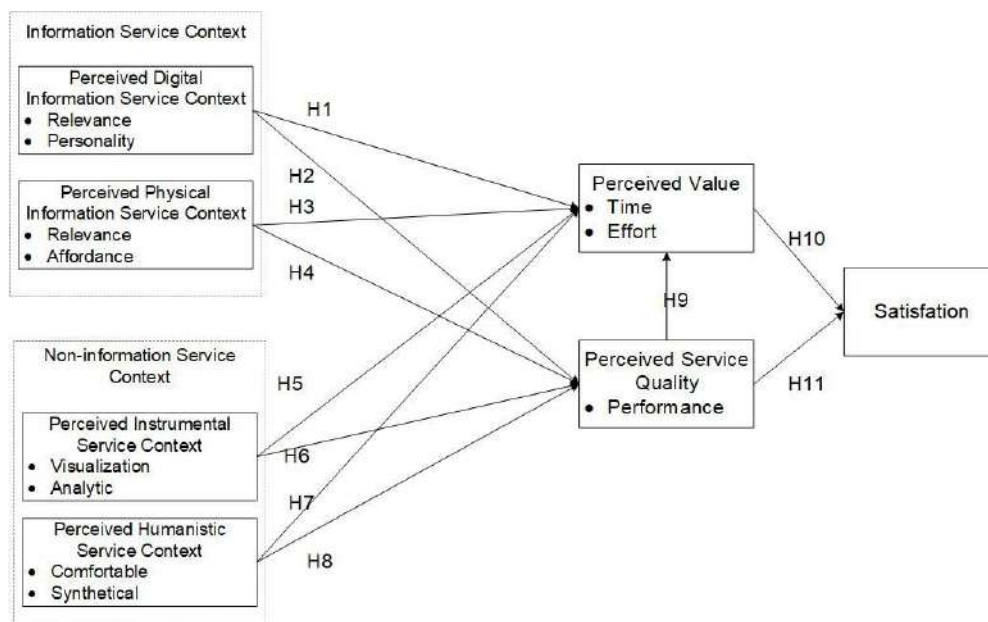


Figure1: Research Model

3. METHODOLOGY

This research mainly uses questionnaires to investigate library users' perceptions of big data technology applications and test our model. Through the questionnaire, we learned that users' perceptions of changes in service quality and value after applying big data technology.

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Exploring a Hybrid Algorithm for Price Volatility Prediction of Bitcoin

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Abstract: In recent years, the Bitcoin investment market has become increasingly popular. We collected existing literature on Bitcoin and found that predictions about the role of Bitcoin in investment portfolios and the volatility of Bitcoin price as well as return have become advanced research topics. This study shows our current work on the prediction of Bitcoin price volatility and proposes an idea for predicting the price volatility. We have designed an experiment that compares different combinations of machine learning algorithms with GARCH-type models, intending to compare the effects of these models in the prediction of Bitcoin time series and finally implement an optimized algorithm.

Keywords: Bitcoin, GARCH, volatility prediction, machine learning

1. INTRODUCTION

Since the advent of Bitcoin, many investors and researchers worldwide have set their sights on cryptocurrencies. Satoshi Nakamoto^[1] proposed the design of Bitcoin, and defined Bitcoin as an electronic cash system for point-to-point transmission to financial intermediaries. Though Bitcoin was originally created for disintermediated payments, it had gradually become a financial asset-like item. As the Bitcoin market had rapidly become fascinating, other cryptocurrencies such as Litecoin and Ethereum had also been issued and became new investment targets. But many scholars^{[2][3][4]} believed that Bitcoin is the first and most popular cryptocurrency in the world, so Bitcoin is also the most representative cryptocurrency which can reflect the characteristics of cryptocurrencies. Hence, many existing pieces of research on cryptocurrencies have Bitcoin as their main research object. Glaser et al.^[5]'s research found that most Bitcoin holders use this cryptocurrency as a special financial asset rather than a means of payment through empirical methods. It is well known that Bitcoin does not have any assets or government credit issuance as a guarantee, and the demand side of the market was dominated by short-term speculators and follow-up investors. They wanted to keep cryptocurrencies and waited for the price to rise in order to make a profit. By analyzing the correlation between the search results of “Bitcoin” in Google Trends and the price of Bitcoin, Kristoufek^[6] found that the price of Bitcoin is positively correlated with the popularity of public opinion.

Although Bitcoin investment is risky, the decentralized nature of Bitcoin and the frequent fluctuations of the investment market make the Bitcoin investment market an excellent “battlefield” for investors with high-risk appetite. More scholars are also trying to learn more about the nature of the cryptocurrencies and the characteristics of the cryptocurrency market. As the amount of Bitcoin in the market is fixed, the supply of Bitcoin is a constant, which is fundamentally different from other centralized currencies. In the traditional financial field, additional currency will affect the relative value of the currency, but this nature does not apply to cryptocurrencies such as Bitcoin. Böhme^[7] classified Bitcoin as a kind of virtual currency and defined virtual currency as a kind of digital asset that is created to act as a transaction intermediary using cryptographic methods. Hence, Bitcoin can be regarded as a new type of financial asset because it can be used for both payment and investment.

Existing researches have showed that cryptocurrencies are more volatile than traditional currencies^[8], and

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estimating cryptocurrencies' volatility is necessary. Dyhrber^[9] analyzed the volatility of bitcoin return rate and gold price, the exchange rate trend of bitcoin against the U.S. dollar and the pound with the GARCH model, founding that bitcoin has certain similarities with traditional currencies and gold, which can be used as an effective risk management tool in the investment market. The research at this stage comprehensively analyzed the relationship between Bitcoin and its derivatives (e.g. the Bitcoin futures) and other currencies (e.g. USD, EUR, GBP and mainstream currency exchange rates), financial assets (e.g. the gold), investment markets. To some extent, it proves that cryptocurrencies such as Bitcoin have the characteristics of both traditional currencies and financial investment targets. In particular, it has been found that bitcoin has the ability to hedge in investment^[10]. These findings support the research on risk management and other aspects.

In our study, the time series models especially the GARCH-type models and machine learning methods will be tested to find a hybrid algorithm which is used to examining the volatility of Bitcoin efficiently.

2. LITERATURE REVIEW

2.1 Bitcoin volatility prediction based on GARCH-type models

As cryptocurrencies becoming popular investment targets, research on the risk control, price prediction, and volatility prediction of cryptocurrencies investment has begun to have very important academic and practical significance. In empirical research on Bitcoin, the prediction of Bitcoin price volatility or return volatility has been a popular topic in recent years. Polasiket et al.^[11] found that under the condition of constant supply, Bitcoin investors are more inclined to keep Bitcoins rather than using them for consumption or trade. And it is one of the reasons that the price of Bitcoin is more volatile than traditional currencies^[12]. Besides, Bitcoin, as a new type of financial asset, has a considerable daily transaction volume and shows obvious fluctuation characteristics in the time series, which is very suitable for using time series analysis methods^[13]. The GARCH-type models (Generalized Autoregressive Conditional Heteroscedasticity model) are very classical in time series analysis. Kim W et al.^[14] used the Difference-In-Differences model (DID) and the Markov-GARCH model to study the effect of Bitcoin futures trading on the intra-day fluctuation of Bitcoin and found that the introduction of Bitcoin futures will initially stimulate the Bitcoin market volatility but the Bitcoin market will gradually stabilize. Chu^[3] used 12 kinds of GARCH models to predict the logarithm of exchange rate returns for seven mainstream cryptocurrencies (obtained based on total value) and found that the IGARCH and GJR-GARCH models fit best. Chu^[3] also pointed out that by looking at the intraday fluctuations of cryptocurrencies, it is clear that the prices of cryptocurrencies are volatile, which makes it more suitable for investors with a medium-high risk preference. Katsiampa et al.^[15] proposed AR (1)-CGARCH (1,1) model to predict the price return of Bitcoin, which can be useful in risk management and portfolio.

An important premise of GARCH models is that the variance is not constant. Factors such as policy, financial news, etc. may cause differences in prediction accuracy, and the variance of the error term is up to its changes in the previous period, that is, there is autocorrelation. As previous studies show, besides conventional regression analysis, GARCH models also analyze the variance of errors, which makes it ideal for predicting and analyzing volatility.

2.2 Financial prediction based on methods of machine learning

With the increasing application of Artificial Intelligence in financial market research, many researchers have combined machine learning algorithms with econometric models to provide new research methods for financial asset pricing and even related research on cryptocurrencies. Rekabsaz et al.^[16] used Support Vector Machines (SVMs) to conduct sentiment analysis on the annual report information of more than 3,000 U.S. stock listed companies. At the same time, the study utilized panel data on U.S. stocks, using the GARCH-type models to analyze the sample stock price volatility. Finally, the feature vectors obtained by SVMs were used to predict

the stock price volatility, and a combination of structured and unstructured data analysis was realized, which achieved higher accuracy than the traditional econometric model.

Of course, Bitcoin is also a good object for this type of method. Chen et al.^[17] had done a lot of valuable work. Focusing on the high dimensional dataset, Chen used traditional econometric models such as Logit Regression, and machine learning models such as SVMs, Random Forest, Long-Short-Term Memory Neural Network (LSTM), etc., respectively, to make prediction about the daily frequency data and the five-minute price data of Bitcoin. They found that traditional models have better performance on low-frequency data. On high-frequency data, machine learning models, especially SVMs and LSTM, have better results in terms of accuracy. However, Chen's research did not combine time series analysis models, leading to a lack of explanation of changes in the Bitcoin market. McNally^[13] suggested that the price prediction of Bitcoin is very similar to other financial assets, especially in time series prediction tasks, such as the prediction of stock transactions and foreign exchange, so deep learning algorithms were used to predict the price of Bitcoin, and compared the experimental results with the results of traditional time series analysis model e.g. ARIMA model. It is found that the accuracy of deep learning prediction is higher than that of the ARIMA model, and the mean square error is greatly reduced. Peng et al.^[18], in order to build a non-linear model based on the GARCH (1,1) model, introduced the SVR-GARCH model, based on the Support Vector Regression model (SVR), which perform better than GARCH (1,1) model in the price prediction of 3 kinds of cryptocurrencies.

It can be said that the existing researches have made a lot of contribution to Bitcoin price prediction and return prediction. However, most related researches using hybrid algorithms for prediction simply emphasize the accuracy of the models, without considering the feature engineering. Although Google Trend, Baidu Index, and other indicators have been proven to be applicable to the research on the price and return of Bitcoin, the use of this type of data has not been effectively combined with Bitcoin panel data.

We hope that by comparing different machine learning algorithms or time series analysis models (e.g. SVR-GARCH model^[18], LSTM and traditional GARCH-type models, etc.), a better way of predicting the price volatility of Bitcoin in the case of high-dimensional data can be found.

3. METHODOLOGY

This study intends to use the Bitcoin price data from Bitstamp from January 2018 to December 2019 as basic data, and collect Twitter text, Baidu Search Index and Google Trend Index from the Internet as supplements. Figure 1. shows the daily closing price of Bitcoin, and Figure 2. Shows the daily standardized Google Trend Index of Bitcoin.



Figure 1. Daily frequency of Bitcoin

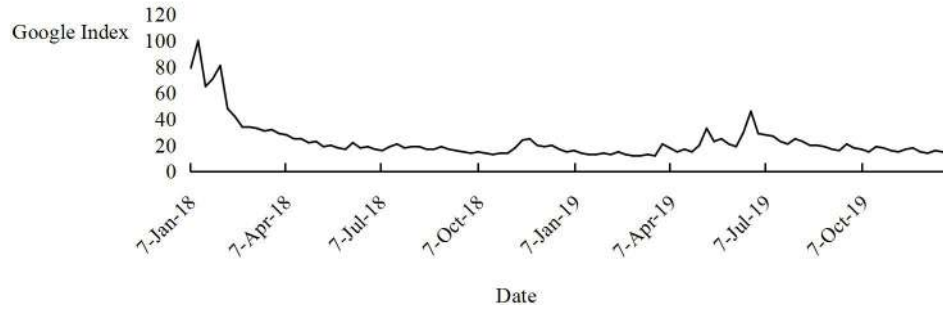


Figure 2. Daily Google Trend Index of Bitcoin

3.1 GARCH-type models

As mentioned before, Peng^[18] introduced the SVR-GARCH model to Bitcoin price volatility prediction, the study compared combinations of GARCH-type models (e.g. GARCH (1,1), EGARCH, and GJR-GARCH) and SVR. Chu^[3] compared 12 kinds of GARCH models and found that IGARCH (1,1) fits Bitcoin best. We consider using the IGARCH (1,1) model, combined with SVR, to test whether the SVR-IGARCH model outperforms SVR-GARCH model and GARCH (1,1) model.

3.1.1 GARCH (1,1) model

Following Bollerslev^[19], the GARCH (1,1) model can be defined as:

$$r_t = \mu + a_t, a_t = \sqrt{h_t} \varepsilon_t, \varepsilon_t \sim N(0,1),$$

$$h_t = \alpha_0 + \alpha_1 a_{t-1}^2 + \beta_1 h_{t-1},$$

where r_t is the return at period t . Let ε_t denote the random error term with a zero mean and a variance of one, and h_t is the conditional variance at time t . In the GARCH (1,1) model, the coefficients need to satisfy $\alpha_1, \beta_1 \geq 0$ and $\alpha_0 > 0$, and $\alpha_1 + \beta_1 < 1$ is required to ensure that the fluctuation does not tend to infinity. The distributions of error terms mainly include Normal Distribution, Generalized Error Distribution, and Students' t Distribution.

3.1.2 IGARCH (1,1) model

The IGARCH model is a one-time difference to the GARCH model. With the same sign as GARCH (1,1), the model can be defined as:

$$r_t = \mu + a_t, a_t = \sqrt{h_t} \varepsilon_t, \varepsilon_t \sim D(0,1),$$

$$h_t = \alpha_0 + \alpha_1 a_{t-1}^2 + (1 - \alpha_1) h_{t-1},$$

where $r_t = \log(\frac{P_t}{P_{t-1}})$, which represents the return at t , let ε_t denote the random error term with a zero mean and a variance of one, and h_t is the conditional variance at t .

3.1.3 SVR-GARCH (1,1) model

The SVR-GARCH model is a combination of Support Vector Regression and GARCH models. It introduces nonlinear components into the GARCH (1,1) model. In essence, it introduces a kernel function into the error term of the GARCH (1,1) model. An empirical study by Chen et al.^[21] proves that the SVR-GARCH model performs better in prediction than standard GARCH-type models and fits nonlinear financial data better. Compared with the GARCH (1,1) model, the SVR-GARCH (1,1) model has slightly difference:

$$r_t = f_m(r_{t-1}) + a_t,$$

$$h_t = f_v(h_{t-1}, \varepsilon_{t-1}^2),$$

where $f_m(\cdot)$ is the decision function of the SVR mean formula, and $f_v(\cdot)$ is the decision function of the SVR wave equation.

3.2 Machine learning algorithms for Bitcoin prediction

Chen's research^[17] trained almost all mainstream algorithms to predict the rise and fall of the Bitcoin price and finally found that SVMs and LSTM achieved the highest accuracy. We plan to replace the role of SVR with other machine learning algorithms for further analyzing the effects of SVMs and LSTM, after comparing SVR-IGARCH and SVR-GARCH.

3.2.1 Support Vector Machines (SVMs)

Support Vector Machines are supervised algorithms. It can transform non-linear problems into quadratic programming problems by mapping samples from the original space to a higher-dimensional space, making the samples linearly separable. As we selected data from January 1, 2018 to December 31, 2019, which is a kind of small size sample in machine learning practice, SVMs may be suitable for our study due to its good performance on small sample data. Support Vector Regression is an example of SVMs used for regression. The difficulty of this algorithm lies in the selection of kernel function in practice. The kernel function plays a decisive role in the quality of feature space, which affects the performance of SVMs. At present, there is no clear method to choose kernel function, and most researchers and practitioners can only determine the choice of kernel function by experience and repeated attempts. The following table lists the commonly used kernel functions^[20]:

Table 1. List of common kernel functions

Kernel Functions	Expression	Note
Linear Kernel	$\kappa(\mathbf{x}_i, \mathbf{x}_j) = \mathbf{x}_i^T \mathbf{x}_j$	
Polynomial Kernel	$\kappa(\mathbf{x}_i, \mathbf{x}_j) = (\mathbf{x}_i^T \mathbf{x}_j)^d$	d is the polynomial degree
Gaussian Kernel	$\kappa(\mathbf{x}_i, \mathbf{x}_j) = \exp\left(-\frac{\ \mathbf{x}_i - \mathbf{x}_j\ ^2}{2\sigma^2}\right)$	σ is the bandwidth of the Gaussian kernel
Sigmoid Kernel	$\kappa(\mathbf{x}_i, \mathbf{x}_j) = \tanh(\beta \mathbf{x}_i^T \mathbf{x}_j + \theta)$	\tanh is the hyperbolic tangent function

3.2.2 Long-Short-Term Memory Neural Network (LSTM)

LSTM is a kind of deep learning neural network. The LSTM model stores information by structures named “cells”. Compared with Recurrent Neural Network, LSTM is special in that there are three special structures: Input Gate, Forget Gate, and Output Gate^[22]. Through these three “gates”, the LSTM can control the information to circulate within the model, thereby solving the gradient disappearance problem. The LSTM model can be expressed as in^[22]:

$$\begin{aligned}
X &= \begin{bmatrix} x_t \\ h_{t-1} \end{bmatrix}, \\
f_t &= \delta(W_f \cdot [h_{t-1}, x_t] + b_f), \\
i_t &= \delta(W_i \cdot [h_{t-1}, x_t] + b_i), \\
o_t &= \delta(W_o \cdot [h_{t-1}, x_t] + b_o), \\
\tilde{C}_t &= \tanh(W_c \cdot [h_{t-1}, x_t] + b_c), \\
C_t &= f_t * C_{t-1} + i_t * \tilde{C}_t, \\
h_t &= o_t * \tanh(C_t),
\end{aligned}$$

x_t is the input information at time t , h_t denotes the hidden layer at time t , W_f, W_i, W_o, W_c is the weight matrix of LSTM, b_f, b_i, b_o, b_c are the bias terms of the model, and δ is the activation function. Usually, neural network models use the Sigmoid function as the activation function, which $*$ means dot multiplication. The function Sigmoid is used to convert the input information into values from 0 to 1, where 1 represents all

reserved information and 0 represents all forgotten information. The specific form is as follows:

$$\delta(x) = \frac{1}{1 + e^{-x}}$$

4. FUTURE WORK

4.1 Feature selection

Feature selection is a very important part of the practice in machine learning. For many machine learning algorithms e.g. SVMs, the quality of the feature space directly affects the training result of the model. Many studies on bitcoin price or return forecasting focus on how to improve the accuracy of the model by ignoring fine-grained processing of features. Part of the reason is that most of the relevant studies use data from Bitcoin panel data, but there is very little practice of adding search indexes or even financial text data to the panel data. Table 2. shows the features we intend to select, in addition to the features from panel data.

Table 2. The features planned to use

Number	Feature	Description [—]	Unit
1	Blockchain Size	Blockchain is the record of Bitcoin transactions which is public to all Bitcoin users.	GB
2	Total Amount of Blocks	Blocks are records in the blockchain that contain and confirm many waiting transactions.	Ten thousand
3	Google Trend Search Index	The daily standardized search volume of “Bitcoin” on Google. ^[6]	
4	Baidu Search Index	The daily standardized search volume of “Bitcoin” on Baidu.com. ^[17]	
5	Twitter Sentiment	The result of sentiment analysis of Twitter text. ^[23]	

4.2 Experimental steps

Whether the combination of machine learning / deep learning algorithms and GARCH-type models can achieve good results in Bitcoin price prediction is the question we want to explore. First, we will compare the mature SVR-GARCH (1,1) model with the SVR-IGARCH (1,1) model to judge whether there is any possibility of improvement in the combination of SVMs and GARCH-type models. Then, we will replace SVR with other machine learning algorithms, and compare the newly improved model with the SVR-GARCH model and LSTM model, and finally find a way to achieve the highest accuracy under given conditions. Figure 3. shows the workflow we have designed.

[—] From: <https://bitcoin.org/en/vocabulary#bitcoin>

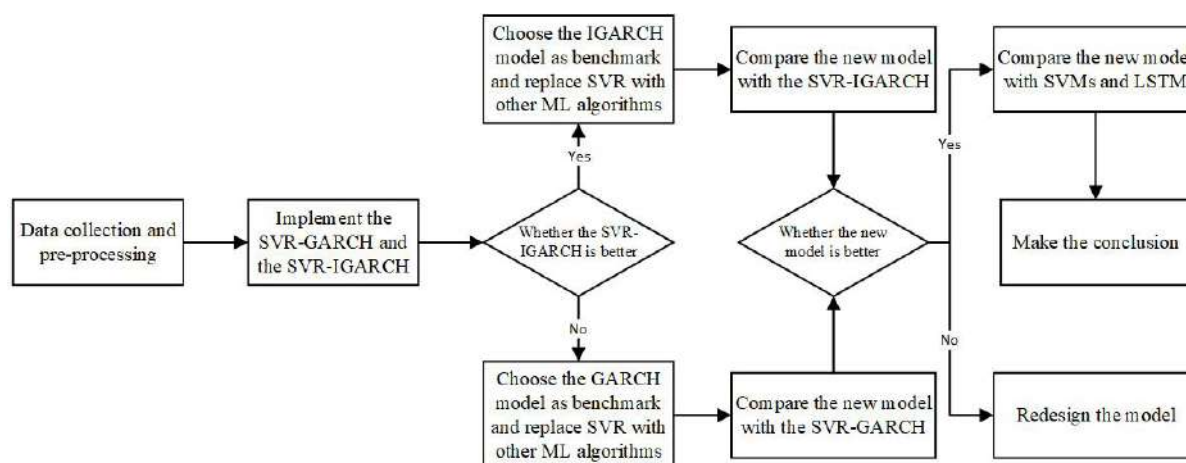


Figure 3. The workflow of the experiment

The core idea of this study is to test and improve the existing Bitcoin volatility prediction methods. Existing studies have fully discussed the factors that affect the price of Bitcoin, and the difficulty we met is that it is difficult for us to obtain complete data of these factors, especially high-frequency data. Furthermore, we are not sure if there is a more suitable mathematical model as a benchmark. Hence, besides the experiment, we will further our study on related theoretical frameworks and mathematical models.

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Awareness or Persuasion? How Free Sampling Affects Crowdfunding Performance

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Abstract: Free sampling, which has been widely applied and studied in marketing, has recently been adopted by entrepreneurs on crowdfunding platforms. Using a dataset from a unique crowdfunding platform, we study whether opting to provide free samples to potential backers increases the likelihood of a campaign meeting its goal. We also investigate how free sampling influences the fundraising dynamics. Using a matched sample of crowdfunding campaigns, we demonstrate that providing free samples significantly improves crowdfunding performance. And among those projects which opt for free sampling, persuasion effect during the report period contributes to the positive effect. The higher the score from the evaluator, the more successful the campaign will be. We also find that the longer the investors are exposed to the evaluation report, the more money is raised.

Keywords: free samples, Reward-Based crowdfunding, crowdfunding success

1. INTRODUCTION

Crowdfunding is a novel approach to early stage financing that enables entrepreneurs to raise small amounts of capital from a large network of people^[1]. However, with increasing competition, entrepreneurs are now seeking out new ways to improve their likelihood of success in meeting their fund-raising goals. For instance, on Kickstarter, which is one of the leading crowdfunding platforms in the US, only 33% of the projects are funded. This is largely due to the fact that backers face a lot of uncertainty when they consider whether to support a project. There is very little information on reward-based crowdfunding platforms about the quality of the product being pitched, the diligence of the project initiators and their commitment to follow through after the project is funded. This means fundraisers may have to provide as much information as possible to convince backers to fund their project.

One way to mitigate this information asymmetry is to provide free samples of the product, whenever possible, to potential backers. Entrepreneurs on crowdfunding platforms go to great lengths to effectively present their product and its features through text, pictures and videos. However, as the adage says, “the proof the pudding is in the eating”, and the real value a product has to offer can be judged only from practical experience. It is, therefore, not surprising that offering free samples has become a recent trend on crowdfunding platforms.

A large number of studies have shown that product samples help promote sales, and many scholars have suggested that the effect of free samples on sales depends on the type of product^{[2] [3][4]}, the type of consumers^[5] ^[6] and the timing of the launch^[7]. However, the effect of free samples in the crowdfunding context is not clear yet, and we attempt to explore this in this study.

There are several reasons that free samples should have a positive impact on the crowdfunding process. First, instead of describing the product which is not produced yet, which is what crowdfunding campaigns typically do, offering a free trial indicates to the potential backers that the product has already been produced, at least in the form of prototype. This is especially attractive to backers who are risk-averse. Secondly, as every

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potter praises his pot, the voice of the consumer is more valuable and trustworthy. After trying the free sample, each consumer submits an evaluation report. The evaluation report can mitigate the inherent information asymmetry in this online market. Third, as the process of selecting and announcing the winner of free samples brings some entertainment to the campaign, the campaign is likely to gain more attention and engagement, which probably leads to more fund. On the other hand, the trial report, which is not controlled by the entrepreneur, may not always be positive. In this case, the negative comments can severely hurt the campaign.

As the effect of the free trial offering in the crowdfunding context is not clear yet, we are motivated to explore some interesting research questions. First, what is the effect of going opting to offer free trials on fund raising outcomes? Does this feature increase the likelihood of a project meeting its goal? How does the free trial process affect the fundraising dynamics? How does the trial report affect the fundraising dynamics?

2. RESEARCH HYPOTHESES

Giving free samples to customers should benefit the fundraising for several reasons. First, enticed by the chance of getting a free product, more users on the crowdfunding platform will pay special attention to the campaign. This increased awareness in the form of higher number of the visitors to the campaign can potentially translate into a higher number of backers. Secondly, some researchers have noted that offering free trial samples signals superior product quality. When entrepreneurs provide samples even to a small number of potential backers, it can reduce the uncertainty around product quality by serving as a direct source of information via experience, personal or vicarious. It has been shown that such learning from experience leads to a greater positive effect on sales than advertising^{[8] [9]}. The persuasion effect of free sampling can also attract higher amounts of contribution because those visitors who decide to back the project are more confident in their decision after knowing the results of sampling. Based on the reasons above, we hypothesize:

H1. Offering product samples increases the likelihood of success of a crowdfunding campaign.

However, success can be achieved either through more backers, or backers who contribute more, or both. We, therefore, test for both possibilities.

H1(a): Offering free samples increases the number of backers a campaign attracts.

H1(b): Offering free samples increases the average amount of backers' contribution.

From the perspective of uncertainty reduction, information, provided by both the fundraiser and the evaluators (backers who sample the product) should contribute to the success of the campaign. The opinion of the evaluators is likely to be unbiased and objective relative to that of the entrepreneur's. Therefore, when the evaluation report is released on the page of campaign, more information is revealed to the potential backers and it aids the investment decision. Prior literature suggests that the post-trial word-of-mouth generated by satisfied consumers spreads to other consumers and thus increases sales^[10]. In addition, sampling can accelerate the discussion process and the best time to send free samples is just before the product is launched^[7]. Zhou and Duan found that free sampling not only directly leads to more sales but also enhances the online word-of-mouth effect^[11]. Therefore, we hypothesize:

H2(a): The higher the evaluation score from the free-samplers, the more successful the project will be.

H2(b): The longer the potential backers are exposed to the evaluation report, the more successful the project will be.

3. RESEARCH CONTEXT AND DATA

We collected data from JD (z.jd.com), the largest crowdfunding platform in China. JD allows fundraisers to go through a stage of free sampling during the campaign. If a fundraiser opts into the free sampling feature, she can post a "call for applicants" for the free samples and pick several applicants to be the recipients of the free sample. The recipients then try the free sample and post an evaluation report of the product on the campaign

page based on their first-hand experience.

We collected data on 3321 campaigns which started after March 31, 2017 and ended before November 11, 2017. Of these, 145 projects adopted free sampling. For each project, we collected project-related variables, fundraiser-related variables, and sampling-related variables.

4. EMPIRICAL ANALYSIS

A challenge in estimating the effect of free samples on campaign performance is that there could be factors that simultaneously affect the decision to provide free samples and the performance of the campaign. In other words, fundraisers who choose to offer the free sample may be more likely to achieve their fundraising goals for some unobserved reasons. To address this endogeneity issue, we construct a matched sample of campaigns that offer free samples and those that do not. We use propensity score matching (PSM) to construct the matched sample^[12]. PSM attempts to mimic randomization between sampling projects and non-sampling projects by creating a group of non-sampling projects that is comparable on all observed covariates to a group of sampling projects.

We use sampling as the explanatory variable, and characteristics of project and fundraisers as the covariates, then employ Logit function to calculate the propensity scores for each applicant with these covariates. After the application of the PSM, 3085 unmatched observations were dropped from our observations to avoid potential bias, resulting in improvement in the balance between the two groups along the key variables.

4.1 Model specification

We first investigated whether offering free samples affects crowdfunding performance (e.g. success, ratio, money raised). We log-transformed the non-categorical variables which vary widely to reflect percentage changes. It is more helpful to understand these effects in percentage terms^[13].

In model 1(a), we examined the impact of the sampling on a set of non-categorical outcomes as follows.

$$Y_j = \alpha_0 + \alpha_1 \text{Sampling}D_j + \alpha_2 \text{Project}_j + \alpha_3 \text{Fundraiser}_j + \varepsilon_j \quad 1(a)$$

j indicates the j th project. Y_j is one of the six non-categorical dependent variables, including the log-transformed backer, moneyraised, AverageAmount, Ratio and success. $\text{Sampling}D_j$ is a binary variable indicating whether the project has the product sampling (1=yes, 0=no). Project_j is a vector of observable project-level characteristics, such as goal, duration, number of types, whether the project had an introductory video^[14], number of pictures, project progress^[1] etc. Fundraiser_j is a vector of characteristics of the fundraiser, including the log-transformed startercreate, startersupport and starterfollowed, which represents the fundraiser's experience and internal social capital on the platform^[15].

In model 1(b), we explore the impact of sampling on project success.

$$\text{Logit}(\text{Success}_j) = \alpha_0 + \alpha_1 \text{Sampling}D_j + \alpha_2 \text{Project}_j + \alpha_3 \text{Fundraiser}_j \quad 1(b)$$

Success_j is a binary variable indicating whether project j reached its goal, we used the same set of control variables as in Model 1(a) above.

Next, In Model 2(a) and Model 2(b), we focus on which variables of the product sampling will affect the performance of the crowdfunding projects.

$$Y_j = \alpha_0 + \alpha_1 \text{Sample}_j + \alpha_2 \text{Project}_j + \alpha_3 \text{Fundraiser}_j + \varepsilon_j \quad 2(a)$$

$$\text{Logit}(\text{Success}_j) = \alpha_0 + \alpha_1 \text{Sample}_j + \alpha_2 \text{Project}_j + \alpha_3 \text{Fundraiser}_j \quad 2(b)$$

The projects in Model 2 are the 127 projects which has offered the free samples (we removed 18 projects

without evaluation report). The dependent variables are the same as that in Model 1. $Sample_j$ is a vector of characteristics of the sampling, including number of applicants, number of evaluation reports, evaluation score of the product, etc. The project vector variables and fundraiser vector variables are similar to Model 1's.

4.2 Result

The initial results of Model 1 show that the impact of sampling is significantly positive on raised, ratio and success (supporting H1), suggesting that free sampling does increase the amount of fundraising thus increase the chance of succeeding in crowdfunding. It shows that free sampling didn't bring more backers to the campaign (rejecting H1a), but it increases the average investment amount of each backer (supporting H1b). To rule out the alternative explanation like the projects which adopt free sampling are better projects in terms of quality, we employed the variables "number of followers" and "number of likes" to measure the quality of the projects. The result shows that there is no significant effect of the sampling on either the number of likes or the number of followers. Therefore, it is unlikely that unobserved quality of the project will be a confounding factor when estimating the effect of the sampling on crowdfunding outcomes.

The results of Model 2 show that the impact of the "length of application period" is not significant on all crowdfunding outcomes, which means that the length of the free sample application period does not affect the performance of crowdfunding. While the impact of "the length of reporting period" is significantly positive on Raised and Ratio (supporting H2b), which means that the number of days the reports posted on the website before crowdfunding ends positively affects the amount of funding and the ratio of fundraising goal. We also find that the average score from the evaluators has positive impact on the crowdfunding success (supporting H2a). Similar to model 1, we also estimate the effect of the sampling on "number of likes" and "number of followers" to exclude the alternative explanation of project quality.

5. CONCLUSION

Using data from JD, a leading crowdfunding platform, we empirically examine the underlying mechanisms of the effects of free sampling in the context of crowdfunding. Our analysis reveals that offering free samples to potential backers does help increase the likelihood of success of a crowdfunding campaign. Interestingly, it does not increase the number of backers but does increase the average contribution amount per backer. We also find the role of evaluation report to be similar to that of online work-of-mouth in the e-commerce context, i.e., the higher the average score on the product, the more successful the project will be. It appears that the length of the report and the number of pictures in the report has no significant impact on crowdfunding performance. Meanwhile, as the report from the evaluator reduces the uncertainty, the longer the potential investors are exposed to the evaluation report, the more money the campaign raises.

The findings from this study broaden our understanding of the effects of free samples. These insights also provide important managerial implications to entrepreneurs and crowdfunding platform managers. Providing the option of free sampling can help crowdfunding projects succeed in meeting their goals. For those who opt to provide free samples, it is crucial to achieve the satisfaction of the evaluator so that they submit a strong evaluation report. In addition, it is just as important to make the evaluation report available to the crowd as early as possible to maximize the benefit from the exposure of the report.

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Research on Multi-Dimensional Dynamic Clustering Method of Big Data Alliance Users

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Abstract: In order to improve the clustering accuracy of big data alliance users, this paper studies users' dynamic clustering based on their multi-dimensional attributes. First of all, the user profile of big data alliance is constructed from five dimensions of user basic attribute, domain attribute, preference attribute, social attribute and value attribute. And the K-means algorithm is used to cluster user profiles to complete the initial clustering. Then, based on the group user profile, combined with the user's recent dynamic behavior data, the FCM algorithm is used to achieve secondary clustering. Finally, the proposed user clustering method is tested by recommending data resources to the clustered user groups. The experimental results show that the user clustering method proposed in this paper has higher accuracy and lower error rate.

Keywords: big data alliance users, multi-dimensional attributes, dynamic clustering

1. INTRODUCTION

With the development of cloud computing, Internet of things, artificial intelligence and other new generation of information technology, the huge value contained in the huge volume of data covering all walks of life has been gradually discovered and applied. In order to promote the sharing and application of data resources, and avoid the risks brought by information islands, the establishment of big data alliance has become an important means to promote the development of big data. Big data alliance provides users with corresponding data resources in time and accurately by connecting the upstream and downstream enterprises of big data industry for data fusion, which lays a solid foundation for the realization of alliance profits. However, the volume of users in big data alliance is huge, providing corresponding services based on users' real-time data will not significantly improve service efficiency, and will generate colossal resource consumption and high alliance operation costs. Therefore, in order to improve the efficiency of the alliance's management of users, it has become an inevitable trend to cluster users of the big data alliance. As we all know, the most commonly used user clustering method is the K-means algorithm, but users belong to only one specific group when using this method, which has some limitations. Existing researches on user clustering mainly focus on web user clustering, and get similar information needs from user behavior data. In addition, some scholars studied user clustering from such aspects as the time attributes of user preferences ^[1], various factors affecting user clustering, dynamic user clustering ^[2], and improvement of user clustering methods ^[3]. The existing research results of user clustering provide strong support for the research of big data alliance user clustering.

2. MULTI-DIMENSIONAL DYNAMIC CLUSTERING OF USERS IN BIG DATA ALLIANCE

Big data alliance user clustering mainly consists of the following steps:

(1) User data collection and processing. The user data of big data alliance includes the basic information filled in by the user during registration and the behavior data left after the user operation. By integrating user data from alliance members and alliance platforms, the user registration data and behavior data are analyzed and processed to obtain user multi-dimensional attributes.

(2) Users are clustered for the first time. In order to fully describe the characteristics of users, we divide

the attributes of user behavior data based on the characteristics of user behavior data of big data alliance. When users browse and purchase data resources, they first pay attention to the domain of the data resource, and look for data resources that match their preferences in the corresponding domain. In order to understand the real situation of data resources, users will obtain detailed information by browsing the reviews or interacting with other users. After the corresponding data resource is determined, the big data alliance platform will evaluate the value of the user based on the user's visit and purchase behavior. Therefore, this paper divides user attributes into basic attribute, domain attribute, preference attribute, social attribute and value attribute. Based on the user's multi-dimensional attributes, a user profile of the big data alliance is constructed, and similar user profiles are aggregated by K-means algorithm to form a group user profile to complete the initial clustering.

(3) Second user clustering. The user profile of big data alliance is constructed without considering the timeliness of user data, and the user need changes dynamically with time, which result in the inability to provide accurate data resource services for the user groups only divided by the group user profile. Therefore, this paper uses the user's recent behavior data to mine the user's recent needs, and dynamically classifies the users in the same group profile according to the recent needs, so as to improve the accuracy of the clustering results. The user's recent behavioral data can be divided into two categories based on the explicitness and implicitness of user behavior. One is the explicit data left when users purchase and evaluate data resources, and the other is the implicit data left when users browse and search data resources. By analyzing and processing the user's explicit and implicit behavior data, users' recent needs are obtained. This paper uses the fuzzy c-means clustering method (FCM) to cluster users under the same group user profile according to the user's recent needs, and completes the second division of user groups.

3. CONCLUSIONS

The study of big data alliance users clustering is beneficial to improve the management efficiency of users in the alliance. However, the traditional user clustering methods do not consider the comprehensive information of users and the timeliness of user data, which result in unsatisfactory results. This paper integrates the user data shared by alliance members and the new user data after the alliance is formed, constructs user profiles from five dimensions of the user's basic attribute, domain attribute, preference attribute, preference attribute and value attribute, and aggregates similar individual user profiles to form group user profiles to complete the initial clustering. On the basis of group user profile, users are clustered again based on the user's recent explicit and implicit needs. Clustering users of the big data alliance through the above method can ensure the long-term preferences and recent needs of users in the same group are highly similar, improve the accuracy of clustering results and the efficiency of alliance management of users, clarify the use of alliance data resources and adjust the data resource layout in time to maximize data resources usage efficiency.

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Dropout Predictions of Ideological and Political MOOC Learners

Based on Big Data

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Abstract: The massive open online course (MOOC) has expanded rapidly, providing users with a low-cost, high-quality learning experience. High dropout rate is a serious obstacle that restricts the development of ideological and political MOOC. One of the ways to solve this obstacle is to use the rich data resources in MOOC to explore the relevant factors of dropout. Reduce dropout rates by building drop-out prediction models and establishing early-warning mechanisms. However, the ideological MOOC data is huge and complex, which is prone to problems such as loss of data value, mismatch between data and models, and poor research reproducibility. This paper uses a more mature logistic regression method of machine learning to transfer it to the field of education, providing a new path for data-driven MOOC dropout prediction research.

Keywords: MOOC, learner, behavior prediction, dropout

1. INTRODUCTION

Modern information technology has promoted the reform and development of education informatization. Massive Open Online Courses (MOOC) is a new teaching model emerged at the historic moment in the information age under the network environment^[1]. The birth and development of MOOC has lowered the education threshold and promoted knowledge sharing^[2]. Compared with traditional classroom education, MOOC has almost no registration threshold and the cost of dropping out is very low. Behind the huge number of users is a generally high dropout rate, of which the dropout rate for ideological and political courses is generally higher than 90%^[3]. The high dropout rate severely restricts the development of ideological and political MOOCs. At present, some researchers use the increasingly mature learning behavior analysis technology to quantitatively study the MOOC dropout problem. Based on the existing behavior data of learners, analyze the behavior patterns of dropouts and non-dropouts, and predict possible dropouts. Some progress has been made^[4].

How to use the MOOC system to record a wealth of learning process data, as a basis for early warning, intervention, optimization of the learning process of the MOOC, to help the MOOC to better develop and play its due role, it is particularly important^[5]. However, the increasing volume of data and the complexity of records also make data processing and analysis more difficult. With the development of technology, machine learning is gradually applied to learning behavior analysis^[6]. This study uses machine learning methods to transform raw data into meaningful feature data to improve the operability and interpretability of data analysis and modeling, and to explore the complementary role of human researchers and machine learning techniques in MOOC dropout prediction analysis^[7].

2. MOOC DROPOUT FACTORS

Compared with the traditional teaching model, MOOC is considered to lack self-efficacy, and poor self-regulation is the main reason for MOOC learners to drop out of school^[8]. In addition, study time, course setting, and course difficulty are also the main reasons for learners to drop out of class^[9]. Some scholars have

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pointed out that teacher guidance and credit encouragement have significantly improved the completion rate of MOOC. Students with higher learning expectations and better grades are more likely to persist in learning^[10]. Based on questionnaire surveys, Xu Zhenguo and others found that lack of self-control, lack of encouragement mechanisms, and regulatory measures were the main factors for school dropout^[11]. The platform factor is also an important factor affecting learners, such as poor platform supervision measures, inconvenient interaction between teachers and students, etc., will affect the course completion rate^[12].

Table1. Common MOOC dropout factors

Learner factors	Teacher factors	Curriculum factors	Platform factors
Lack of self-control	Lack of interactive Q & A	Long course period	Lack of incentives
Time is limited	Boring teaching	Content is not as expected	Lack of regulatory measures
Lack of motivation to complete	Poor language expression	Stale content or low quality	Inconvenient teacher-student interaction
Can't keep up with learning progress	Poor teacher image	Teaching focus is not prominent	High certificate fees

3. LOGICAL REGRESSION PREDICTION MODEL

Logical regression originates from the linear regression mathematical model in mathematical statistics, and is the most widely used classification algorithm model, which is often used to solve two classification problems. Nagrecha uses LR to predict dropouts, which is good. The main idea is to use the Sigmoid function to calculate the probability of a sample x belonging to class 1 $h(x)$ ^[13].

Make $z = x^\theta$, x is the sample input, θ is the model parameter,

$$g(z) = \frac{1}{1 + e^{-z}}$$

The model output is:

$$h = \frac{1}{1 + e^{-x\theta}}$$

The value of $h(x)$ is between $[0,1]$. The larger the value, the higher the probability that the sample belongs to class 1. The smaller the value, the higher the probability that the sample belongs to class 0. This model was chosen mainly to realize the LR by using the Logistic Regression function of the free open source resource sklearn.linear-model library in Python.

4. PREDICTION of DROPOUT RATE IN IDEOLOGICAL MOOC

4.1 Study design

Learning is a complicated process. Under the MOOC environment, a large number of learners form a more complex learning system, with rich but difficult to use data resources and urgent demand for dropout prediction^[14]. The ideological MOOC dropout prediction framework includes four modules: data acquisition, feature data selection, predictive modeling, and result analysis.

4.1.1 Data acquisition

In data-driven education research, data acquisition and storage are the primary tasks^[15]. In terms of data acquisition, the MOOC learner behavior data used in this study mainly comes from the MOOC platform of Chinese universities. MOOC log data is often in JSON format, which needs to be parsed and dumped into tabular data. In addition, the study needs to supplement the course cycle, videos and number of tasks. And other metadata to explore feature weights and predictive effects in different curriculum contexts^[16].

4.1.2 Feature data selection

MOOC learner behavior data is heterogeneous and complex. It needs to combine learning scientific theories to extract data features from various aspects of certain behaviors. It also needs data cleaning, feature transformation, featureless dimensioning, and samples Balance and other processing^[17].

4.1.3 Predictive modeling

Predictive modeling needs to compile the data into training and test sets. In order to effectively reduce the possible bias and imbalance when randomly splitting the sample data, a ten-fold cross-validation method is used to generate the training and test sets.

4.1.4 Result analysis

Here is a simple and effective, explanatory traditional machine learning classifier LR for the practice of thinking MOOC drop-out prediction practice, monitoring the number of learners visiting course content, the number of videos viewed, the number of tasks submitted, the number of visits to post content, and the impact of the total number of active days in drop-out rates^[18].

4.2 Data source

This research data is derived from the "School Online" platform, which is a future-oriented Internet University initiated by Tsinghua University, bringing together more than 600 well-known institutions around the world to provide learners with a full range of online education services ranging from prestigious school courses and academic degrees to practical skills. The subjects chose the course of introduction to the basic principles of Marxism, and the courses in which the evaluation scores were in the top 5 were selected for analysis. These courses are week-by-week and include videos, courseware, tests, assignments, discussions, and final exams. These courses were chosen because they were a quality course with earlier and more iterations, teaching design was recognized by peers, the quality of teaching was recognized by the students, and the "cliff-cut" drop-out caused by the quality of the course itself could be effectively avoided, the course was dominated by video, and the unit tasks included tests, assignments and discussions. The teaching elements are fully equipped, the course data is large, and the learners are active, the data quality is relatively good, suitable as an exploratory predictive modeling sample.

4.3 Feature selection

In the learning environment, MOOC learners interact with a series of learning content or learning tools to produce specific learning behaviors, obtain corresponding learning effects, and then form individual learning trajectories. We select corresponding features from them for modeling.

4.3.1 Learning environmental characteristics

MOOC online learning environment mainly includes social environment and network environment. Social environment includes group environment, organization environment, and family environment. The network environment is mainly hardware or software that supports learners' smooth learning, which is divided into infrastructure, learning resources and teaching platforms. This study is based on the same courses on the same learning platform, and it can be considered that the network facilities, the level of resource construction, and the nature of the courses are the same. These are not the reasons that cause learners to show different behavior patterns. Therefore, this study only considers the group environment in the social environment.

The group environment is specifically the learning participation of teachers and other learners in the learning community. It mainly includes teachers' MOOC teaching. Teachers usually measure their participation in the learning process from two aspects: teaching guidance and evaluation. Other learners in the MOOC teaching, the consideration of other learners is mainly the learning atmosphere of the learning group, and the

interaction between the learning members and learners in the group as a measure of participation.

Table2. Learning environmental characteristic indicators

Group environment	Index
Teacher (T)	Teacher guidance times (T1)
	Number of teacher evaluations (T2)
Student (S)	Class average participation in discussions (S1)
	Class average postings (S2)

4.3.2 Learning behavior characteristics

MOOC learning activities are based on a series of interactions with learning content or learning tools that occur in MOOC courses, which correspond to the construction of different cognitive levels of learners. Therefore, we divide a series of learning behaviors from cognitive participation. The first behavior is environmental interaction behavior. Learners understand the behavior of the learning environment, including browsing teaching dynamics, browsing teaching resources, etc., with a low level of cognitive participation. The second type of behavior is learning interactive behaviors. Everyone in the learning community conducts learning activities, including reading posts, finding information, establishing learning groups, etc., involving some collaborative behaviors of learners. The degree of cognitive participation is higher than that of operational interaction. The third behavior is interactive behavior, which focuses on negotiation, communication and sharing, such as creating discussion topics, asking and answering questions, sharing and recommending learning resources, and summing up learning gains. The required cognitive participation is the highest.

Table3. Learning behavioral indicators

Learning behavior	Index
Environmental interaction	Number of signed-in courses (E1)
	View course progress times (E2)
	Number of browse course resources (E3)
Learn interactive behavior	Number of videos watched (L1)
	Watch the duration of the video (L2)
	Views of forum posts (L3)
Interactive behavior	Participation in discussions (I1)
	Questions(I2)
	Posts(I3)
	Number of replies(I4)

4.3 Analysis of results

The sample was randomly divided into 10 parts by the ten-fold cross-validation method. Each time, one of the samples was used as the test set, and the remaining nine were used as the training set. The logistic regression algorithm was used to train the prediction model. This study uses test set data as input data to predict whether learners will eventually complete the course. Because the dependent variable Y of both models is a final grade with a range of 0-100, in order to facilitate the analysis of the accuracy of subsequent predictions, this study uniformly defines the final grade less than 60 as "dropout", and the final grade is greater than or A score equal to 60 is defined as "passed the course", and the numerical proportion of the results of "predicted dropout" and "predicted pass" in "real dropout" and "real pass".

Table4. Test results of 5 courses

Course code	C1	C2	C3	C4	C5
Number of people who passed the test	448	816	749	1422	3356
Number of dropouts in the test set	4346	2883	2953	3730	6259
Actual to passed and predicted to pass	65.7%	83.7%	75.1%	39.7%	42.3%
Actual dropouts and predicted dropouts	87.6%	86.6%	88.2%	81.7%	83.8%

The average accuracy rate of the LR model in correctly "predicting dropouts" (that is, actual dropouts and predicted dropouts) is 85.6% on average. This is largely related to the usual learning habits of dropout learners. Generally, most learners drop out because they have less learning participation and less learning behavior, and their behavior patterns are relatively simple and easier to predict. The analysis of the accuracy of the correct "prediction pass" found that the accuracy rate of the 5 courses is high or low (up to 83.7%, and the lowest is only 39.7%)-this aspect has more behaviors with learners who have passed the course. The model is more complicated, and on the other hand it is related to the sparse number of people who pass the course in the data set.

5. CONCLUSIONS

In the MOOC environment, the number of learners is much larger than teachers and education administrators. This makes the "human" resources that provide learning support for learners relatively scarce. It is impossible to rely on manual tasks to identify problem learners and provide targeted timely intervention.^[19] Inadequate intervention sits unable to cope with the serious problem of dropout, and unnecessary intervention is a waste of resources and more likely to affect learners who are learning normally. Dropout prediction can help teachers and education administrators monitor learners' dropout risk, accurately identify which learners need help, analyze what problems learners have, or what factors contribute to learning risk, in order to select the right resources and methods for timely intervention^[20]. This study helps:

5.1 Categorize learners according to the prediction results

According to the forecast results, learners are divided into two categories. Learners who have a high risk of dropping out and need help can be divided into learners who have left the course and learners who have not yet quit but have shown problematic behavior according to the disengagement node. The former needs to use means other than MOOC, such as email to remind them to continue the class. The latter needs to be intervened during the MOOC learning process. Learners who are expected to adhere to the course content, and these learners can provide good guidelines for learning behaviors and provide suggestions for radically improving MOOC teaching.

5.2 Provides learner behavior analysis

This study found that dropouts and non-dropouts have different learning behavior characteristics when they visit pages, watch videos, submit tasks, and collaborate on forums. Based on the learning behavior patterns of non-dropouts, it is able to identify the problem behaviors of dropouts and find that their dropout factors, such as insufficient learning investment, such as low video and task completion rates, lack of self-control, and activity gradually decline over time. Base on these learning difficulties to develop targeted interventions.

5.3 Advise on data-based support for improving ideological and political MOOC

Early warning system can be constructed on the basis of predictions of dropouts, feedback of learning risk levels to learners in the form of "signals", and the prediction results are presented to teachers or teaching assistants in a visual form, and teaching improvements or learning are provided Intervention recommendations, manual intervention by teachers or teaching assistants combined with educational theory.

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Exploring Customer Behavior Patterns: A Process-based Perspective

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Abstract: With the increasingly fierce competition among enterprises, it is important for enterprises to understand customer behaviors accurately in a dynamic environment. While data mining methods have been applied to investigate customer behavior patterns with high-quality objective data, the process perspective has been largely neglected. Given that customer behaviors can be reflected in process event logs, it is possible to mine the real behavior patterns from a process-based perspective. To this aim, this paper presents a method for exploring customer behavior patterns using process mining techniques. The method consists of five steps: data collection and preprocessing, customer service process modeling, identifying deviant behaviors, clustering analysis and discovering customer behavior patterns. This method provides a viable way to understand the customer behavior patterns from a process-based perspective.

Keywords: process mining, customer behavior pattern, conformance checking, cluster analysis

1. INTRODUCTION

A deep understanding for customers is crucial in customer relationship management for achieving competitive advantage^[1]. Since customer behaviors are highly dependent on the specific context, it is often difficult to explore behavior patterns for a huge number of customers^[2]. Traditional customer behavior analysis with questionnaires or interviews may be time consuming and involves high costs, with only subjective data obtained^[3]. Therefore, data mining techniques have been widely applied for the identification of customer behavior patterns with high-quality objective data (e.g. web visit logs)^[4,5]. Currently, complex customer service processes are executed in large service companies for delivering quality customer services^[6]. These business processes compose an important dimension for understanding customer relationship management^[7]. However, few studies have examined customer behaviors from a process-based perspective.

Process mining has emerged as a set of new techniques, aiming at the automatic construction of models explaining the behaviors observed in the business process data^[8]. Over the last decades many algorithms, techniques and tools for process mining have been developed^[9-10]. In various areas including education^[11], e-commerce^[1,12], government^[13], logistics^[14] and manufacturing^[15], process mining techniques have been applied for extracting process knowledge in support of process improvement and compliance. For understanding customer behaviors reflected in the service processes, nevertheless, there still lacks a comprehensive method that can be applied in real scenarios. Hence, the purpose of this paper is to answer the following research question: *how to learn customer behavior patterns from a process-based perspective?*

The paper is organized as follows. In Section 2 we will briefly outline related concepts and techniques concerning customer behavior analysis and process mining. Section 3 presents the method based on process mining techniques. Section 4 elaborates on the case study and Section 5 provides the results. Finally, Section 6 concludes the paper.

2. RELATED WORK

This section outlines related concepts and techniques concerning customer behavior analysis and process mining, which will be utilized in the remainder of the paper.

2.1 Customer behavior analysis

In many previous studies, customer behavior data was gathered with questionnaires and interviews^[3].

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These studies obtaining subjective customer behavior data often involve high costs and consume long time. Therefore, data mining techniques based on objective data have been widely used in customer behavior analysis. For example, cluster analysis has been considered helpful for divide customers into similar variety of teams that take high intra similarity and low external similarity^[16]. For another example, association rule mining has been widely used to find the patterns of customers' consumption behavior^[17] and discern social relationships between users^[18]. The information systems like CRM, HR as well as ERP generate process event logs, which provide the possibility to explore customer behavior patterns using process mining techniques. However, there is still a lack of effective methods from a process-based perspective to explore customer behavior patterns.

2.2 Process mining

Process mining is a new and emerging interdisciplinary field of data science and business process management. The basic idea of process mining is to discover, monitor and improve real processes by extracting knowledge from event logs^[19].

In this paper, conformance checking, which is an important process mining technique, will be applied to identify deviant customer behaviors. Conformance checking aims at the detection and quantification of inconsistencies between a process model and its corresponding execution log^[20]. Before performing the conformance checking, we need to pre-define the existing business process model (e.g. Petri Net model). The pre-defined process model will be compared with the real process executions reflected in the event log. As a result, the deviant customer behavior can be identified this way.

In addition, process cluster analysis^[21] will be used in our study to categorize customer service process cases into similar groups. Subsequently, process discovery algorithms will be employed for each group of event log cases. In this paper, we will employ heuristic algorithm for it takes the frequency of the task order in the event logs into consideration and deals with the noise log data in a good way^[22,23]. The discovered process models are able to provide illustrations for different customer behavior patterns.

3. THE METHOD

In this section, we propose a method for exploring customer behavior patterns using process mining techniques. The method consists of five steps: data collection and preprocessing, customer service process modeling, identifying deviant customer behaviors, cluster analysis for customer behavior patterns, and discovering customer behavior patterns in each cluster, as illustrated in Figure 1.

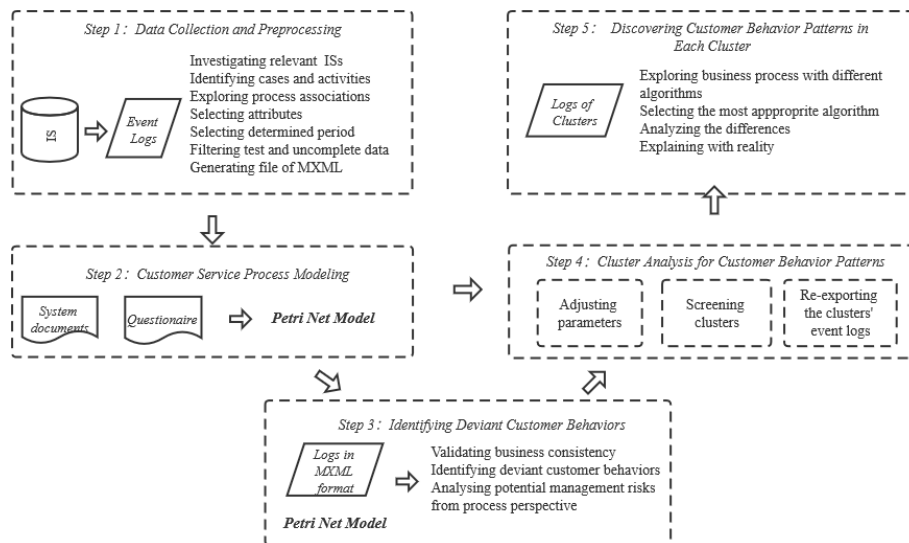


Figure 1. Comparison diagram of preprocessing

- 1) **Data collection and preprocessing:** Process data can be collected from multiple information systems which support the customer service. The obtained process data is then preprocessed to get the event log, containing information about customer service activities, their occurring time, and other activity context data.
- 2) **Customer service process modeling:** The obtained event log reflects the real process executions of customer service. This can be compared with the pre-defined process model. Thus, customer service process modeling is performed in this step to provide the illustration of pre-defined customer service process.
- 3) **Identifying deviant customer behaviors:** With the event log and the pre-defined process model for the customer service, conformance checking technique can be applied, comparing the event log with valid execution path specified by the process model. Deviant customer behaviors can be identified this way.
- 4) **Cluster analysis for customer behavior patterns:** Process cluster analysis^[25], which categorizes customer service process cases into similar groups, will be performed in this step. Process cases within the same cluster demonstrate similar customer behavior patterns.
- 5) **Discovering customer behavior patterns in each cluster:** In this step, process discovery technique will be applied to the process cases in each cluster. Together with the comparative analysis of different clusters, the discovered process models illustrate different customer behavior patterns.

4. CASE STUDY

In this section, a case study is presented to illustrate our method. We describe the case scenario and event logs in our case study firstly, and then build the Petri Net model which will be used in conformance checking.

4.1 Case scenario

G port is an important comprehensive hub port in South China with more than 14,000 customers and 340,683 customer service process records. In this study, we collected process data from 1 Jan, 2018 to 31 Dec, 2019 for the case study. The complete customer service process includes four main sub-processes: documents handling, shipping, delivering and billing.

The process starts with the signing of contracts and ends with payment, including a total of 32 activities including ship plan, ship unloading, cargo lists checking, outbound, delivery and billing and so on. Table 1 shows that the logs contain the fields of case id (e.g. 'BBL02180117'), activity id, timestamp and resource, indicating the content, operation time and operator of activities respectively. Cargo name and customer record more detailed customer service information to support in-depth analysis of customer behavior patterns.

Table 1. An example of the extracted event log of the customer service process

Case ID	ACTIVITY ID	FORMDATE	FORMMAN	CARGO NAME	CUSTOMER
BBL0218017	Long-term contract	2018-01-08 00:00:00	Liu	Coil	Customer 1
BBL0218017	Ship plan	2018-04-11 09:24:51	Zhang	Coil	Customer 1
BBL0218017	Cargo list	2018-04-12 00:00:00	Qu	Coil	Customer 1
BBL0218017	Billing	2018-04-28 10:05:15	Lin	Coil	Customer 1

4.2 Modeling the customer service process

A process model was built describing the customer service process with Petri Net, as shown in Figure 3. In order to illustrate the relationship between processes and customers more clearly, we divided the main process into four sub-processes, *documents handling*, *shipping*, *delivering* and *billing*. The relationship between processes and customers, as well as the relevant activities and documents of each sub-process are shown in Table 2. The *documents handling* sub-process reflects customer's habit of dealing with documents. And the *shipping* and *delivering* reflect the planned and actual quantity and frequency of cooperation, respectively. The last *billing* sub-process directly reflects the customer's consumption habits and economic capacity. To sum up, the event logs can reflect customer behaviors fully. And the more detailed illustration of each activity is shown in Table 3.

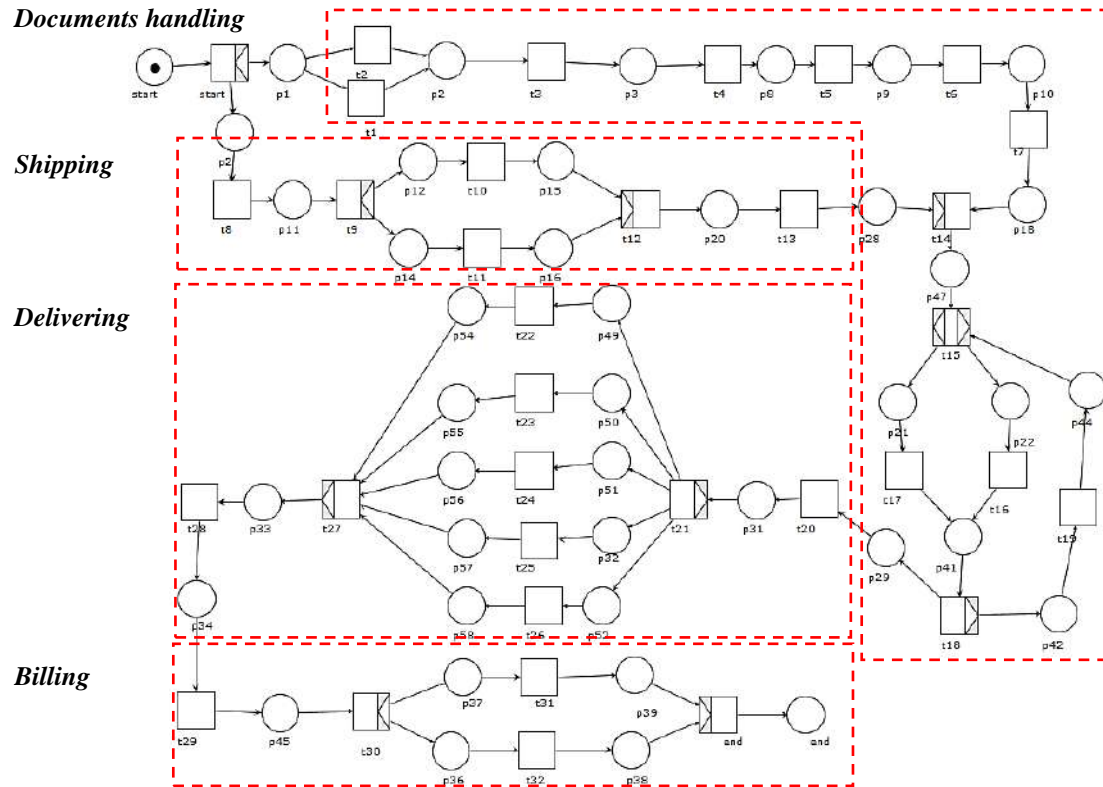


Figure 3. Petri Net model of pre-defined business process

Table 2. The relationship between sub-processes and customer behavior patterns

Sub-process	Relevant activities or documents	Operator	The reflected information of customers
<i>Documents handling</i>	Contract, Cargo-list, outbound order, prebill	Customer	Contract type, the order and type of handling documents
<i>Shipping</i>	Forecast, shift planning, day and night planning, ship unloading	Company	Planned operation quantity, frequency of cooperation
<i>Delivering</i>	Delivery card, loadometer records	Customer	Delivery habits, actual operation quantity
<i>Billing</i>	Billing, payment, invoice	Customer	Consumption habits, economic capacity

Table 3. The activities of the pre-defined business process model

Activity ID	Activity Name	Sub-process	Activity ID	Activity Name	Sub-process
T1	Long-term contract	Documents handling	T18	Outbound check	Documents handling
T2	Single ship contract	Documents handling	T19	Outbound sub-order	Documents handling
T3	Cargo list	Documents handling	T20	Loadometer	Delivering
T4	Cargo list check	Documents handling	T21	Delivery card	Delivering
T5	Cargo list sign	Documents handling	T22	Truck-weigh record	Delivering
T6	Cargo list claim	Documents handling	T23	Barge-weigh record	Delivering
T7	Outbound	Documents handling	T24	Barge-unweigh record	Delivering
T8	Ship forecast	Shipping	T25	Train-weigh record	Delivering
T9	Day and night plan	Shipping	T26	Train-unweigh record	Delivering
T10	Shift plan	Shipping	T27	Outbound complete	Delivering
T11	Ship berth	Shipping	T28	Outbound settlement	Delivering
T12	Ship unload	Shipping	T29	Billing	Billing
T13	Unload tally	Shipping	T30	Settlement handover	Billing

Activity ID	Activity Name	Sub-process	Activity ID	Activity Name	Sub-process
T16	Prebill	Documents handling	T31	Transfer income	Billing
T17	Bind prebill	Documents handling	T32	Invoice	Billing

5. RESULTS

Results are presented in this section in terms of the deviant customer behaviors and different customer behavior patterns.

5.1 Deviant customer behaviors analysis

Deviant customer behaviors were identified through conformance checking. After data collection and preprocessing, the event logs were exported into MXML forma. The pre-defined Petri Net model is another input source for conformance checking. The event logs were mapped with Petri Net model one by one to compare the consistency between the actual business process and the pre-defined process. Figure 4 shows the conformance checking results.

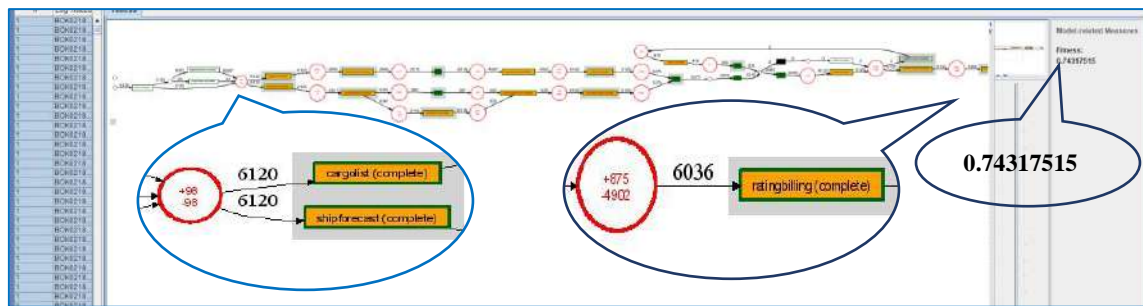


Figure 4. Screenshot of Conformance checking results

As can be seen in Figure 4, the fitness value is **0.74317515**, indicating a good fit and the actual customer behavior patterns contained in actual event logs is meaningful. However, there are still many missing tokens (identified by "-") and redundant tokens (identified by "+") when we "replay" the pre-defined model using the real process execution event log^[14] (see Figure 4). By continuing to analyze the number of missing and redundant tokens between each event, the deviant customer behaviors can be identified and should receive more attention from managers.

Table 3. Deviant Customer Behavior Identification

Activity	Ideal process model	Token (+/-)	Deviant Customer Behavior Identification
T29: Billing	The activity should be operated after the of the activity <i>outbound settlement</i> is completed	+875 -4902	80% of the delivery and billing phases were without settlement operations. The deviant is that may lead to inaccurate billing content, or the delivery operation still exists during billing phase. Thus, the deviant behavior associated with a group of customers should be corrected promptly to reduce the goods loss.
T3: Cargo list	The activity should be operated after signing the contract	-98	1.6% of cargo list documents were completed before the contract was signed. The deviant is that the goods occupy the resources of berth and warehouse after unloading. The delivering and billing phase can only start after the contract is signed. Thus, this deviation of customer behavior should be eliminated for increasing productivity.

5.2 Analysis of customer behavior patterns

Before further analysis, we first regrouped the pre-processed event logs according to customers, cargos to improve the performance of the clustering analysis. Event logs were clustered using a clustering algorithm integrated in ProM. In our study, we set the value of the parameter 'max-diameter' to 0.7, as repeated experiments

showed that the boundaries of the clustering results are very clear with this parameter value. As a result, we got 10 clusters with at least 3 traces as shown in Figure 5. The clusters with more than 100 traces were then selected for further analysis.

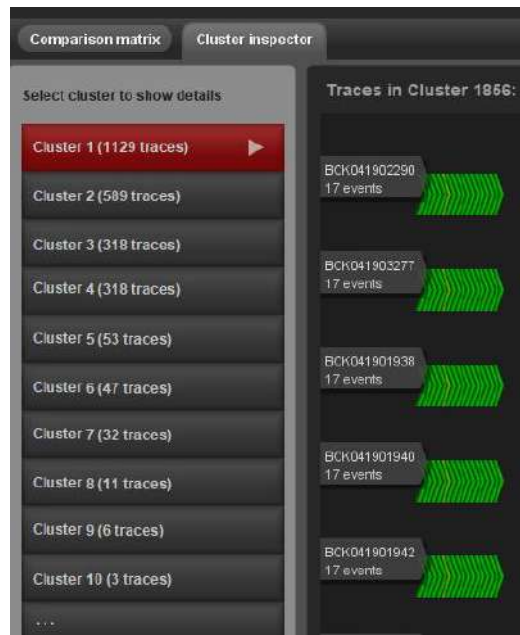


Figure 5. Screenshot of Cluster analysis results

Process discovery was then performed to explore the traces contained in each cluster. As shown in Figure 6, the process models discovered indicate significantly different customer behavior patterns.

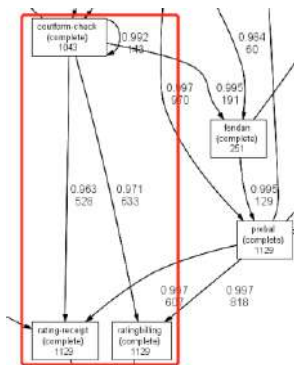


Figure 6 (a). Cluster 1

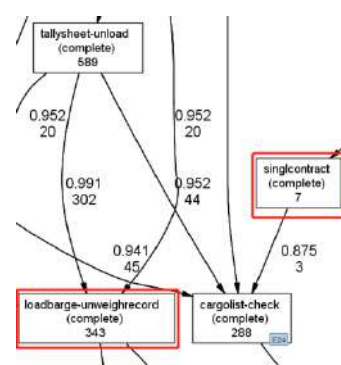


Figure 6 (b). Cluster 2

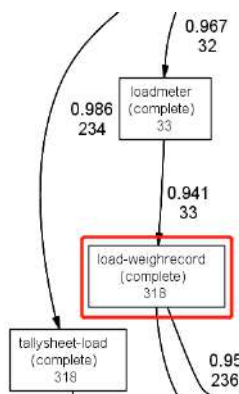


Figure 6 (c). Cluster 3

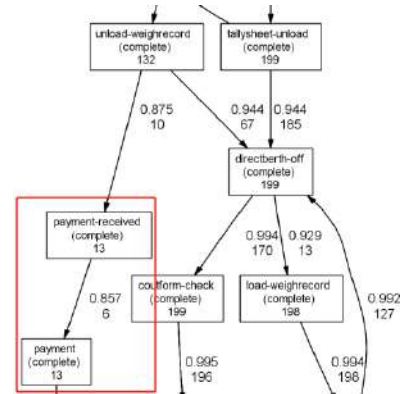


Figure 6 (d). Cluster 4

- 1) First, Figure 6 (a) reflects that customers in **Cluster 1** has no delivery process and goes directly into the billing phase after completing the documents. The cargos of the cluster are directly sent to the customers through pipelines or belts, without counting or weighing. The efficiency of the whole process can be improved as long as the efficiency of **documents handling** sub-process is improved.
- 2) Figure 6 (b) shows that customers in **Cluster 2** have signed more single ship contracts rather than long-term contracts, and most of the delivery way is *barge-unweigh record*. Through interviews with system personnel, we acknowledged that most contracts are long-term ones. Because the single-ship contracts need to be signed at the port site when the customers deal with documents in the selected systems.
- 3) Different from the previous cluster, almost all the customers of **Cluster 3** have chosen the delivery way of *truck-weigh record*. When the way of delivery is obtained in advance, the warehouse and weighbridge can be ready as soon as the ship plan is completed for high efficiency.
- 4) Surprisingly, unlike other customers who take the payment activity as the end of the main process, most customers of **Cluster 4** have completed the payment activity at the documents phase which is popular for enterprises. Managers can pay more attention to these customers and cooperate with them more often.

Thus, our study provides a viable method for exploring event logs generated by customers. Different customer behavior patterns can be effectively identified. For different customer clusters, further customer relationship management measures can be carried out accordingly.

6. CONCLUSIONS

With the increasingly fierce competition among enterprises, it is really important for enterprises to understand the behavior of customers. Considering that event logs generated by information systems contains the complete behaviors of customers, it is possible to mine customer behavior patterns from a process-based perspective. This paper proposes a complete method. The required data is easy to obtain, and the method is easy to operate. The method has some important managerial implications for enterprises. The customer clustering allows for more effective customer management with less cost. In addition, discovery of the behavior patterns of different customer clusters makes it possible to perform the service operations with better preparations, leading to higher service efficiency and less resource consumptions. What's more, timely detection and correction of customer deviation behaviors would help reduce potential risks in the customer services. Our case study of an important Chinese port shows that this method is applicable. Future work includes the optimization of algorithms and techniques.

ACKNOWLEDGEMENT

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Research on Online Word-of-mouth Sentiment Analysis and Attribute Extraction Based on Deep Learning

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Abstract: Online word-of-mouth content mining is of great significance to product, service improvement and demand prediction of online marketing enterprises. However, most studies have focused on the identification of the sentiment tendency of online word-of-mouth, and lack of text content mining for online word-of-mouth, especially negative word-of-mouth. This paper introduces deep learning into online word-of-mouth sentiment tendency analysis and negative word-of-mouth word attribute feature extraction, and builds an online word-of-mouth sentiment tendency analysis and attribute extraction model based on LSTM deep learning algorithm. The model was trained and tested through online word-of-mouth data of a fashion apparel e-commerce company. The results show that the LSTM model has a good effect on sentiment analysis and negative word-of-mouth attribute feature extraction. Through comparative experiments, it is shown that the model has a better effect than the traditional machine learning methods (SVM, Naive Bayes) in the analysis of sentiment tendency.

Keywords: online word-of-mouth, LSTM, attribute extraction, sentiment analysis, deep learning

RESEARCH QUESTION

With the popularity of online shopping, information exchange based on the information interaction platform of e-commerce websites has gradually increased. These interaction information include user generated content such as user experience, perception and evaluation information of a certain product or service, forming an online reputation. The user sentiment and the descriptions of products, services and other attributes contained in online word-of-mouth are of great significance to the product, service improvement and demand prediction of online marketing companies. However, most studies focused on the identification of the sentiment tendency of online word-of-mouth^{[1][2][3]}, or only extract the subject of online word-of-mouth^{[4][5]}, but lack of text content mining for online word-of-mouth, especially negative word-of-mouth. Some studies have pointed out that in the decision-making process of consumers, the impact of negative reviews is far greater than positive reviews^[6]. Word-of-mouth text information contains specific issues that users are more interested in, especially negative word-of-mouth. Moreover, the negative word-of-mouth contains the user's feedback information, which is the user's experience about the quality of the product and service, and such information is the focus of the user's purchase process. Therefore, it is necessary to dig the text information in negative word-of-mouth.

With the rapid increase in the number of online word-of-mouth in major e-commerce platforms, the manual filtering and word-of-mouth content extraction implemented in traditional management is becoming increasingly difficult to achieve. Deep learning model has strong feature learning ability and can overcome many difficulties in artificial feature extraction^[7]. In particular, LSTM (long short term memory) model can effectively fit serialized data. Therefore, we can consider designing a comprehensive model that can simultaneously implement sentiment analysis and attribute extraction to fully mine online word-of-mouth content, and provide automated and intelligent methods and tools for product design, service improvement, and demand forecasting.

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MAIN FINDINGS

This paper divides the manual online word-of-mouth of a fashion apparel e-commerce platform into a training set and a test set. First, the natural language processing method is used to preprocess the word-of-mouth content of the training set and the test set, and the initial text is converted into a text corpus. Then use the Word2vec model to realize the word vector construction of the word segmentation. On the training set, the LSTM deep learning algorithm is trained on the online word-of-mouth sentiment analysis and negative word-of-mouth attribute feature extraction. Furthermore, the effectiveness of this model in extracting sentiment tendency features and negative word-of-mouth attribute features is verified on the test set. Finally, the effectiveness of this model compared to traditional machine learning algorithms in extracting sentiment tendency is further verified through comparative experiments. The results show that the LSTM model has a better effect on the extraction of sentiment tendency features and negative word-of-mouth attribute extraction. At the same time, compared with the SVM model and the Naive Bayes model, the LSTM model is superior to the other two models in accuracy, recall, and F value.

RESEARCH CONTRIBUTION

This paper delves into the text content of online word-of-mouth. Based on the feature that LSTM model can fit serialized data effectively, an online word-of-mouth sentiment identification and negative word-of-mouth attribute extraction model based on deep learning is constructed. Online word-of-mouth, a text that has a word order relationship, is modeled, and at the same time, sentiment analysis and attribute extraction are realized, so that online word-of-mouth content can be fully mined. This provides automated, intelligent methods and tools for product design, service improvement, and demand forecasting.

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Research on the Construction of Sales Forecasting Model of Fashion Products Based on Feature Representation of Multimodal and Deep Learning

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Abstract: By improving the accuracy of sales forecasting, this paper provides support for fashion product sales enterprises to make better inventory management and operational decisions. The deep neural network is introduced into the construction of multimodal features, and the internal structure of different modes, such as historical sales features, picture features, and basic attribute features of products, are fully considered, and finally the sales forecasting model of fashion products based on multimodal feature fusion is constructed. In addition, combined with the actual data of the enterprise, the proposed model is compared with the exponential regression model and shallow neural network model. The paper finds that multimodal features and deep learning representation method has better performance than traditional methods (exponential regression and shallow neural network) in the task of predicting sales of fashion products. The results help enterprises use the deep learning method and the data of multiple modal to make accurate sales forecast.

Keywords: sales forecasting, deep learning, multimodal features, fashion products

1. INTRODUCTION

Since the value of fashion products will decline rapidly over time, it is of great significance for enterprises to improve the sales forecasting accuracy of fashion products for reducing the impact of demand fluctuation on inventory and reducing the probability of unsalable and out of stock.

Because the demand of fashion products fluctuates greatly, in the sales forecasting model, the more comprehensive the factors that reflect the sales trend contained, the higher the forecast accuracy. In the past, scholars used the structural static data such as product price and discount, or used the dynamic data of the sales changing with time in the historical sales time series to predict product sales, so there are many deficiencies in combining multiple data to forecast the sales of fashion products. In addition, in the task of sales forecasting under the e-commerce environment, few scholars research the role of product pictures, which have an important impact on the users' purchase decisions.

On the other hand, different modal data such as basic attributes, sales time series and pictures of the same product are a group of data with different structures. The traditional sales forecasting methods can't directly use these data, so it is very necessary to propose a feature extraction method for multimodal data to effectively improve the sales forecasting accuracy of fashion products. In recent years, deep learning model has been proved to be able to effectively learn the hidden information of different types of features, and have obvious advantages in establishing connections between different modes and feature fusion^[1]. Therefore, when synthesizing multiple data to predict the sales of fashion products, we can consider designing the multimodal feature extraction and feature representation method based on deep learning.

Therefore, this paper focuses on the following three research issues: (1) How to use deep learning methods to represent multimodal features and achieve feature fusion. (2) How to build and evaluate the sales forecasting

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model of fashion products based on multimodal features. (3) How to verify the performance of the model in the task of sales forecasting of fashion products through empirical methods.

2. RELATED RESEARCH

2.1 Factors for sales forecasting of fashion products

The problem of sales forecasting has been studied for many years, and many researchers have proposed forecasting theoretical models. Through the summary, we can see that the main factors involved in sales forecasting include: time series features of historical sales^[2-3], basic attribute features of products^[4], etc.

In the early stage, scholars used methods based on time series and machine learning to predict sales. For example, Sim^[2] proposed an autoregressive model, and Thissen et al.^[3] used support vector machine to model and estimate time series data. Later, Ramanathan et al.^[4] used the basic attribute features such as the discount of products that affect the user's purchase decisions to predict the sales of products, and obtained better results. In e-commerce, because users can't get the physical information of products, many product information needs to be displayed through pictures. Although pictures have never been used for sales forecasting, Kim et al.^[5] confirmed that picture information can have a significant impact on the user's purchase decisions, and then affects product sales. In particular, deep learning provides an effective methodological basis for the extraction of picture features, making it possible to use pictures as an influencing factor for product sales forecasting.

In the field of fashion products, the existing sales forecasting researches mainly use the methods based on time series. For example, Choi et al.^[6] solved the problem of less historical data of fashion products by combining the extreme learning machine (ELM) with the grey prediction model. At the same time, due to the short sales cycle of fashion products, the prediction accuracy of the time series methods is poor. Therefore, later scholars also explore more explanatory variables related to product sales to improve the forecast accuracy of the model. Sun et al.^[7] explored the influence of product features such as color, size and price on the sales. Ni et al.^[8] considered the influence of historical sales, seasons, holidays and discounts.

It can be seen that most of the existing researches predict the sales of fashion products based on the historical sales time series and product basic attribute data, but there is no research to prove the role of product pictures in the sales forecasting task of fashion products under the e-commerce environment. In addition, there is also a lack of research on the sales forecasting of fashion products by using historical sales time series, basic attributes and pictures of products simultaneously.

2.2 Multimodal feature representation based on deep learning

Data from different information channels, such as historical sales time series, basic attributes and pictures, describe different aspects of the same product, each different kind of data or data from each different observation perspective can be called a different mode. Neural networks with deep structure can effectively reveal the hidden internal structure among these data and extract high-level abstract features that are useful for classification or regression tasks. For example, in the research field of multimodal feature learning, through integrating the information of audio and video modes, Ngiam et al.^[9] trained the depth confidence network and extracted the fused feature expression from the two modes, then obtained good results.

The methods of multimodal feature fusion based on deep learning have been widely used in many fields. In the task of human posture prediction, Chu et al.^[10] designed a deep neural network, which combined the whole attention model and the part of the body attention model, and realized the fusion of various information from different sources. Feiran et al.^[11] proposed a image and text sentiment analysis model, using a hybrid fusion framework of sentiment analysis to mine the recognition features and internal associations of visual and semantic content, and then make effective sentiment prediction. In the field of e-commerce, multimodal data can also better learn product features. For example, zahavy et al.^[12] took the image and text description of

e-commerce products as the research object, and carried out research on the product classification problems of multi-mode and multi category. Kannan et al.^[13] used text descriptions and images of products to optimize product classification in commercial search.

In conclusion, although the existing feature representation and learning methods of deep learning have mature applications in multimodal data fusion, at present, under the specific task of fashion product sales forecasting, few people have discussed how to generate the most effective features representation based on multimodal data and deep learning feature representation methods, which is the focus and innovation of this study.

3. MODEL BUILDING

3.1 Feature construction

In view of the good performance of feature learning model with deep structure on multimodal high-dimensional unstructured data, we introduce deep neural network into multimodal feature extraction and multimodal feature representation model, and fully consider the internal structure of different modes, and then transform the original high-dimensional heterogeneous data into abstract semantic expression in the same feature space through multiple nonlinear transformation, to realize feature extraction of multi-modal shared fusion.

In the process of constructing the sales forecasting model of fashion products, we choose two kinds of characteristics: the historical sales features and the features that affect the user's purchasing behavior. The features in each category are divided in detail, as shown in Figure1. In product pictures, the color, texture, and contour of the product are the focus of the user's attention, which can help the user to form an understanding of the product. In addition, the price and discount of the product will affect the user's perceived utility and perceived risk, and it will also have a significant impact on the user's purchasing decisions. For fashion products, the time to market will affect the value of the product, and then affect the user's purchase decisions^[14]. So picture features and product basic attribute features together constitute the features that affect the user's purchase decisions in the model. In addition, we also selected the historical sales features commonly used in the study to add to the model.

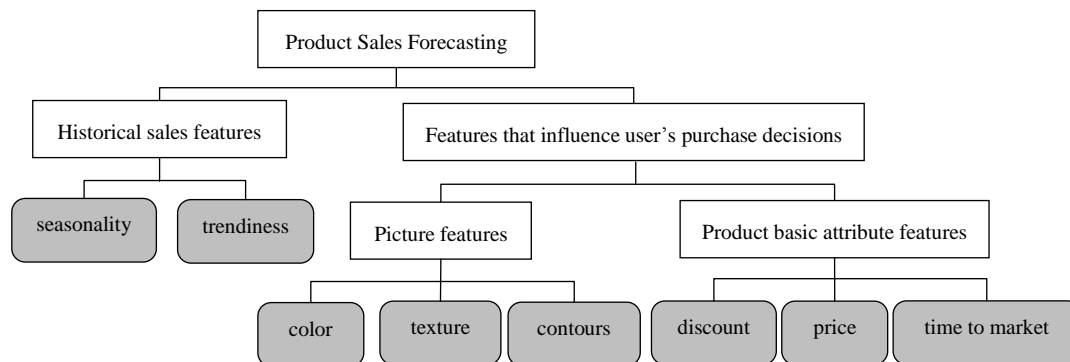


Figure 1. Data features of fashion products for sales forecasting

3.2 Feature representation

In recent years, deep learning has been widely used in feature extraction and high-dimensionality reduction. In the field of deep learning, representation refers to the input observation sample X of the model through the parameters of the model, in what form and in what way. Representation learning refers to learning the effective feature representation of observation sample X . In order to solve the problem of heterogeneous data structure of fashion product sales forecasting in multimodal data environment, we select suitable deep learning feature representation for different modal data describing fashion product sales.

(1) Deep learning representation of basic attribute features of fashion products

In this paper, aiming at the phenomenon that the relationship between sales and factors such as price in the

sales forecasting is not simple linear, we use the feature representation based on the fully connected neural network (DNN), and connect all neuron nodes in adjacent layers such as the input layer, each hidden layer and the output layer through the fully connected neural network. Then we use the activation function (Relu) and cascade of neural network to express the non-linear features of structured data. The calculation method is shown in equation 1:

$$\text{Re lu}(x) = \max(0, x) \quad (1)$$

Let the output of the previous layer X be $\{x_1, x_2, \dots, x_n\}$, the connection weight between the previous layer and a node of the layer is $\{w_1, w_2, \dots, w_n\}$, the output of this node is o , and the calculation is shown in equation 2:

$$o = \text{Re lu} \left(\sum_{i=1}^n (x_i * w_i) \right) \quad (2)$$

Assuming that this layer has m nodes, the matrix W composed of the connection weights between this layer and the previous layer is $\{W_1, W_2, \dots, W_m\}$, where W_i is $\{w_1^i, w_2^i, \dots, w_n^i\}$, and the output of this layer is vector Output. The calculation method of Output is shown in equation 3:

$$\text{Output} = \text{Re lu}(X \cdot W^T) \quad (3)$$

It can be known that the fully connected neural network can construct the non-linear model based on structured data. Therefore, it can better learn the basic attribute features of products such as price, time to market.

(2) Deep learning representation of picture features of fashion products

In this paper, we use convolutional neural networks (CNN) to learn the picture features of fashion products. The core of CNN is to perform convolution operations on pictures to form new feature maps, extract high-dimensional features, so it can automatically extract the color, texture and contour feature of pictures. The convolution kernel consists of a third-order tensor. CNN uses the convolution kernel to traverse the input pictures, and is activated by the non-linear function Relu after element-level multiplication calculation, outputs an activation value, and finally gets a new feature map. Let the input of the convolutional neural network be X , which is used to represent the picture features of fashion products such as color and contour, and $X \in \mathbb{R}_{m \times n}$, and the convolution kernel is $K \in \mathbb{R}_{j \times k \times q}$. When the bias of the convolution kernel is b , the output of the convolutional neural network is O , and the calculation method is shown in equation 4:

$$O = \text{Re lu}(\text{conv}(X, k) + b) \quad (4)$$

After the convolution calculation, the output of the convolution neural network is still a third-order tensor O , which can't be calculated directly. Then we expand the feature map into a vector O' , eliminating the heterogeneity between different data modes, so as to realize the feature representation of picture data.

(3) Deep learning representation of historical sales features of fashion products

In view of the serialization feature of historical sales information, long short term memory network (LSTM) can learn and represent the feature of time series data better. Aiming at the seasonality and trendness feature in the historical sales data, LSTM solves the problem of sequence modeling by designing two state variables for storing short-term state and long-term state, saving the features of past time and output reference state variables of the current time. It is assumed that the historical sales information of fashion products at time t can be expressed by the long-term state C_t and the short-term state at that time as h_t , and the input x_t is the sales information at the current time. Then the LSTM uses the Sigmoid function and the forgetting gate operation with the symbol σ to determine which information in the current input and short-term state is forgotten and which information is updated into the long-term memory. The calculation method is shown in equation 5:

$$C'_t = \sigma([h_{t-1}, x_t]) * \tanh([h_{t-1}, x_t]) \quad (5)$$

And then, the LSTM neural network updates the long-term state by formula X , and then combines the updated long-term state, the short-term state of the previous moment and the input of the current moment to calculate the short-term state of the current moment, that is, the output of the current moment. And the

calculation method is shown in equation 6:

$$h_t = \sigma([h_{t-1}, x_t]) * \tanh(C_t) \quad (6)$$

Through the above calculation process, we can use LSTM neural network to better learn the time series features of fashion products that need to consider long-term dependence conditions, such as seasonality.

3.3 Feature fusion

In order to integrate data information of many different high-dimensional heterogeneous modes, and extract different formal feature vectors from each mode of the original data, we designed a new feature vector by combining the feature vectors obtained by different deep learning models. Finally, we got a fashion product sales forecasting model which considered different information modes, deep learning representation method, and feature fusion. The overall framework is shown in Figure2.

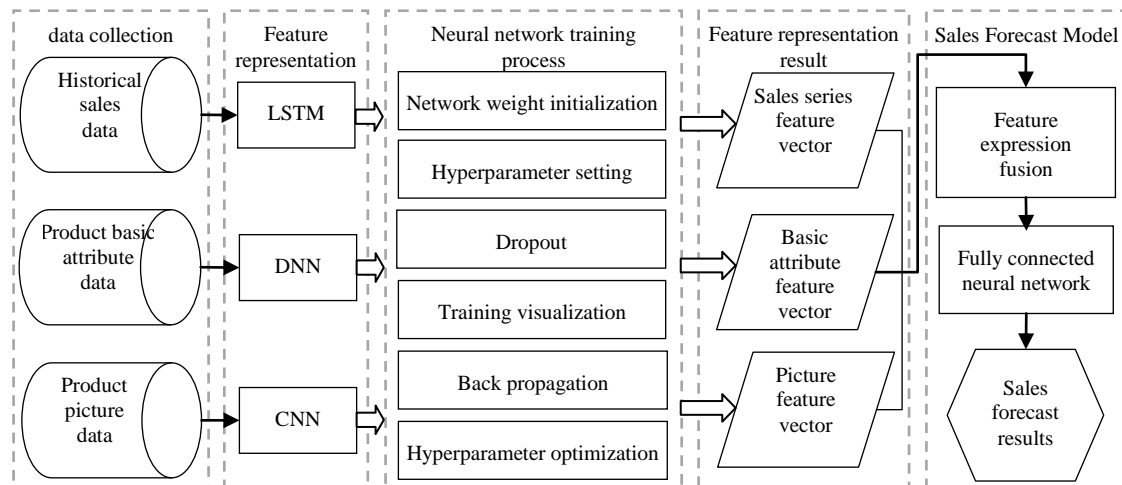



Figure 2. Framework of sales forecasting model of fashion products based on feature representation of multimodal and deep learning

4. EMPIRICAL RESEARCH AND RESULT ANALYSIS

4.1 Data

The data used in this experiment are 9,189,419 sales records from a clothing e-commerce company in Nanjing from September 2013 to December 2017, including 4,354 products. Among them, the data that can be used to reflect the time series feature of products are counted by week. Table 1 shows the original data with the product number 1427228, where i is the number of weeks in which the product is sold, indicating that the data provided is in the i -th week after the start of product sales. The product is sold for 32 weeks, x_i is the average of the original price of the product in the i -th week, y_i is the average of the discount of the product in the i -th week, z_i is the product sales in the i -th week.

Table 1. The original data for product number 1427228

product id	product original price ($x_i, i=1, 2, \dots, 32$)	time to market	product discount ($y_i, i=1, 2, \dots, 32$)	product image	product sales ($z_i, i=1, 2, \dots, 32$)
1427228	(135.32, 169.52, 162.86, 168.64, 162.1, 132.31, 148.32, 164.84, 160.11, 161.76, 161.75, 161.13, 168.29, 186.14, 119.67, 117.21, 99.97, 98.62, 98.36, 99.43, 153.3, 112.25, 143.42, 145.79, 137.11, 121.79, 139.15, 117.01, 103.29, 118.67, 107.57, 110.78)	Summer	(6.09, 6.74, 4.44, 9.01, 4.30, 12.41, 5, 6.31, 4.93, 7.44, 8.48, 7.97, 5.92, 2.99, 4, 14.64, 7.27, 1.64, 5, 2.44, 8.37, 8.29, 11.59, 12.43, 7.9, 4.34, 5.19, 5.69, 6.18, 8.24, 5.49, 2.83)		(84, 33, 37, 70, 194, 478, 150, 50, 42, 28, 38, 38, 31, 11, 3153, 38, 218, 56, 192, 19, 39, 1, 59, 15, 152, 145, 29, 270, 96, 41, 64, 64)

4.2 Research process

(1) Data preprocessing. Because the sales and discount difference between different products is very large, we deal with the sales and discount logarithmically to avoid the influence of extreme values on the model. Therefore, we normalize all structured features. The normalization method is shown in equation 7:

$$\text{standarlization}(x) = \frac{x - x_{\min}}{x_{\max} - x_{\min}} \quad (7)$$

Where, x represents an attribute in structured data, x_{\min} represents the minimum value of the attribute, and x_{\max} represents the maximum value of the attribute.

Since categorical data cannot be directly calculated, here one-hot encoding is used to encode the categorical data, and the categorical variables are converted into numeric vectors. For example, according to the time to market, we divide it into four seasons of listing. If the time to market is in summer, it is expressed as [0,1,0,0]. Because the resolution of the product pictures is inconsistent, and most product pictures have a resolution of 200×200, the bicubic linear interpolation algorithm is used to convert all the picture resolutions to 200×200.

(2) Using deep learning model to train. By adjusting the weights of neural networks such as CNN and LSTM, we can get the effective deep learning representation vectors of different modal features, avoiding problems that often occur in training such as overfitting. We use dropout for training during the training process. (3) Model parameter adjustment and optimization. In order to further improve the forecast accuracy, we adjust the learning rate and dropout retention rate to determine the optimal solution. In order to ensure the stable and effective training process, we visualized the loss function value and the output of each layer, and used the visual data chart to keep the training running normally. (4) Model effect comparison. In order to verify the efficiency of the multimodal learning model after the feature representation, we choose the classical exponential regression method and shallow neural network method to compare.

4.3 Analysis and results

(1) Model training and testing. We use random initialization to ensure the heterogeneity of neuron nodes. Suppose that each dimension of the input is a standard normal distribution, and the neural network weights are also initialized to a standard normal distribution, then the output of the current node is a normal distribution satisfying $N(0, (n_i-1)/2)$, Where n_i-1 is the number of inputs for the current node. This will make the output of more neural network nodes in the inactive state of the activation function. For the modified linear unit, the local gradient in the inactive state is 0, which means that a large number of neuron nodes will not be trained. Therefore, we initialize the neural network weight to $N(0, 2/(n_i-1))$, which can keep the output variance of each layer unchanged, and improve the training speed of the neural network.

In terms of setting hyperparameters, for basic attribute data and sales series data, we use the single hidden layer structure neural network with 8 nodes for feature representation respectively. For the neural network of picture data feature representation, due to computational resource constraints, we set the convolution kernel dimension to the common 5×5, the number of convolution kernels to 16, and the number of convolution layers to 4. The initial learning rate is set to 0.001 and the retention rate of dropout is set to 0.5. In order to further improve the accuracy of the model, we adjust the learning rate and dropout retention rate.

It can be seen from Figure3 that when the learning rate is less than 0.0005, the fitting speed of neural network is too slow to fit correctly in 100000 times of training, resulting in the rapid rise of the loss function value of train set and test set. Therefore, this paper determines the learning rate of the model to be 0.0005. In addition, we take 0.5 as the center, take five equally spaced points for testing, and search for the best retention rate. It can be seen from Figure4 that when the retention is 0.5 and 0.6, the test set loss function value performs better, while the train set loss function value is lower and the training speed is faster when the retention is 0.6. So this paper uses 0.6 as the retention rate of model training. The following experiments are carried out under

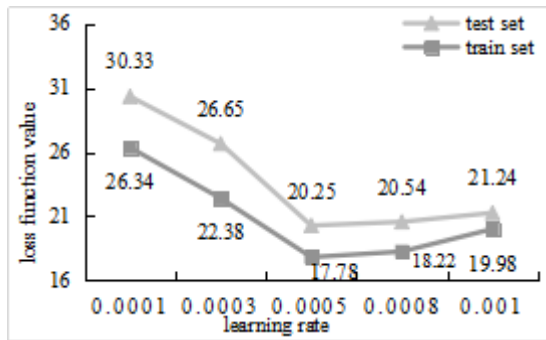


Figure 3. Trend of learning rate - loss function value

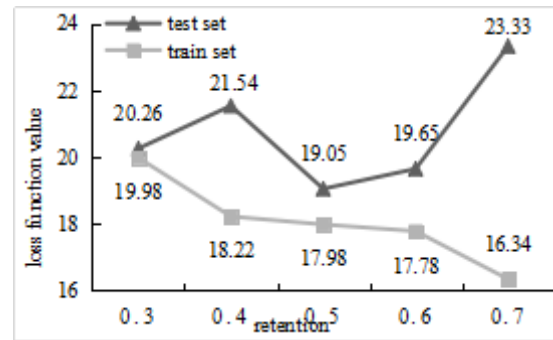


Figure 4. Trend of retention - loss function value

the above optimal parameters.

(2) Comparative test. In order to test the performance of our multimodal deep learning model in the fashion product sales forecasting task, we selected the exponential regression and shallow neural network commonly used in actual production for comparison. Then we select the company's summer dress from the sales date of 20 weeks of sales data for testing. The comparison between the predicted sales of each model and the real sales is shown in Figure 5.

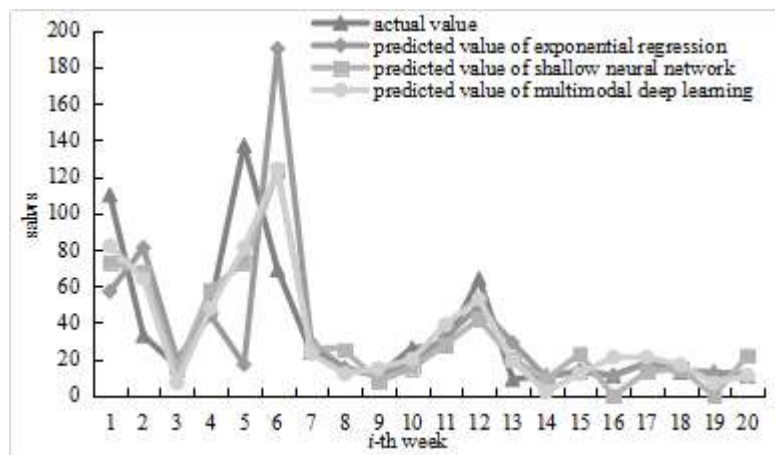


Figure 5. Comparison between predicted sales and real sales of models constructed by different methods

Table 2 shows the mean absolute deviation (MAD), mean absolute percentage error (MAPE) and root mean square error (RMSE) of three different models. It can be seen that under the three error indicators of MAD, MAPE and RMSE, the prediction results of the model proposed in this paper are better than the exponential regression model and the shallow neural network model. It can be said that the sales forecasting model of fashion products proposed in this paper is more accurate than the traditional models.

Table 2. Error comparison of prediction models constructed by different methods

	Multimodal Deep Learning Model	Exponential regression model	Shallow neural network model
MAD	12.95	20.35	15.70
MAPE	41.17%	41.78%	51.75%
RMSE	20.78	41.79	23.53

5. CONCLUSIONS AND DISCUSSIONS

In this paper, we combine multimodal data and deep learning feature representation methods to build a relevant prediction model for the task of sales forecasting of fashion products, and prove that different modal features and deep learning representation methods have better results than the traditional methods in this prediction task. The research results show that when the basic attribute features and historical sales features of products are represented respectively by the single hidden layer neural network with eight nodes, the picture features are represented by a neural network with convolution kernel dimension set to 5×5 and convolution kernel number set to 16, and the learning rate and dropout retention rate are 0.0005 and 0.6 respectively, the

accuracy of the sales forecasting model proposed in this paper is high, and the effect of preventing overfitting is the best. The results of the comparative test show that the model proposed in this paper has better prediction effect than the exponential regression and shallow neural network model.

This paper innovatively uses picture data, historical sales data and basic attribute data for feature representation and feature fusion, and applies them to the sales forecasting of fashion products, improving the forecast accuracy. Therefore, enterprises can use the model to predict product sales, in order to prepare the right products at the right time, better control seasonal operations costs, and improve their profitability of selling. And this paper provides a reference for enterprises to use deep learning methods in actual production operations. However, there are still some shortcomings. On the one hand, the scale of convolution neural network in this paper is small, which may lead to the inadequate use of picture data; on the other hand, the prediction accuracy of the model proposed in this paper in the later stage of product sales still needs to be improved. The follow-up research will further expand the network scale and improve the prediction accuracy of the model.

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Research on Listed Companies Clarification Announcements'

Stock Prices Reaction and its Influencing Factors

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Abstract: Using text analysis, this paper analyzes the textual features of clarification announcements released in the stock market. According to behavioral finance, cognitive psychology, event study and multivariate statistical methods are used to depict the characteristics of texts such as readability, descriptive approach, and structure. From the perspective of the reaction of stock prices, this paper explores whether the listed companies' clarification announcements are effective and what influences their effectiveness, using investor attention as a moderating factor.

Key words: clarification announcements, stock prices, text analysis, investor attention

1. INTRODUCTION AND THORETICAL DEVELOPMENT

Information from the online communities is an important basis upon which investors make investment decisions. If a rumor is not restrained, it can have a great influence on the securities market. Eventually, stakeholders may lose trust in the information disclosure system, resulting in disorder in the securities market.

Researchers have proven that not all the clarification announcements issued by listed companies can reduce the abnormal fluctuation of stock prices and promote their recovery^{[1][2]}. The main factors affecting stock price reaction to clarification announcements are the authority of the media releasing the rumors, the timeliness of the announcements, and the way the announcements are responded to^[3]. However, the textual features of clarification announcements still need to be further explored. Meanwhile, many researchers have begun to use data from social media to study the impact of investor attention on stock prices^[4], but few have studied the role of investor attention in stock price reaction to clarification announcements.

By summarizing the existing research on clarification announcements, we conducted an empirical analysis of stock price reaction to clarification announcements. Then, following the relevant theories such as behavioral finance and psychology, we analyzed what affects the difference in stock price reaction to clarification announcements using text mining. Finally, we constructed an investor attention indicator and analyzed its role in the relationship between the characteristics of the announcements' text and stock price reaction.

2. RESEARCH DESIGN

2.1 Data selection

After selecting the samples by specific criteria to reduce the noise, this paper collected 137 announcement samples from January 1, 2016 to March 1, 2018 from the cninf platform; The stock data used in the research come from the Resset Database; This paper crawled investor attention data from Guba forum.

2.2 Event study

This paper adopts event study as the method to study stock price reactions to clarification announcements, and measures whether clarification announcements contribute to stock price recovery by looking at whether the

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absolute value of cumulative average abnormal return decreases.

2.3 Multivariate regression model

This paper used a multivariate regression model to study the influence of the clarification announcements' characteristics on stock price reactions. The basic model is as follows:

$$\begin{aligned} Car_id = & \beta_0 + \beta_1 PE + \beta_2 PB + \beta_3 EPS + \beta_4 ROE + \beta_5 Revenue + \beta_6 Amount + \beta_7 Turn \\ & + \beta_8 describe + \beta_9 readability + \beta_{10} structure + \beta_{11} participants + \beta_{12} describe \times participants \\ & + \beta_{13} readability \times participants + \beta_{14} structure \times participants \end{aligned} \quad (1)$$

Car_id is the average cumulative abnormal return (CAR) in the event window. The independent variables in this paper are *describe*, *readability* and *structure*. *describe* refers to the descriptive method of clarification announcement. *readability* refers to the readability of the announcements. *structure* is the ratio of the clarification portion to the rumor portion. *participants* are the number of participants, which is used as the moderator to measure the level of investor attention. The remaining indexes are the control variables of the equation. The regression analysis process is as follows: firstly, the effects of the control variables on the dependent variable were analyzed. Then the independent variables were added to the model. Finally, the moderator and the interaction terms were added to study the moderating effect of investor attention.

3. CONCLUSIONS

This paper finds that clarification announcements denying positive rumors are conducive to the recovery of the stock price, reducing CAR. By contrast, clarification announcements that deny negative rumors do not help a stock recover or help the negative CAR increase; As for the recovery of stock price, the more detailed the clarification announcement is, the stronger the refutation wording is, the greater the proportion of the clarification portion of the clarification announcement is and the easier it is to read, the better the stock price recovery is; Investor attention plays a moderating role in the relationship between stock price recovery and textual features, and the higher the investor attention is, the better the stock price recovery is.

Our research lends evidence supporting the validity of behavioral finance, cognitive psychology, and the predictive ability of data on financial forums. This study can be referenced for the textual analysis of similar announcements, and puts forward suggestions for listed companies publishing clarification announcements and regulatory agencies developing information disclosure systems.

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Using Text Mining and Sentiment Analysis To Explore Tourists Consumer Focus From Online Reviews – Taking Mausoleum Of The First Qin Emperor As Example

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Abstract: With the development of the economy, high-quality free travel has become a mainstream leisure tourism method, and tourism-related information has also grown exponentially. Coupled with the diversity of information sources, tourist attraction consumers received a lot of fragmented information. Previous research pointed out that tourist attraction consumers' decision-making basis is increasingly relying on electronic word of mouth. However, the variety of reviews on the Internet makes it easier for tourist attraction consumers to make timely or even wrong judgments due to information integration errors. In order to solve the problems mentioned above, this research is based on big data text mining and sentiment analysis processing analysis, using the existing electronic travel review data to conduct mining analysis, in order to recommend the most useful review information to tourist attraction consumers, allowing tourist attraction consumers to make effective decisions. In other words, tourist attraction consumers can enable users to get advance reminders before making decision and presented with visualization. In this way, tourists who are consumers of tourist attractions can receive the information they need quickly and logically, and quickly make decision. Then, improve user satisfaction. Finally, results provide tourist attractions operators as a reference to improve and strengthen their core business contents and priorities.

Keywords: tourist attraction consumers, attraction information visualization, big data text mining, sentiment analysis

1. INTRODUCTION

1.1 Background

In the era of big data, people are constantly exploring how to find potential value from huge amounts of data ^[1]. It is estimated that unstructured materials account for about 80% of the current social data structure ^[2]. Therefore, analysis of unstructured data is inevitable ^[2]. Unlike structured data, unstructured data cannot be used directly in the database and must be reprocessed before it can be used.

This study is concerned that a large amount of unstructured data is generated every day in the website of the tourism industry, but most of these data are just scattered around the webpage or stored in the database and piled of ash, due to existed website design requirement dilemma (cannot show visualization of big data), which will be cleared after a period of time. If the data can be processed and analyzed, the value of the data can be tapped and the utilization rate of the data can be increased.

Most of the time, due to the geographical distance, in addition to the official introduction of the scenic spot, tourists can only learn more about the comprehensive information of the scenic spot by browsing travel reviews. Tourists write travel reviews to share their travel experiences, convey more information about the scenic spot, and reduce the unequal information among tourists about the scenic spot. However, everyone's focus and needs for play are different. Usually, after browsing dozens of reviews or travel notes, they only find the information they need.

In the operation mode of travel reviews, because reviews are written by tourists, the contents of these

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reviews do not have a qualitative standard, and the quality is not uniform. In many cases, users need to filter out many meaningless information by themselves or repeat the browsing. Not only wasting time but not focusing.

The authors believe that the website does not make full use of the review information of tourists, and we can use the information visualization method to rearrange the review information into images with visualization. Users can quickly find the key information from the charts, without having to absorb and filter by themselves, at a glance, easy to consult, and the graphical communication form also enhances the fun elements, so that the information browsing is no longer boring^[3].

According to previous research, humans have a much faster absorption rate of image data than text data^[4]. In order to make it easy for users to understand the comments, we collected the tourist comments and used Mausoleum of the First Qin Emperor as a case study, collect its related reviews for analysis and then visualization.

2. RESEARCH PURPOSE

The content of tourist comments generally includes feelings about the weather, traffic, people flow, tickets, and their own subjective experience. The authors hope to extract and count the high-frequency vocabulary through big data text analysis and sentiment analysis; perform positive and negative sentiment analysis between the contexts of the review content; use word vectors to build a multi-dimensional model to find out the relevance to the central topic vocabulary that appear more frequently. After the above processing, we hope to get a visualized image of tourist attraction that can help users, reduce user reading, summarize high-frequency information, and reduce subjective influence of reviews.

By understanding the visual images of reviews, consumers of tourist attractions can find out in the keywords section whether they are interested in the attraction, such as 'family tours', 'places of interest', 'shopping' and other needs; The score and the number of comments are obtained, and everyone's impression score of the scenic spot; from the comment cloud word map, you can see some of the important points that people often mention about scenic spots. The aim of this study are as follows:

- (1) To integrate fragmentation information of tourism attraction.
- (2) To help users quickly understand the tourism attraction.
- (3) To improve reading interest, effectiveness and efficiency of tourist attraction consumers.

3. LITERATURE REVIEW

3.1 Visual Communication of Tourist Information

With the advent of the information age, the amount of data has grown tremendously, and people have used data visualization to statistically classify and present many structured data in charts and reports. But gradually, the data visualization no longer meets people's needs. We generate more and more textual data, which need to be processed. Information data images gradually enter people's vision.

Data visualization and infographics are two similar professional field names^[5]. In simple terms, the difference between the two is that data visualization is to organize, process, and classify structured data through statistical charts, while information visualization is to visualize the logical relationship between information in an intuitive way. Show it like a form.

William Playfair published the book "The Commercial and Political Atlas" in 1786^[6]. The data-based diagrams in the book became the buds of the image processing of the data. Since then, the visual infographics have become people's reconstruction. Important method for abstract data and unstructured complex information. The concept of information visualization was first proposed by Stuart Card, Mackinlay and George Robertson in 1989. He directly reflects how information visualization technology can improve people's access to information.

Maximum capacity.

3.2 Development and Researches of Cloud Word Graph

The concept of tag cloud was proposed by Fernanda B. Viégas in the 2008 paper Tag Clouds and the Case for Vernacular Visualization and has been active in socially oriented websites^[7]. They use tags to index and visualize information.

Stepchenkova^[8] and others studied the image of Russian travel destinations through online surveys. By comparing the relevant information on Russian travel on the US travel website and Russian travel website, using high-frequency word analysis, etc. The information on Russia's definition of tourism image is incomplete.

William^[9] analyzes the image of Seoul's tourist destinations through comparative semiotics of visual performance. He mainly studies the image of Seoul's destination by copying previous research and comparing it with traditional projection images in printed brochures and guides. Zhang, et al.^[10] used text analysis methods such as word segmentation and word frequency statistics to analyze online reviews of books to provide decision-making basis for online bookstores.

4. METHODOLOGY

This article mainly collects travel review data, organizes, cleans, and processes word segmentation, and uses the obtained words for keyword extraction, sentiment analysis, and word vector calculation. We collected and analyzed the travel reviews generated by specific sites in a website within three months. The purpose is to enhance the value of reviews, construct regional keywords, and help users quickly understand the public's reviews of attractions to reduce user decisions. time. We use web crawlers to crawl the user's travel review data on the website and use IBM SPSS 22.0 as analysis tool to clean and manage the data. The processed data is used for word segmentation, calculation of vectors, and sentiment analysis to obtain cloud word maps, keywords, and comment sentiment scores. The cloud word map is displayed in the comment area, keywords are used for 'labels', and comment sentiment scores assist in the calculation of partitions. Here is the research process of this study:

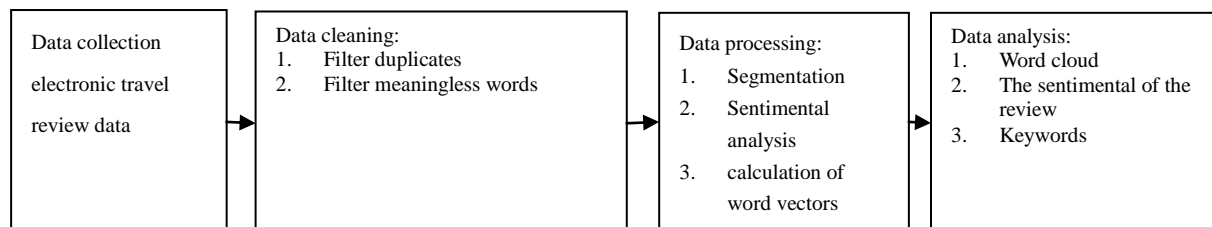


Figure 1. The research process of this study

4.1 Data collection

There are three main forms of data: structured data, semi-structured data, and unstructured data. Structured data is mostly database files or tables, while semi-structured data is similar to xml and json format files, but in real life, it is more unstructured data. The webpage we collected for Ctrip's tourists' reviews of Mausoleum Of The First Qin Emperor is unstructured data in html. This kind of data requires us to scrape down the required individual by some means and then process it.

We use the request library in Python. Grab the reviews of each attraction through a certain URL. Due to the anti-crawling mechanism built into some websites, the URL of the review is hidden in the json file, so the original URL requires us to manually go to the source code of the webpage Rummaging. After finding the link, we started program crawling. Due to Ctrip's data protection settings, we were only able to crawl the latest 3051 articles in the past three months, so we crawled each of the attractions twice.

The anti-crawling sensitivity of the website is very high. During the crawling process, we implemented

guerrilla tactics-fighting each other, shooting one, and changing places. After being masked by multiple IPs, we successfully crawled down all the materials used in the topic. The screenshots of some information in this study as shown in Figure 2. The information we obtained in this study includes the five major parts: name of attraction, name of reviewer, review score, review content, and review time.

2911	兵马俑	5	155990000	很方便,秒出票,直接刷身份证,免去了排队换票	_WeChat27540	2018-08-04 12:13
2912	兵马俑	3	156001512	不是太理解:为什么没有60岁以上不到65岁老人的半价优惠	M281009****	2018-08-04 11:59
2913	兵马俑	4	156000518	好是好,节假日人太多,公交车排队两小时。	234088****	2018-08-04 11:52
2914	兵马俑	5	156001181	向往的地方,感受到中国文化的源远流长	1365196****	2018-08-04 11:38
2915	兵马俑	5	156001428	太震撼了,直接扫码进园很方便。	M12216****	2018-08-04 09:58
2916	兵马俑	5	156000938	兵马俑还是比较壮观的,1号坑这里,还有志愿者在做讲	M8544****	2018-08-04 09:52
2917	兵马俑	5	155999917	买票特别方便,进去也方便,体验很好	110085****	2018-08-04 09:48
2918	兵马俑	2	156000335	价格贵。导游介绍一般般,还不如现场找的导游。不值这	110072****	2018-08-04 09:39
2919	兵马俑	4	155999910	还可以,特别是导游不错,但行程安排法门寺时间不够用	1398502****	2018-08-04 09:39
2920	兵马俑	5	155999801	气势磅礴,还是很值得一看的地方	black****	2018-08-04 09:37
2921	兵马俑	3	155998607	人造景,一般吧。。。。。。。。	_WeChat36785	2018-08-04 08:06
2922	兵马俑	5	155998891	景点本身不错,就是暑期出游人太多了。	E0118****	2018-08-04 08:03
2923	兵马俑	5	155999746	很好,朋友玩的很开心!下次 	_WeChat26907	2018-08-04 07:40
2924	兵马俑	5	155999933	订票方便,免去排队的麻烦了。。	M54503****	2018-08-04 06:43
2925	兵马俑	5	155999735	来西安必看兵马俑,而我是特意为了看兵马俑而来西安的	M36468****	2018-08-04 06:29
2926	兵马俑	5	155998761	早上人少,不然就看不人了,现在买票都很方便,现场也能	1381915****	2018-08-04 06:19
2927	兵马俑	5	155008022	网络上的兵马俑,没有实地看兵马俑来的震撼	M1300162****	2018-08-04 02:50

Figure 2. The screenshots of some information in this study

Content of Figure 2 including following 4 elements:

1. Data collection electronic travel review data
2. Data cleaning: 1. Filter duplicates 2. Filter meaningless words
3. Data processing: 1. Segmentation 2. Sentimental analysis 3. calculation of word vectors.
4. Data analysis: 1. Word cloud 2. The sentimental of the review 3. Keywords

4.2 Data cleaning

Tourism websites usually provide a block that supports and is complemented by a corresponding reward mechanism to encourage tourists to write reviews. This caused some problems. Some tourists just wrote some humble reviews just to get rewards, such as 'Nice, good, good, good, good. "Booming, sloppy, hip-hop," comments like this, which have no practical meaning, we will remove them when the data is cleaned, so that users can browse the essence.

In the materials we crawled from Ctrip, there are some duplicate contents, garbled characters, etc. We need to remove these parts to facilitate subsequent semantic understanding. The garbled is generated by the emoticons in the comments. This is because the encoding of the emoticons after crawling is inconsistent with our preset. In addition, we also filter repeated and meaningless words.

4.3 Data processing

We imported the data compiled by IBM SPSS 22.0 into Python, and used the Jieba word segmentation tool to perform two round cleaning and filtering to obtain the parts we needed; we performed word frequency statistics on the segmented vocabulary, visualized the frequency of part-of-speech words, and performed sentiment analysis. Discuss the accuracy of the existing data and propose ways to modify it; extract topic keywords from the comments to facilitate user indexing and meet users' various needs.

In the four popular word segmentation modules on the market-Jieba, SnowNLP, Pynlpir, Thulac and other word segmentation tools, For comparison, we chose to use the easier-to-use Jieba module as our word segmentation tool. Jieba has third-party vendor libraries in Python, which can be used by directly pip downloading. Jieba provides three kind of word segmentation modes, namely precise word segmentation mode, full word segmentation mode, and search engine mode, and Jieba provides a custom dictionary function. We can set relevant proper nouns based on the environment of the target text and those that have not appeared in the Jieba corpus. New words, which are helpful for subsequent processing and analysis. SnowNLP is mainly used

for sentiment analysis and comes with word segmentation tools. The word segmentation is not as detailed as jieba (if necessary, it can be corroborated by the picture above). The so-called surgery industry has a specialization. We will use the SnowNLP to perform sentiment analysis in the future.

4.4 Sentiment analysis

Sentiment analysis or opinion mining is people's opinions, emotions, and assessments of attitudes to entities such as products, services, and organizations. The development and rapid start of this field are due to the rapid development of social media on the Internet, such as product reviews, forum discussions, Weibo, and WeChat, because this is the first time in human history that there has been such a huge digital record. Since the beginning of 2000, sentiment analysis has grown into one of the most active research areas in natural language processing (NLP). Extensive research in data extraction, web mining, text mining and information retrieval.

According to the different nuances of processing text, sentiment analysis can be roughly divided into three research levels: word level, sentence level, and text level. Chapter-level sentiment classification specifies an overall sentiment direction / polarity, which determines whether the article (for example, a full online review) conveys overall positive or negative opinions. In this context, this is a binary classification task. It can also be a regression task, for example, an overall score inferred from a review of 1 to 5 stars. It can also be considered as a 5-level classification task.

The sentiment analysis of a sentence is inseparable from the sentiment of the words that make up the sentence. The sentiment analysis methods of words can be summarized into three categories: (1) knowledge-based analysis methods; (2) web-based analysis methods; (3) corpus-based analysis methods. The sentiment of words is the basis of sentiment analysis at the sentence or discourse level. Early text sentiment analysis mainly focused on judging the positive and negative polarity of the text. The corpus of sentiment analysis includes two types of vocabulary packages: positive vocabulary and negative vocabulary. According to the meaning scoring method, each comment is scored from words to sentences.

word2vec is also called word embeddings, Chinese name "word vector", it can convert words in natural language into dense vectors (Dense Vector) that the computer can understand. Before the advent of word2vec, natural language processing often turned words into discrete individual symbols, namely One-Hot Encoder.

1. Hangzhou [0,0,0,0,0,0,0,1,0, ..., 0,0,0,0,0,0]
2. Shanghai [0,0,0,0,1,0,0,0,0, ..., 0,0,0,0,0,0]
3. Ningbo [0,0,0,1,0,0,0,0,0, ..., 0,0,0,0,0,0]
4. Beijing [0,0,0,0,0,0,0,0,0, ..., 1,0,0,0,0,0]

For example, in the above example, in the corpus, Hangzhou, Shanghai, Ningbo, and Beijing each correspond to a vector. Only one of the vectors has a value of 1 and the rest are 0. However, using One-Hot Encoder has the following problems. On the one hand, the city codes are random, the vectors are independent of each other, and there is no relationship between the cities. Second, the size of the vector dimension depends on how many words are in the corpus. If the vectors corresponding to the names of all cities in the world are combined into a matrix, then this matrix is too sparse and will cause dimensional disaster.

Using Vector Representations can effectively solve this problem. Word2Vec can convert One-Hot Encoder into low-dimensional continuous values, that is, dense vectors, and words with similar meanings will be mapped to similar positions in the vector space. If the vectors corresponding to the names of all cities in the world are combined into a matrix, then this matrix is too sparse and will cause dimensional disaster. Using Vector Representations can effectively solve this problem. Word2Vec can convert One-Hot Encoder into low-dimensional continuous values, that is, dense vectors, and words with similar meanings will be mapped to similar positions in the vector space. If the city vector after embedding is visualized through PCA dimensionality reduction, this is what it looks like.

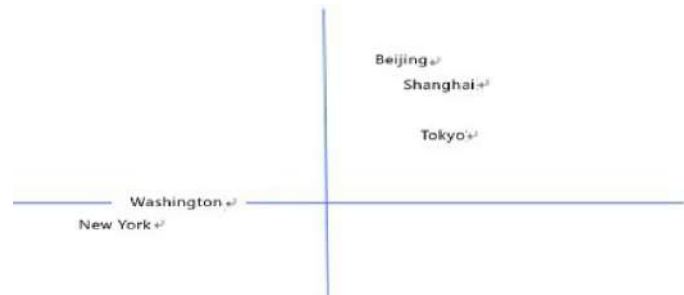


Figure 3. City vector after embedding is visualized through PCA dimensionality reduction

We can find that Washington and New York come together, Beijing and Shanghai come together, and the distance from Beijing to Shanghai is like Washington to New York. In other words, the model learns the geographical location of the city and the relationship between the city's status.

4.5 Analysis of travel reviews

This research crawls the tourist attractions and tourist reviews of some of the attractions on the Ctrip website. We extract the high-frequency words in the reviews and present them in a more interesting and intuitive way. Scoring makes a rough comparison, researches and finds factual problems, and proposes solutions to improve them. The comments are upgraded with word vectors to find related words on a topic, and to implement keyword query and other functions.

5. RESULTS

5.1 Word cloud of Mausoleum Of The First Qin Emperor travel reviews

We perform word frequency statistics and label classification on the review data of words. The larger the font appears in the picture; the same nature of words are marked with the same color, different colors represent different nature of words, and the colors of the nature of words are randomly assigned.



Figure 4. Word Cloud of Mausoleum Of The First Qin Emperor

5.2 Comparison of the sentimental of Mausoleum Of The First Qin Emperor travel reviews

The scores of scenic spots on travel websites are generally obtained by averaging the review scores. However, you will find that the content of many reviews and scores are inconsistent. We compared the review scores and review sentiments of Mausoleum of The First Qin Emperor attractions to prove that this phenomenon is more common.

According to SnowNLP's own corpus, this study use the Python third-party library SnowNLP to score sentiment on Mausoleum Of The First Qin Emperor.

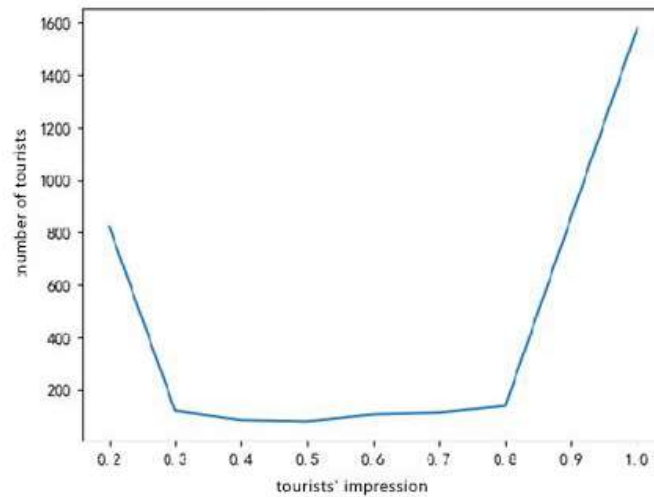


Figure 5. Score on Mausoleum of The First Qin Emperor. (x: tourists' impression; y: number of tourists)

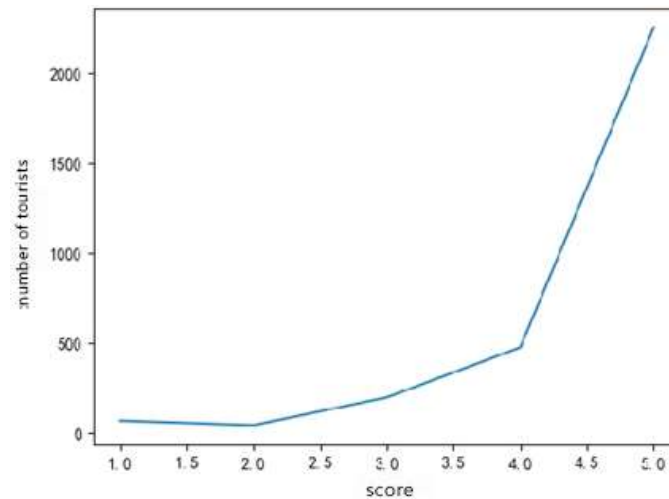


Figure 6. Score on Mausoleum of The First Qin Emperor. (x: score; y: number of tourists)

Figure 5 shows the user reviews sentiment and the number of users of The First Qin Emperor attractions. Figure 6 shows the user ratings and number of users of The First Qin Emperor attractions. It can be seen from the two figures that the good rating of content is about 60%, and the good rating accounts for about 90%. The conclusions reached by the two dimensions are not consistent, indicating that there is a personal subjective view of tourists when scoring or habitually giving full marks.

Gensim is an open source third-party Python toolkit for unsupervised learning from the original unstructured text to the topic vector representation of the text hidden layer. It supports a variety of topic model algorithms including TF-IDF, LSA, LDA, and word2vec. We use Gensim to implement the word2vec model.

Extract the keywords of the travel reviews of The First Qin Emperor and calculation, then remove the meaningless contents. This study summarized six keywords of The First Qin Emperor: children, crowds, convenient ticket access, scenery, tour guide, history. However, in order to facilitate user indexing, we have defined these 6 keywords as babies, popular attractions, quick entry to parks, places of interest, guided tours, and cultural heritage. Such daily expressions are simple, easy to understand and closer to the needs of users.

6. CONCLUSIONS

We aggregate the output results of the above three parts on one image. This presentation method is interesting and easy to read. From the high-frequency vocabulary counted by word cloud, it is found that many people in the Mausoleum of The First Qin Emperor need a tour guide when they visit. And based on the result of two figures of sentimental analysis, it is found that there are different curves between reviews and ratings, which represent the scoring doesn't exactly reflect tourists' real feeling about this visit. Therefore, this study concludes that scores do not represent the true views of tourists. Therefore, it is recommended that future tourism managers, tourists and researchers should no longer rely on biased quantitative scores but must retrospectively review the true original review data to listen tourists in order to get real opinions and get real public opinion tendencies, and further to create a higher quality tourism environment for tourists.

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Identifying Chinese Leading Venture Capital Firms Based on Graph Convolutional Neural Networks

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Abstract: It is a meaningful challenge to identify leading venture capital firms (VCs) in the analysis of the Chinese investment market. Identifying leading VCs is equal to determine influential nodes in the field of complex network analysis. Many studies have applied centrality measures to determine influence nodes. However, only a few studies have explored more efficient and flexible ways to accomplish this task. In this work, we propose a new approach which using graph convolutional neural networks to identify influential nodes in the network, so as to determine leading VCs. We build an undirected graph based on co-investment of VCs, then learn a VCs Graph Convolutional Neural Network (vcGCNN) for nodes classification. Our vcGCNN is labeled with ‘1’ and ‘0’ for ‘is leading VCs’ and ‘is not leading VCs’. The experiment results on VCs dataset demonstrate that vcGCNN outperforms multiple centrality measures and some typical spectral-based GNN methods for leading venture capital firms identification.

Keywords: venture capital firms, graph convolutional neural networks, influential nodes identification

1. INTRODUCTION

Previous research found that Chinese venture capital market is usually dominated by leading Venture Capital Firms (VCs), who are more likely to obtain good investment opportunities and play the role of main investors, that is, to formulate investment plans or organize investment partners, while other VCs are tending to follow leading VCs^[1]. On the one hand, the effect of preferential attachment^[2] allows main investors to improve status in the market which is beneficial to main investors. On the other hand, co-investment among VCs is helpful to share investment risks^[3], establish reputation network against opportunistic behaviors^[4], improve the competitiveness in the industry^[5], share resources among members and learn from each other^[6]. Therefore, to deal with high investment risk, it is the best strategy to identify leading venture capital firms and cooperate with them in venture capital market^[7].

Identifying leading venture capital firms is equal to determine influential nodes while the co-investment network of VCs is given^[8]. In the field of complex network analysis, centrality measures are the most common used methods in identifying important nodes, however, centrality measures usually only evaluate the importance of nodes from one single aspect, and different network structures may have various centrality measure methods, it's a challenging job to decide a best one. At the same time, the centrality measures ignore the characteristics of the node itself, but these characteristics are also important features to identify the influence of nodes. Since centrality measures in complex network analysis only concern about structure between nodes, Graph Neural Networks (GNNs) which integrate the network topology information and the feature of the nodes, has been used for node classification, and reached higher accuracy in the classification of network nodes.

Due to the rapid changes in Chinese venture capital market, new investment companies have joined the venture capital team. In the absence of labels, it is practical to identify new leading VCs through semi-supervised learning algorithms. Graph convolutional networks (GCN) is a robust learning algorithm that can efficiently identify the categories of unlabeled nodes by partial labeled nodes^[9].

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In this work, we propose a new approach to identify leading venture capital firms basing on graph convolutional neural networks. We build a dataset of investment events collected from website, then construct a large graph of co-investment between VCs from the dataset, which contains a set of nodes as VCs and a set of edges as co-investment relationship, also, frequency of co-investment is set as weight on edges. Then we model the graph with a Graph Convolutional Network (GCN), which captures information of graph efficiently. In this way, we have turned a leading venture capital firms identification problem into a node classification problem. Nodes are labeled with ‘1’ and ‘0’ for ‘is leading VCs’ and ‘is not leading VCs’. Result shows that our method can achieve strong classification performances with limited labeled nodes. To summarize, our contributions are as follows:

- We propose a new approach for leading VCs identification. As far as we know, this is the first study to model an investment events dataset as an undirected graph and construct model with graph convolutional neural networks to learn nodes classification.
- Results on investment events dataset demonstrate that our method outperforms most common used methods of centrality measures. With a small proportion of labeled nodes, our method also learns predictive nodes efficiently.

The rest of this paper is organized as follows: Section 2 summarizes related works about centrality measures and graph neural networks. Section 3 proposes the method of identifying leading VCs. Section 4 presents the empirical settings and results of proposed method comparing with baseline methods, which illustrate the accuracy of the proposed method. At last, section 5 presents the conclusion and future work expected.

2. RELATED WORK

2.1 Traditional Centrality Measures

The most common used methods of identifying influential nodes are centrality measures, which have been widely used in social, biological and technological network analysis^[10,11,12]. Centrality measures includes degree centrality^[13], betweenness centrality^[14], closeness centrality^[13], eigenvector centrality^[15], K-core^[16], PageRank^[17], etc. Unlike these methods, our method not only uses the structure information between nodes, but also makes good use of nodes’ characteristics information, which is important to determine influential nodes in the network.

2.2 Graph Neural Networks

As graph convolutions are more efficient and convenient to composite with other neural networks, convolutional graph neural networks (ConvGNNs) has been rapidly growing in recent years, which falls into two categories^[18], spectral-based ConvGNNs and spatial-based ConvGNNs. The core of spectral-based ConvGNNs is how to define the convolutional operation, for example: ChebNet^[19] approximates the convolutional filter by Chebyshev polynomials, GCN^[9] makes several approximations and simplifications to reduce computation complexity, CayleyNet^[20] further applies Cayley polynomials to capture narrow frequency bands, etc. In addition, spatial-based approaches inherit ideas from recurrent graph neural networks by information aggregation to define graph convolutions.

3. METHOD

3.1 Graph Convolutional Networks (GCN)

The pioneering work of GCN has presented a simplified graph convolutional neural networks model, which achieved excellent nodes classification results on a number of benchmark citation datasets^[9].

First of all, let’s consider an undirected graph $G = (V, \mathcal{E})$, where $V = (v_1, v_2, \dots, v_N)$ is a set of nodes and \mathcal{E} is the edge set. We introduce the adjacency matrix $A \in \mathbb{R}^{N \times N}$ of graph G which is nonnegative, and the degree matrix $D = \text{diag}(d_1, d_2, \dots, d_N)$ of adjacency matrix, where $d_i = \sum_j a_{ij}$. So that the graph Laplacian is defined as $L = D - A$. We introduce the feature matrix $X \in \mathbb{R}^{N \times M}$ where N is the number of nodes and M is the

dimension of feature vectors, so that $x_v \in \mathbb{R}^M$ is the feature vector with M dimension for node v . GCN can capture information about one-hop neighbors with one layer of convolution, and larger scale of neighbors while multiple GCN layers stacking. Considering one-layer GCN, the 1st layer $H^{(1)} \in \mathbb{R}^{N \times K}$ with K -dimensional node feature matrix is computed as

$$H^{(1)} = \sigma(\tilde{D}^{-\frac{1}{2}} \tilde{A} \tilde{D}^{-\frac{1}{2}} X W^{(0)}) \quad (1)$$

Where \tilde{A} is adjacency matrix added with self-loop, \tilde{D} is the degree matrix of \tilde{A} , let $\hat{A} = \tilde{D}^{-\frac{1}{2}} \tilde{A} \tilde{D}^{-\frac{1}{2}}$ be the normalized symmetric adjacency matrix, $W^{(0)} \in \mathbb{R}^{N \times K}$ is a weight matrix. $\sigma(\cdot)$ is activation function, e.g. $ReLU(\cdot) = \max(\cdot, 0)$. As mentioned above, we can integrate larger scale of neighborhoods information by stacking multiple GCN layers like this:

$$H^{(l+1)} = \sigma(\hat{A} H^{(l)} W^{(l)}) \quad (2)$$

Where $H^{(0)} = X$ and l denotes the layer number.

3.2 VCs Graph Convolutional Neural Network (vcGCNN)

We build a large graph which contains nodes of VCs so that co-investment among VCs can be simply modeled and graph convolutional neural networks can be easily adapted. The model based on graph convolutional neural networks for leading VCs detection, so called vcGCNN consist of three steps as describe:

Step 1: construct co-investment network.

Firstly, we have to define the co-investment relationship of VCs. We defined indicator I_{ij} as co-investment between VC i and VC j , where $t = 1, 2, \dots, T$ is the investing timestamp. Accordingly, $I_{ij}(t) = 1$ indicates VC i and VC j have invested in the same company at the same time; $I_{ij}(t) = 0$ otherwise. After definition, an undirected co-investment network $G = (V, \mathcal{E})$ is constructed, where V is nodes set of VCs and \mathcal{E} is edges set of relationships connecting VCs. For each edge (v_i, v_j) , denote by $e_{ij} = \sum_{t=1}^T I_{ij}(t)$ the weights on the edge. The summary of the co-investment network is presented in Table 1.

Step 2: extract feature matrix.

In this work, we derive nine indicators related to investing scale and experience of VCs^[21] from investment events dataset, to make up for the limitation of graph structure information. The status of VCs can be described by how many companies a venture capital firm has invested in (NoCom), which indicates whether the venture capital firm has sufficient assets and resources to invest or not. Similarly, how many times of investments overall (NoAll), how many industries has invested in (NoInd), how many periods has invested in (NoPer), how many countries has invested in (NoCou), how many provinces has invested in (NoPro), how many stages: initial stage (NoIni), expansion stage (NoExp) and seed stage (NoSee) has invested in all measure the scale and experience of VCs. The summary statistics of the nine feature indicators are presented in Table 2.

Step 3: build vcGCN model.

After building the co-investment graph and extracting feature matrix, we feed the graph and feature matrix into a two-layer GCN, where SoftMax classifier is used for classification:

$$f(X, A) = \text{softmax}(\hat{A} \text{ReLU}(\hat{A} X W^{(0)}) W^{(1)}) \quad (3)$$

Where $\text{softmax}(x_i)$ is $\frac{1}{S} \exp(x_i)$ with $S = \sum_i \exp(x_i)$. We use stochastic gradient descent (SGD) to train weight parameters $W^{(0)}$, $W^{(1)}$, and cross-entropy error as loss function:

$$\mathcal{L} = - \sum_{d \in y_D} \sum_{f=1}^F Y_{df} \ln Z_{df} \quad (4)$$

Where y_D is indices set of labeled VCs and F is the number of classes. In equation 3, $E_1 = \hat{A} X W^{(0)}$ implements the first layer convolutional operation, $E_2 = \hat{A} \text{ReLU}(\hat{A} X W^{(0)}) W^{(1)}$ explore to the second layer of co-investment network. The overall vcGCN model is schematically illustrated in Figure 1.

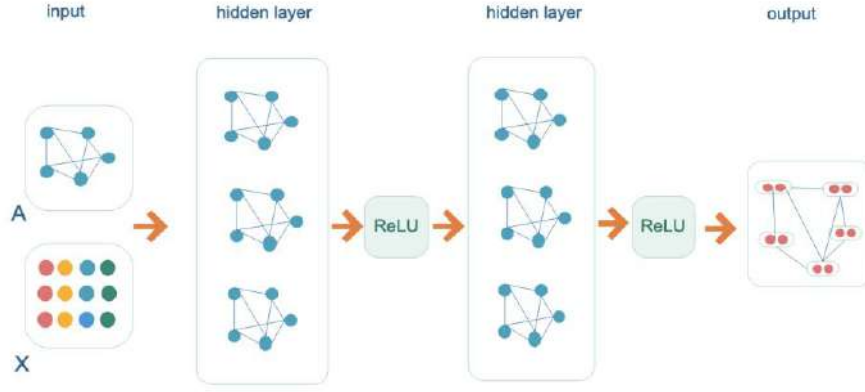


Figure 1. Graph convolutional neural network for leading venture capital firms identification

The vcGCNN model naturally integrate the connectivity patterns between VCs and feature attributes of VCs. We found that two-layer performs better than one-layer, but when we added more than two layers, the performances did not improve significantly.

4. EXPERIMENT

4.1 Baselines

- **Degree centrality (DC).** Degree centrality is the sum of one node connected to other nodes^[22,23]. A high DC score represents a node has a large number of neighbors.
- **Betweenness centrality (BC).** Betweenness centrality refers to the number of shortest paths that a node appears between other nodes. In other words, this node is intermediary, and the nodes usually pass through it to reach other nodes.
- **Closeness centrality (CC).** there must be shortest path from one node to the other, and the average length of these shortest paths is closeness centrality^[22,23].
- **K-core centrality (K-core).** K-core is the degree of a maximal subgraph in which all nodes have a degree of at least k^[16]. Also, it is formed by repeatedly deleting all nodes of degree less than k.
- **Eigenvector centrality (EC).** The main idea of eigenvector centrality is that the influence of a node relatively depends on the influence of its neighbors. Computing eigen decomposition of adjacency matrix, and the eigenvector centrality of nodes is the corresponding eigenvector of the largest eigenvalue^[15].
- **Chebyshev spectral CNN(ChebNet).** Spectral-based methods have a solid mathematic foundation in graph signal processing, the key difference of which lie in the choice of filter^[18]. Formally, define spectral convolutions on graph as the product of signal $x \in \mathbb{R}^N$ and filter g_θ : $g_\theta * x = U g_\theta U^T x$, $\theta \in \mathbb{R}^N$. ChebNet uses Chebyshev polynomials of diagonal matrix of eigenvalues as filter^[19]. i.e. $g_\theta(\Lambda) \approx \sum_{k=0}^K \theta_k T_k(\tilde{\Lambda})$. Where U is the matrix of eigenvectors of the normalized graph Laplacian $L = I_N - D^{-\frac{1}{2}} A D^{-\frac{1}{2}} = U \Lambda U^T$, and $\tilde{\Lambda} = \frac{2}{\lambda_{max}} \Lambda - I_N$. The Chebyshev polynomials are defined as $T_k(x) = 2xT_{k-1}(x) - T_{k-2}(x)$ which is recursively, with $T_0(x) = 1$ and $T_1(x) = x$. Going back to the definition of spectral convolutions on graph, we now have:

$$g_\theta * x \approx \sum_{k=0}^K \theta_k T_k(\tilde{L}) x \quad \tilde{L} = \frac{2}{\lambda_{max}} L - I_N \quad (5)$$

- **First order of ChebNet (1st order model).** Set $K=1$, equation 5 is linear. In the linear formulation we further approximate $\lambda_{max} \approx 2$. Under these approximations, equation 5 simplifies to:

$$g_\theta * x \approx x\theta_0 + D^{-\frac{1}{2}} A D^{-\frac{1}{2}} x\theta_1 \quad (6)$$

Then, we set a single parameter $\theta = \theta_0 = \theta_1$, this leaves us with a simpler expression:

$$g_\theta * x \approx \theta(I_N + D^{-\frac{1}{2}}AD^{-\frac{1}{2}})x \quad (7)$$

4.2 Dataset

In china, major venture capital databases (ChinaVenture, Zero2IPO, and Venture Capital Research Institute's annual reports) release public investment and related index data, and we have collected all venture capital investment events from 1993 to 2014. Each investment event indicates that a VC has invested in a company. At the same time, each investment event records when and where the venture capital company invested in which company, and lists the industry to which the company belongs and the investment period (initial stage, expansion stage, seed stage) at that time.

We construct a large co-investment network from collected dataset, which contains 8,680 nodes and 14,789 edges. The maximum value of the edge weight is 272, which indicates that two VCs have the highest co-investment of 272 times between 1993 and 2014. The summary of the co-investment network is presented in Table 1, and the summary statistics of the nine feature indicators are presented in Table 2.

Table 1. The summary of the co-investment network

#Nodes	#Edges	#Classes	Weights on Edges			
			Max	Min	Mean	Std
8680	14789	2	272	1	9.0587	14.8933

Table 2. The summary statistic of the nine feature indicators

Indicato rs	Mean	Std	Median	Min	Max	Skew	Kurtosis
NoC	2.4914	12.0964	0.0000	0.0000	463.000	17.6994	498.442
					0		6
TNI	3.1347	16.6226	0.0000	0.0000	628.000	18.1528	499.963
					0		3
NoI	1.5173	4.5399	0.0000	0.0000	101.000	7.2042	78.9170
					0		
NoP	0.7089	1.1830	0.0000	0.0000	5.0000	1.8159	2.6722
NoCoun	0.4534	0.7717	0.0000	0.0000	10.0000	3.2962	20.8392
NoPR	0.9250	2.2605	0.0000	0.0000	28.0000	5.0498	34.6475
NoSI	0.8275	5.3147	0.0000	0.0000	215.000	21.3126	686.265
					0		7
NoSE	1.1848	6.4657	0.0000	0.0000	298.000	21.1435	709.439
					0		6
NoSS	0.3808	3.1130	0.0000	0.0000	138.000	22.8652	733.308
					0		4

4.3 Settings

For vcGCNN, we set the learning rate as 0.01, dropout rate as 0.5, L_2 loss weight as $5e-4$, hidden units as 16, validation set as 10% of training set selected randomly. Following the settings of GCN, we trained vcGCNN with Adam^[24] for a maximum of 200 epochs. For ChebNet based methods, we used the same parameter settings but the different filter.

4.4 Accuracy analysis

We have carried out Delphi inquiry interviews in April 2013, and obtained reference label of leading VCs. Before the interview, we calculated K-core centrality of all the VCs and listed 908 VCs based on the K-core score. Then we interviewed four experts who are familiar with the Chinese venture capital market. They are asked to choose the most influential VCs from the list, and tick out "yes" or "no" for all the listed VCs. Among the four experts, one is the leader of a VC research institute in the Chinese central government, and the other three are CEOs of large foreign or domestic VCs. Finally, we selected 42 of the most influential VCs from the checklist as leading VCs, and the others are taken to be not leading VCs.

4.5 Test Performance

For centrality measures methods, we separately consider top-30, top-40, top-50 ranking as leading VCs, the test accuracy of each centrality measures method is presented in Figure 2. As figure illustrate, the accuracy of centrality measures is near 68%, which is not good enough for leading VCs identification.

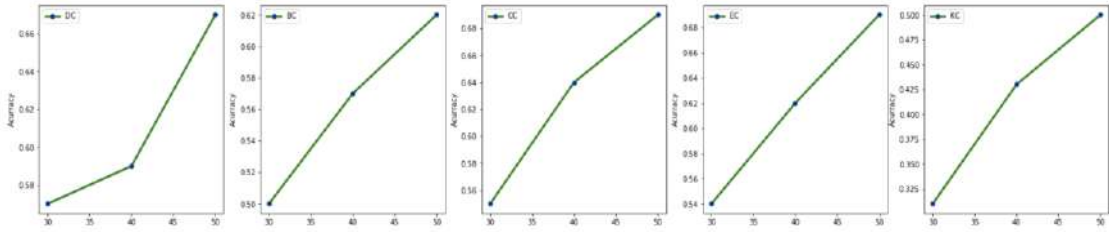


Figure 2. Test accuracy of each centrality measures method

We compare ChebNet with K is 2 or 3, and different per-layer propagation model on the co-investment graph. Following the settings described in the section 4.3, the results are summarized in Table 3. The test accuracy result of our vcGCNN model is in bold. Reported numbers denote mean test accuracy for 10 repeated runs. In case of multiple variables θ_i per layer, we impose L_2 regularization on all weight matrices of the first layer.

Table 3. Comparison of propagation models

Description		Propagation model	Accuracy
ChebNet (Eq. 5)	$K=2$	$X\theta_0 + \tilde{L}X\theta_1 + (2\tilde{L}^2 - 1)X\theta_2$	0.9325
	$K=3$	$X\theta_0 + \tilde{L}X\theta_1 + (2\tilde{L}^2 - 1)X\theta_2 + (4\tilde{L}^3 - 3\tilde{L})X\theta_3$	0.9171
1 st -order model (Eq. 6)		$X\theta_0 + D^{-\frac{1}{2}}AD^{-\frac{1}{2}}X\theta_1$	0.9238
single parameter (Eq. 7)		$(I_N + D^{-\frac{1}{2}}AD^{-\frac{1}{2}})X\theta$	0.9289
vcGCNN (Eq. 2)		$\tilde{D}^{-\frac{1}{2}}\tilde{A}\tilde{D}^{-\frac{1}{2}}X\theta$	0.9346

Table 3 presents test accuracy of each spectral-based model. vcGCNN outperforms all baseline models on co-investment network, which demonstrates the effectiveness of the proposed approach on investment events datasets. For more performance analysis, we note that other propagation models also perform well on leading VCs identification. This is likely due to the fact that spectral graph convolutional network is very suitable and efficient for nodes classification on graph-structure data, especially on co-investment graph of VCs. The performance of different spectral-based model is delicate, after all, our proposed model is better.

4.6 Label Rate Sensitivity

In order to evaluate the effect of the size of the labeled data, we tested several best performing models with different proportions of the training data. Classification accuracies on testing data with label rate as 1%, 5%, 10%, 20% and 40% are reported in Figure 3. Result shows that vcGCNN can achieve higher test accuracy with labeled nodes added and performs well with limited labels. These encouraging results suggest that vcGCNN can

propagate VCs label to the entire graph well and the graph preserves global co-investment information. Mention again, 1st ChebNet and single parameter model which are similar to vcGCN also performs well with different proportions of training data.

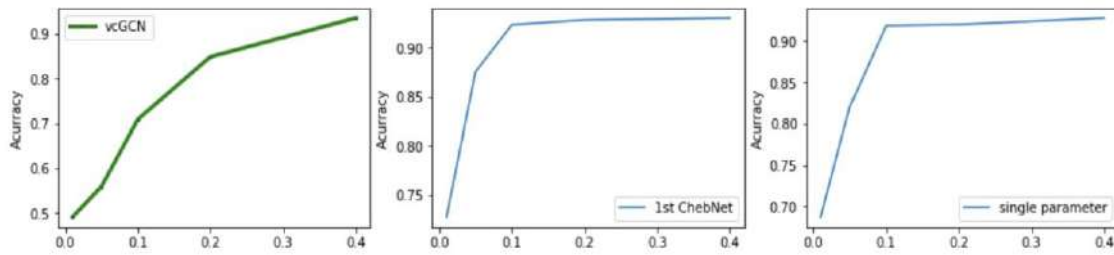


Figure 3. Test accuracy by varying training data proportions

4.7 Co-investment Network Visualization

We give an illustrative visualization of the co-investment network. Figure 4.1 shows the visualization of 8680 venture capital firms with 14789 co-investment relationship. As we can see, there are some of isolated nodes around the graph, we then remove less than 5 times co-investment relationship in the network, which leaves 1123 nodes and 6607 edges, the new graph is showed in Figure 4.2.

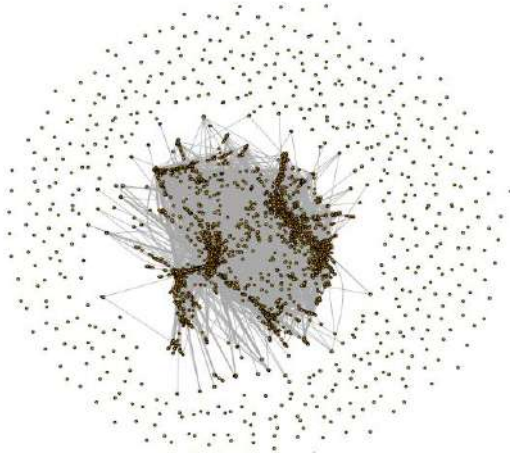


Figure 4.1. The co-investment graph

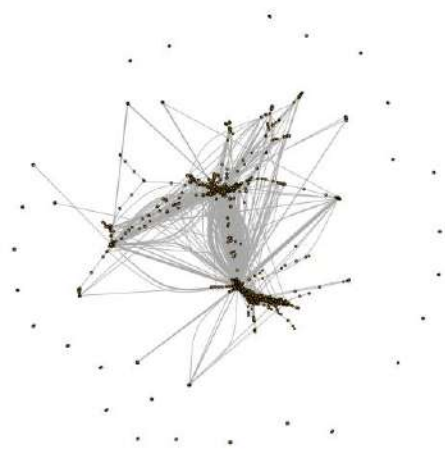


Figure 4.2. Subgraph where weights larger than 4

5. CONCLUSION

To sum up, we propose a new method for leading VCs identification termed VCs Graph Convolutional Neural Networks (vcGCNN). A large graph is built for investment events dataset, so that the problem of leading VCs identification is turned into the problem of node classification. vcGCNN has good performance when capturing graph structure information and learning from limited labels. A simple two-layer vcGCNN demonstrates promising results by outperforming numerous centrality measures methods and typical spectral GNN methods on leading VCs identification. Additionally, there are some interesting directions for future work, including improving the classification performance using different propagation rules, tending to link prediction to search for the most feasibility co-investment partner, and developing unsupervised model for unlabeled graph-structure data.

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Brand User Attention Model Based on Online Text Reviews:

An Empirical Study of New Energy Automobile Brands

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Abstract: Accurately grasping the rules of user behavior and market changes and timely adjusting decisions and strategies are the ways for brand development and innovation. In this paper, we proposed a brand user attention model based on online text review analysis. First of all, we collected and preprocessed the user comment text from the online forum. Secondly, through the LDA topic model and LDAvis visual analysis, the potential topics of user reviews were extracted, and a multi-dimensional feature analysis model was constructed to reveal the users' attention features of brand products. Finally, took the new energy automobile brands as an example, the users' attention features for the different new energy automobile brands were explored and the empirical study was carried out. This study found that the brand user attention model based on online text analysis can effectively extract the characteristics that brand users care about, obtain valuable business insight, and provide support for managers' decision-making.

Keywords: brand user attention, text analysis, LDA topic model, empirical analysis, new energy automobiles

1. INTRODUCTION

Brands are consumers' evaluation and cognition of the enterprise and its production and sales of products or services and are an important basis for clarifying the company's positioning, formulating production and marketing strategies, and enhancing market competitive advantages. Analyzing the brand user's attention and discovering the potential consumption characteristics of the user will help the company to accurately grasp the user behavior and market changes in the fierce market competition, to make better decisions. To get a more comprehensive and in-depth understanding of the differences between the products and services of each brand and the importance that the user places on product features, the user's perception opinion of the product should be studied first.

Nowadays, the public is more inclined to use social media to exchange information about products and brands, listen to multiple views and opinions^[1], so social media contains important business information that brands and sellers need. At present, there are mainly three types of social media platforms: online communities and forums, blogs, and social networks. They can allow the public to participate in brand interaction more extensively and deeply^[2]. The information getting from online forums is more real, more timely, and more comprehensive. Analyzing the actual textual content of social media platform can better understand the consumers' interest for marketing^[3]. Compared with conducting offline surveys, collecting review data from online forums is more controllable, which can not only clearly and accurately reflect the user's true perception and evaluation of the product, but also effectively reduce the cost of obtaining experimental data. Therefore, this article uses the comments of online forums to study users' opinions on brand products.

This paper proposed a brand user attention model and construction method based on text analysis to analyze the characteristics of users' attention to brand products. In this process, first, user review data was collected from online forums and preprocessed. Second, latent topic models were established through LDA (Latent Dirichlet Allocation, LDA) topic analysis and LDAvis visual analysis methods, and users' attention features were extracted from the latent topic models. Then the user's attention and its evolution characteristics

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were analyzed through the multi-dimensional feature analysis model. Finally, the main new energy automobile brands were taken as an example of empirical analysis to verify the effectiveness of the method proposed in this paper.

2. RELATED WORKS

Users' attention to the brand is very important for brand innovation and further development of the industry, it reflects the effect of brand building. At present, the rapid development of information technology provides good support for the brand user attention analysis. More and more scholars have invested in the research of promoting brand building by collecting and analyzing brand users' comments. Tu Haili, Tang Xiaobo and Xie Li^[4] built a user demand mining model based on the online comment data and got the satisfaction of users' demand for the brand product or service attributes, and then put forward the direction of brand improvement. Wei Jiahua, Fan Lili and Lin Xi^[5] thought that private brand purchase intention research is an effective way to understand customers and product development, and built a scale of the influence of product characteristics on private brand purchase intention. Through empirical analysis, they found that product characteristics had a strong influence on purchase intention. Through these research results, it can be seen that brand research is of great significance for the further promotion of brand construction, including planning, design, publicity and management. Analyzing user needs by using brand user attention data is an important direction of brand study.

In the study of consumers' purchase behavior, most scholars adopt the method of the questionnaire. Zhao Yuxiang, Liu Zhouying and Xu Weihai^[6] designed the questionnaire according to the Kano model classification method, analyzed the data collected by the questionnaire, obtained the final decision weight ranking of the elements of the public science platform's game, and put forward corresponding countermeasures and suggestions according to the research results; When Gao Junbo, An Bowen and Wang Xiaofeng^[7] studied the potential influential topics in online forums, they put forward a method of clustering influential words, which can extract important topic information timely and accurately for users and forum managers, and find hot issues in the forums. It can be seen that at present, most scholars choose to use the questionnaire survey method to obtain the user's ideas and opinions, and then study the consumer's purchase behavior. There are more and more studies at home and abroad to obtain consumer information through the social media text mining method. It has important theory and practice to use online comments of online forums to study consumer behavior and provide data-based decision support for managers.

In recent years, many scholars have analyzed online social media based on the LDA topic model and established relevant models, such as microblog, online forum, etc., and achieved certain results. In China, Luo Jianhong et al^[8] used LDA topic model to explore the user's repost pattern of enterprise social media content; Chatao Chen et al^[9] inferred forum topic and user interest by using LDA topic model; Wang Zhenhuang et al^[10] proposed a microblog topic visualization system based on the topic model. This system uses a variety of interconnected views and rich interaction methods. It supports users to analyze and explore the results of the topic model, and can effectively help users analyze microblog topics; Xiong Huixiang et al^[11] proposed a tag generation method based on the LDA topic model, which can describe the user's microblog features more accurately. In foreign countries, Malek hajjem et al^[12] used LDA topic model and other methods to improve twitter topic analysis, which improved the measurement of topic consistency; Daniel Ramage et al^[13] extended LDA topic model, and reflected the content of twitter from the content, style, status and social characteristics of posts, and gave two results of information consumption-oriented tasks. It can be seen that LDA is more practical and practical for topic analysis of online social media text, and LDA has great potential in this field. Many scholars have expanded their research based on the original LDA topic model. Therefore, this paper puts forward a brand user attention model based on LDA topic model, which analyzes user behavior from multiple

perspectives, aiming to help brands, sellers and forum operators accurately understand the consumption characteristics of the users, summarize the connotation of users' attention about brand products, and make more accurate decisions.

3. BRAND USER ATTENTION MODEL BASED ON TEXT ANALYSIS

The comment text of the online forum truly reflects the users' evaluation of the product. The flow chart of the proposed brand user attention model based on text analysis is shown in Figure 1.

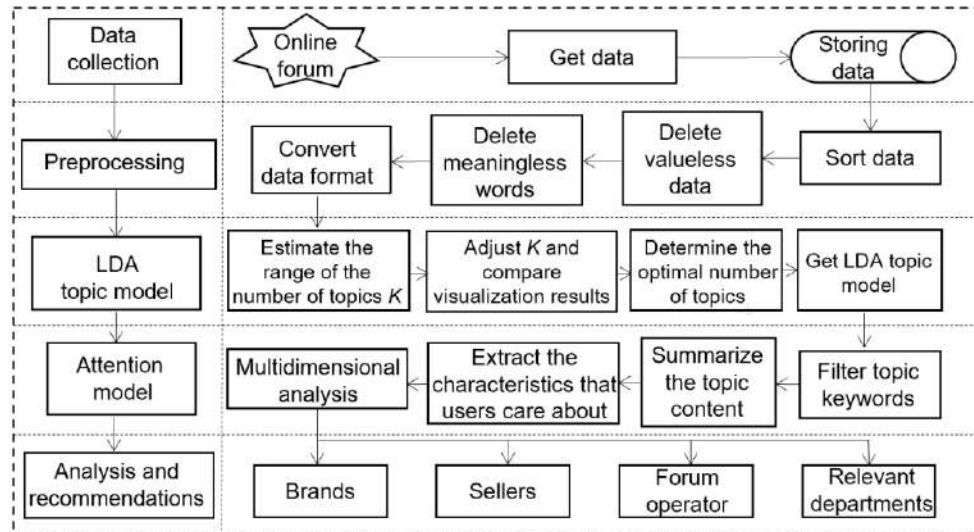


Figure 1. Brand User Attention Model

3.1 Data collection and preprocessing

According to the characteristics of the online forum and the specific needs of data, we collected online comment texts related to brands, including user name, user category, user registration time, comment time, title, comment content, gender, user location and other attributes.

In order to ensure the validity of the experimental data, the text collected from the forum needs to be preprocessed. Firstly, delete incomplete data. Secondly, delete meaningless words in the data set, such as stop words, links, special characters and other words that need to be ignored. Thirdly, transform the processed data into a data format that can be used for LDA topic modeling.

3.2 LDA topic modeling and visualization

After data collection and data preprocessing, we use the LDA topic model and LDAvis to analyze massive text data and find potential topics from the data set. The LDAvis tool developed by Carson Sievert and Kenneth E. Shirley is used to realize the interactive LDA topic model based on Web pages^[14], so as to show the topical differences between brands intuitively.

LDA is a text topic generation model. It was first proposed by Blei et al in 2003^[15]. LDA includes three levels: document, topic and word. Its basic idea is that the topic of a document is mixed. Each document represents a probability distribution of some topics, and each topic represents a probability distribution of some words.

LDA is also known as a three-layer Bayesian probability model, and its generation process can be represented in Figure 2. Among them, α and β represent the prior distribution hyperparameters of the document—topic probability θ and topic—word probability distribution ϕ respectively, Z represents a topic, W represents the word of the text, N represents the total number of words in each document, M represents the collection of the whole document, and K represents the total number of topics in the document^[16].

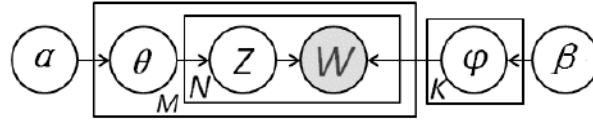


Figure 2. Bayesian network diagram of LDA model

In 2014, Carson Sievert and Kenneth E. Shirley put forward LDAvis, which is a method combining R language and D3. The LDAvis model can map the results of topic recognition to a two-dimensional space based on a multidimensional scaling algorithm, and then reveal the topic-topic, topic-word associations^[17]. LDAvis thinks that the words selected according to the probability of the word item belonging to the topic are not the best result. At the same time, LDAvis puts forward a new basis for selecting the words representing the topic: the correlation between the words and the topic. According to the correlation between the words and the topic, the words belonging to the topic are reordered according to the weight, and the top-weighted words are selected to represent the topic^[18].

In this paper, LDA is used to analyze the text data and get the result of the topic classification. Before determining the optimal number of topics, we estimate the range of topic number according to experience and classification, and continuously adjust the number of topics K at the speed of increment of 1. By observing the LDAvis visualization results of topics corresponding to each K value, the results were compared in terms of the practical significance, the topics simplification and the differences between topics, and finally, we got the optimal number of topics in the data set. Then an appropriate LDA topic model is obtained.

3.3 Brand user attention model

Users' cognition and evaluation of the brand mainly focus on the product characteristics of the brand, so scholars study the brand product characteristics to promote the in-depth analysis and improvement of the brand building. Li Tianjiao et al^[19] think that the product features of pure electric automobiles mainly include the following: comfort performance, driving performance, appearance and interior decoration, safety performance, information interaction, energy consumption, charging convenience, etc. Therefore, to build a brand user attention model, we need to classify each topic content according to the product characteristics, and summarize the Characteristics that User Care about (CUC) from the resulted topics.

The topics in the LDA topic model can be numbered as T_1, T_2, \dots, T_K . We use the topic model to get the distribution of each word in the topic, select the words with larger weight as the topic keywords, and summarize the content of each topic. According to the connotation of the product features, the meaning of each topic is extracted as the CUC of the product, with the numbers of C_1, C_2, \dots, C_h .

After extracting brand CUC based on LDA topic model, we need to further study the collected data and analyze the characteristics of brand user attention and its evolution. The multi-dimensional analysis of data can find insights from multiple perspectives, make up for some aspects that cannot be involved in independent dimensions, to get more meaningful results. Therefore, three dimensions of the time, region and gender are analyzed respectively. By comparing research and analysis, we can further discover the changing law of consumers' attention to product characteristics.

3.3.1 CUC time dimension analysis

Using the "user comment time" attribute of the data, summarize the brand's comment months of each CUC, and take the number of reviewers per month as the measurement index. And the histogram is used to show the distribution of the number of reviewers in each CUC in each month of a year.

$$Q_{mc} = \sum_{i=1}^n P_{mci} \quad (1)$$

Among them, m is the month ($1 \leq m \leq 12$), c is one of the CUC, Q_{mc} is the total number of reviewers in c in the m month, P_{mci} is the number of reviewers of the i^{th} keyword in c in the m month.

3.3.2 CUC regional dimension analysis

Using the "user location" attribute, the number of reviewers in each province or municipality of each CUC is summed. Taking the number of reviewers obtained by statistics as the measurement index, select the top five provinces or municipalities directly under the central government with the number of reviewers ranking first, and draw the bar chart according to the category of CUC.

$$Q_{cr} = \sum_{i=1}^n P_{cri} \quad (2)$$

Among them, c is one of the CUC, r is the region, Q_{cr} is the total number of reviewers in r region in c , P_{cri} is the number of reviewers in r region of the i^{th} keyword in c .

3.3.3 CUC gender dimension analysis

By using the attribute of "user gender", the number of male reviewers and female reviewers under each CUC of each new energy automobile brand are counted, and the ratio of male to female is taken as the measurement variable of the attention value of gender dimension, and the bar chart is shown.

$$R = \frac{\sum_{i=1}^n P_{cim}}{\sum_{i=1}^n P_{cif}} \quad (3)$$

Among them, R is the proportion of men and women, c is one of the CUC, P_{cim} is the number of male reviewers of the i^{th} keyword in c , P_{cif} is the number of female reviewers of the i^{th} keyword in c .

3.4 Analysis and suggestions

Through the analysis of the time, region and gender dimensions of the brand CUC, we can find the evolution characteristics when the users' attention to the brand products. Combined with the characteristics and positioning of the brand itself, the brand user attention model was proposed in this paper. By analysis with this brand user attention model, it can put forward practical and effective suggestions for the brand, the seller, the forum operator, the policymaker and other relevant departments, and also provides suggestions for the brand and the industry development.

4. EMPIRICAL ANALYSIS

4.1 Data collection and preprocessing

Based on the above methods, this paper took the new energy automobile brands as an example, and made an empirical analysis of the brand user attention of Tesla Model X and BYD Yuan new energy automobiles. This paper selected the most influential forum in the field of automobile - "home of automobile" forum as the source of original data^[20], and collected online comment data of Tesla Model X and BYD Yuan in the forum, including user name, user category, user registration time, comment time, title, comment content, gender, user location and other attributes. The collected data of BYD Yuan is from January 1, 2018 to December 31, 2018; As Tesla Model X has less data, in order to improve the reliability of experimental data, Tesla's data time range has been extended from January 1, 2017 to December 31, 2018. In this experiment, 11975 pieces of data about the Tesla Model X and 19902 pieces of data about the BYD Yuan were collected.

4.2 LDA topic modeling and visualization

As Section 3.2 described, after comparing the LDAvis visualization results of topics corresponding to each K value, we got the optimal number of topics is 4 for both two data sets. The results of the Tesla Model X (left) and the BYD Yuan (right) are shown in Figure 3.

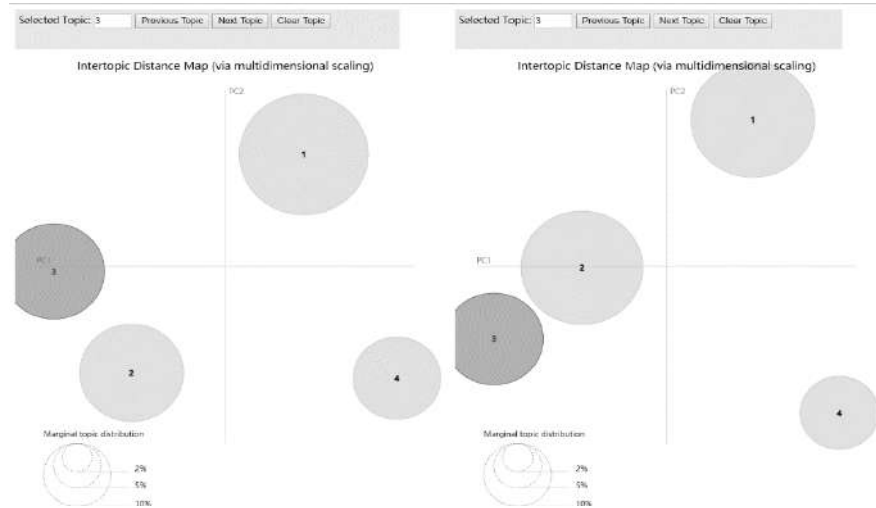


Figure 3. Tesla Model X (left) and BYD Yuan (right) topic model

In Figure 3, each topic is represented by one circle, the size of the circle represents the weight of each topic in the data set, and circles are sorted and numbered by size. We can click the circle and get the detail topic information including keywords list, etc.

4.3 Brand user attention model

According to the above results, the top ten words in each topic for Tesla Model X and BYD Yuan are list in Table 1 and Table 2.

For convenience, Tesla Model X is represented as T_X , BYD Yuan is represented as T_Y . T_{X1} , T_{X2} , T_{X3} and T_{X4} are respectively the four topic numbers of Tesla Model X, and T_{Y1} , T_{Y2} , T_{Y3} and T_{Y4} are respectively the four topic numbers of BYD Yuan. The topic meaning of each topic is summarized and refined according to the top ten weight words for each topic. Then each topic meaning is described as topic content extraction in Table 1 and Table 2.

Table 1. Tesla Model X topic content extraction

Brand name	Topic number	Top ten weight words for each topic (ordered by weights)	Topic content extraction
Tesla Model X (X)	T_{X1}	感觉(feel)、体验(experience)、喜欢(like)、座椅(seat)、科技(technology)、内饰(interior)、加速(accelerate)、鹰翼门(eagle wing gate)、感受(feeling)、模式(mode)	high-tech and experience
	T_{X2}	充电(charge)、驾驶(drive)、自动(automatic)、公里(kilometer)、辅助(auxiliary)、安装(installation)、功能(function)、朋友(friend)、交付(deliver)、销售(sales)	charging performance and endurance mileage
	T_{X3}	充电(charge)、公里(kilometer)、电量(electric quantity)、服务区(service area)、速度(speed)、出发(set off)、行程(itinerary)、里程(mileage)、到达(arrivals)、北京(Beijing)	self-driving travel and long-distance travel experience
	T_{X4}	轮毂(wheel hub)、细节(detail)、效果(effect)、碳纤维(carbon fiber)、原厂(original)、完美(perfect)、产品(product)、施工(construction)、卡钳(calipers)、改色(change color)	auto parts and manufacturing materials

Table.2 BYD Yuan topic content extraction

Brand name	Topic number	Top ten weight words for each topic (ordered by weights)	Topic content extraction
BYD Yuan (Y)	T _{Y1}	设计(design)、空间(space)、感觉(feel)、方向盘(steering wheel)、天窗(Sunroof)、后排(Back row)、不错(not bad)、功能(function)、座椅(seat)、全景(panoramic)	design sense and in-car features
	T _{Y2}	喜欢(like)、感觉(feel)、新能源(new energy)、老婆(wife)、提车(mention cars)、销售(sales)、孩子(child)、买车(buy a car)、时间(time)、家里(at home)	the joy of buying a car and benefits to family life
	T _{Y3}	生活(life)、喜欢(like)、风景(scenery)、出发(set off)、感觉(feel)、地方(local)、媳妇(wife)、时间(time)、景区(scenic)、拍照(Take a picture)	family self-driving travel experience
	T _{Y4}	充电(charge)、公里(kilometer)、续航(endurance)、电池(battery)、里程(mileage)、安装(installation)、电量(electric quantity)、服务区(service area)、km、车辆(automobile)	charging, endurance and infrastructure

As can be seen from the topic content extraction of Tesla Model X and BYD Yuan, the topics result of Tesla Model X and the topics of BYD Yuan show the characteristics of users care about on the two different new energy automobile brands. It depicts the elements of new energy automobiles that users may consider before and after purchase the automobiles. To further understand the characteristics or elements requirements of users, the new energy automobile CUCs framework is constructed according to the above topic modelling results. The CUCs framework includes six categories of CUC: technology interaction, energy consumption, long-distance performance, accessory material, appearance and interior decoration, and short-distance performance. Each CUC is numbered as C₁, C₂, ..., C₆. The proportion of each CUC for each brand is list in Table 3 and Table 4. It means the different proportions of the characteristics of each brand that users pay attention to.

Table 3. The CUC of Tesla Model X

CUC number	C ₁	C ₂	C ₃	C ₄
CUC	technology interaction	energy consumption	long-distance performance	the material of accessories
Proportion (%)	40	24	21	15
Corresponding topic number	T _{X1}	T _{X2}	T _{X3}	T _{X4}
Topic content extraction	high-tech and experience	charging performance and endurance mileage	self-driving travel and long-distance travel experience	auto parts and manufacturing materials

Table 4. The CUC of BYD Yuan

CUC number	C ₅	C ₆	C ₃	C ₂
CUC	exterior and interior	short-distance performance	long-distance performance	energy consumption
Proportion (%)	36	32	26	6
Corresponding topic number	T _{Y1}	T _{Y2}	T _{Y3}	T _{Y4}
Topic content extraction	design sense and in-car features	joy of buying a car and benefits to family life	family self-driving travel experience	charging, endurance and infrastructure

It is clear that although the number of topics of the two brands is the same, but the proportion of each CUC is different for the two brands. Therefore, the brand user attention model is effective to mine the CUC of different brands and can give more insight for the studied brands.

4.3.1 CUC time dimension analysis

According to formula (1), the "user comment time" attribute of the experimental data is analyzed, and

Figure 4 is the monthly number of reviewers of Tesla Model X.

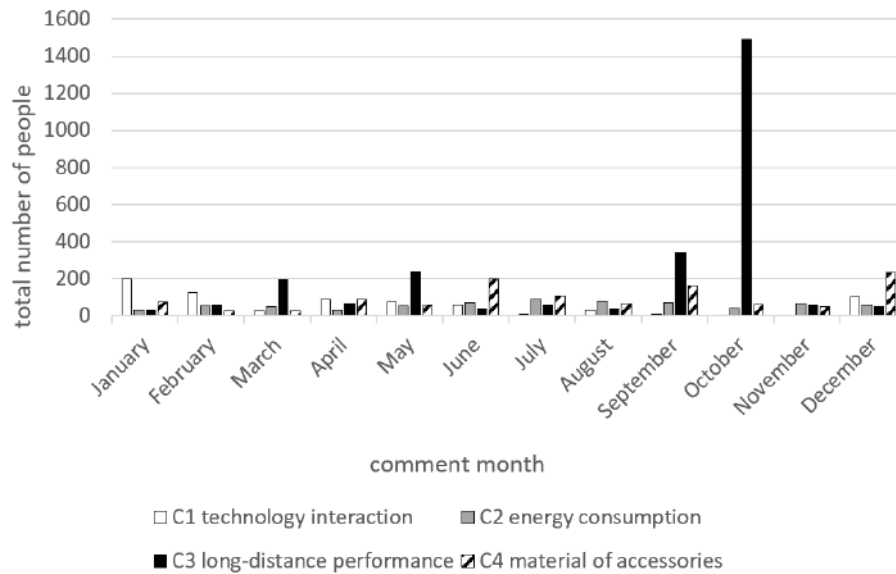


Figure 4. Monthly number of reviewers of Tesla Model X

It can be seen that users talk about technology interaction more in winter and the long-distance performance in spring. In early summer, early autumn and early winter, users pay more attention to the material of accessories of new energy automobiles. It is also clear that Tesla Model X users were active in October, and the number of reviewers on long-distance performance increased significantly, which may be related to seasons, holidays and national subsidy policies.

4.3.2 CUC regional dimension analysis

According to formula (2), we analyzed the "user location" attribute of the experimental data and got the CUC regional dimension analysis results of the two brands. Figure 5 and Figure 6 show the distribution of the top five provinces in terms of the number of reviewers of Tesla Model X and BYD Yuan towards different CUC.

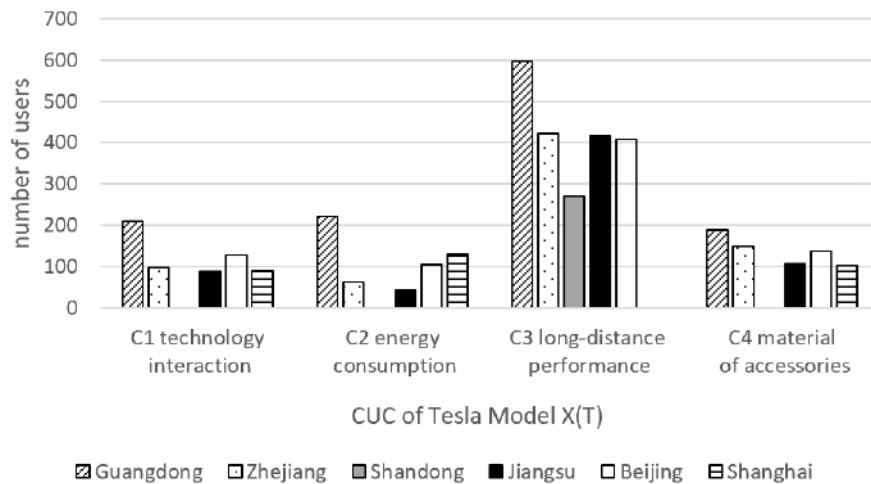


Figure 5. The distribution of the top five provinces of Tesla Model X

It is found that four CUCs including energy consumption, long-distance performance, the material of accessories and technology interaction have attracted more attention. Guangdong, Jiangsu, Zhejiang, Shandong, Shanghai and Beijing are the top five provinces or municipalities with the largest number of reviewers in each CUC. Tesla is targeted at high-income people, who also generally live in the above provinces or municipalities. First-tier cities usually limit the flow of fuel automobiles, so new energy automobiles have entered the choice of

people living in big cities. The province with the largest number of reviewers under each CUC is Guangdong, so Guangdong has the largest sales market.

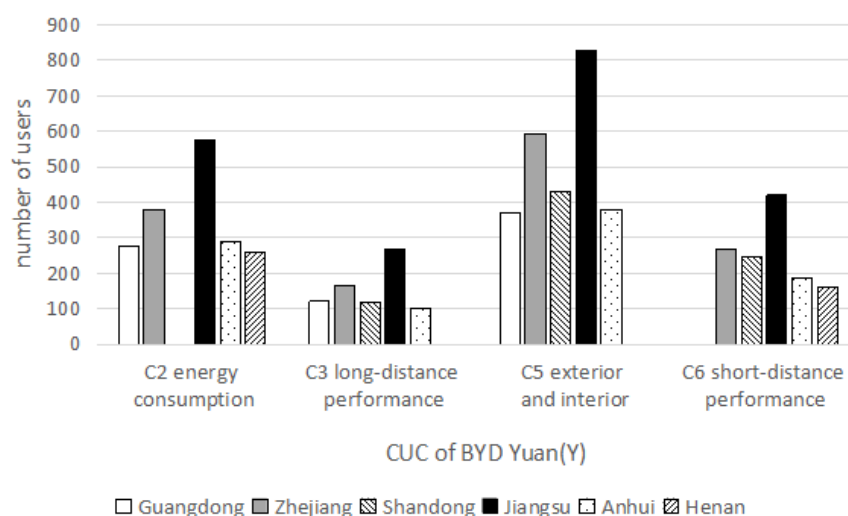


Figure 6. The distribution of the top five provinces of BYD Yuan

As can be seen from Figure 6, users of BYD Yuan mainly pay attention to energy consumption, exterior and interior, short-distance performance and long-distance performance. Jiangsu, Zhejiang, Shandong, Guangdong, Henan and Anhui are the top five provinces in terms of the number of users. According to the Statistics Bulletin released by each province in 2018, the experimental results are consistent with the actual economic strength of each province. Jiangsu and Zhejiang are the first and second provinces in each CUC, which shows that BYD Yuan has a large market in Jiangsu and Zhejiang.

4.3.3 CUC gender dimension analysis

Finally, according to the gender characteristics, the influencing factors of new energy automobile CUC are analyzed by formula (3). Figure 7 is a statistical chart of the gender ratio of each CUC of Tesla Model X and BYD Yuan.

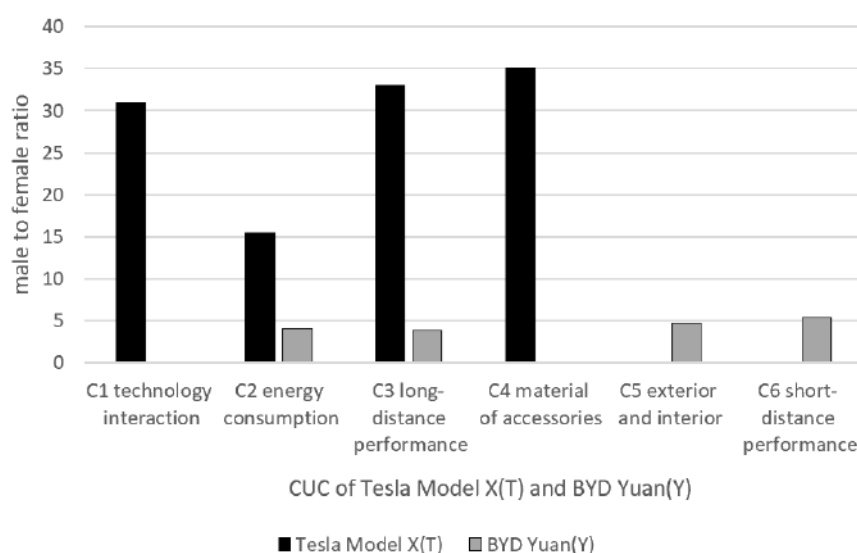


Figure 7. The gender ratio of CUC of the two different brands

From the figure, for Tesla Model X, the ratio of men to women for the CUC of the material of accessories is the largest, and that of energy consumption is the smallest. Relatively speaking, men generally know about

cars and pay more attention to characteristics such as auto parts, car structure and materials. For BYD Yuan, the ratio of men and women for the CUC of long-distance performance is the smallest, while that of short-distance performance is the largest. Therefore, when buying a car or commenting online, women are more inclined to share a specific experience of self-driving with their family and friends, and pay more attention to the emotional experience of the car, while men are more concerned about the practicality of the car, which is in line with the characteristics that women are more emotional than men. At the same time, the gender ratio of Tesla Model X and BYD Yuan has a large difference. Therefore, the gender ratios of different brands are different, specifically, the gender ratio of high-price new energy automobiles is higher than that of low-price new energy automobiles.

4.4 Analysis and suggestions

4.4.1 Opinions on different brand user attention

This paper proposed a new energy automobile user attention model based on text analysis. The attention model is mined and constructed from the perspective of six CUCs. The different brand has different performance in the same dimension.

Specifically, the differences in users' attention of different brands are as follows:

- Compared with mid-low-end, the public is more concerned about the high-end new energy automobiles' technology interaction and the material of accessories, and more concerned about the short-distance performance and exterior interiors of mid lower end new energy automobiles.
- In terms of the time dimension, users of high-end new energy automobiles are active during holidays, such as national day, while the user behavior of mid-low-end new energy automobiles is mainly affected by the seasonal change and national subsidy policy.
- In the regional dimension, the characteristics of different brands show that the vast majority of their consumers are from economically developed regions, but some consumers of mid-low-end new energy automobiles are from middle economic level regions.
- In the gender dimension, the proportion of men and women in high-end new energy automobiles is far greater than that in mid-low-end new energy automobiles.

4.4.2 Suggestion

LDA topic model makes the topic of online reviews intuitive, and the extraction of new energy automobile user attention model shows the multidimensional distribution of attention, reveals the user's attention to new energy automobiles comprehensively. It is conducive to brand makers, sellers and discussion operators to grasp the mechanism of users' attention, to formulate their operation and management plans, and can also help related government departments to put forward effective policies and measures.

Brands should apply the known CUCs to production, sales and operation. First of all, through the user attention model, they can fully understand the user's attention to the product, promote product function optimization. Secondly, the revealed model meaning should be transformed into actual operating plans. According to the user's car purchase needs, they could produce ads that fit the public's psychology and convey the corporate spirit consistent with the public's emotions. Finally, expanding the sales channels is a good way to let the public more contact with the brand, understand the brand.

As a department that directly contacts with customers, the seller plays an important role in product introduction. After knowing the user's attention to new energy automobiles, we can establish sales guidelines, conduct training for sellers, and formulate detailed sales plans. When communicating with customers, the sellers shall focus on the points based on the characteristics of customers' time, region and gender, and the seller should meet the needs of customers for product characteristics and provide corresponding services to users.

Through the CUC multi-dimensional analysis of new energy automobiles, forum operators can first guide forum members to publish posts that cater to the user's attention, grasp hot topics and adjust topics in time.

Secondly, they could use the brand's competitive advantage to improve the core competitiveness of the forum, make the forum as broad as possible, and help more users solve problems.

Since 2010, in order to encourage the public to buy new energy automobiles, the state has continuously introduced policies to promote the development of the new energy automobile industry^[21]. When formulating relevant policies of the new energy automobile industry, relevant departments can fully consider the potential consumption characteristics of customers, and put forward targeted optimization measures according to different users' attention characteristics under different time and space conditions, so that the new energy automobile industry can develop better and faster, and the energy structure can be further optimized and improved.

4.5 Analysis summary of new energy automobile user attention model

The user attention model was proposed and empirical studied with two new energy automobile brands of Tesla and BYD. Through the visual analysis and the topic modelling, the CUC framework was found, which includes six characteristics. Combined with multi-dimensional analysis, the user's attention to the product was deeply explored. The business insights obtained from the model and analysis have important value, which can help brand makers, sellers, forum operators and relevant departments to carry out brand developing and promote relevant work. The model proposed in this paper is applicable to the field of new energy automobiles, and can help to understand the market situation of different brands. The user attention model can be extended to more fields and more brands in the future, and can provide strong support for managers' decision-making, and promote brand construction of various industries.

5. CONCLUSION

With the rapid development of Internet economy, users' attention to product characteristics has become a necessary reference for brand growth and innovation. Obtaining and analyzing consumers' opinions and evaluations of the brand plays an important role in the development of the brand and even the whole industry. This paper proposed a brand user attention analysis method based on text analysis, which collects online comment texts of forums, carries out visual analysis with LDA topic modelling, extracts CUC based on the topic model, and constructs multi-dimensional characteristics analysis model, so as to put forward constructive suggestions. The empirical study shows that this method can get the characteristics that users pay attention to about brands, which can help decision-making for relevant departments.

Based on the text analysis, the brand user attention model makes users' cognition and evaluation of brand products or services clearer. This paper also analyzed the changing rules of users' attention, and put forward constructive suggestions for brand makers, sellers and relevant departments to help establish a brand-building method based on text analysis.

The brand user attention model based on text analysis proposed in this paper is still a basic research model and there is still some room for improvement. In the follow-up research, we can increase the dimension of attention analysis, explore the important business information hidden in CUC, and make the decision-making more comprehensive and accurate. When the experimental data is more abundant, it can analyze the situation and trend of the brand sales market, help risk management and make timely and accurate adjustments when necessary. At the same time, the brand user attention model is applied and improved in the actual application, so as to further improve the accuracy and effectiveness of decision support.

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Impact Of The “Belt And Road” Initiative On The Development Level Of E-commerce In 18 Provinces And Cities Along China

——Based On PSM-DID Method

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Abstract: E-commerce can effectively overcome market obstacles and directly connect consumers with enterprises, and has contributed greatly to the construction of China's “Belt and Road”. At the same time, the construction of the “Belt and Road” has also provided new opportunities for the sustained and healthy growth of e-commerce. In order to explore the specific impact of the “Belt and Road” initiative on the level of e-commerce development in 18 provinces and cities along China's borders, panel data from 31 provinces in China from 2012 to 2017 were used to measure the 31 provinces in 6 years using the vertical and horizontal gap method. The level of e-commerce development, and then using the propensity score matching double difference method (PSM-DID) to explore the impact of the “Belt and Road” initiative on the level of e-commerce development in 18 provinces and cities along China and 13 provinces and cities along non-routes. The results show that the level of e-commerce development in China's provinces or regions is not balanced. Guangdong, Shandong, Jiangsu, and Zhejiang have good e-commerce development levels, and Tibet, Ningxia, Qinghai, and Hainan have poor e-commerce development levels. Eastern regions The level of e-commerce development is higher and the growth rate is faster, while the level of e-commerce development in the western region is lower and the growth rate is slower; the “Belt and Road” initiative can significantly promote the level of e-commerce development in 18 provinces and cities along China, with a promotion effect of 1.71%. And it can promote the vigorous development of e-commerce by increasing regional GDP, increasing mobile phone users and Internet users, and increasing per capita disposable income in cities and towns.

Keywords: “Belt and Road” initiative; E-commerce; vertical and horizontal extension method; PSM-DID

1. INTRODUCTION

The “Belt and Road” initiative is a construction proposed in 2013. It is an abbreviation of “21st Century Maritime Silk Road” and “New Silk Road Economic Belt”. It runs through Asia, Europe, and Africa, and integrates the European and Asian economic circles. connect them. The starting point of the Belt and Road Initiative is China, and then westward in the Eurasia, East Pacific and Indian Ocean. As China's economic construction is gradually moving towards high-quality development, the Belt and Road Initiative reflects China's all-round opening-up pattern in the new era, and China's economy is closely linked to the world economy.

As an emerging industry, e-commerce not only effectively overcomes market obstacles, but also changes the traditional consumption model. At the same time, the advent of the 21st century information era and the gradual unfolding of the Belt and Road Initiative in China's 18 provinces and cities have injected new vitality into China's sustained economic growth, making China's e-commerce level stable in the world in terms of scale and speed. One. According to the China E-Commerce Development Report 2018-2019, although from 2016, China's e-commerce has transitioned from a period of ultra-high growth to a period of stable development, but according to relevant data, China's e-commerce transaction volume in 2018 is still as high as 31.63 trillion.

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RMB, an increase of 8.5% year-on-year, of which, the e-commerce transaction volume of goods and services was 30.61 trillion yuan, an increase of 14.5%; in the first half of 2019, online retail sales of physical goods in China increased by 21.6% year-on-year, and e-commerce is still A powerful engine driving China's economic development. At the same time, e-commerce has played an important role in co-construction of the “Belt and Road”, driving innovation and entrepreneurship, strengthening the digital economy, and helping rural areas to revive.

However, the imbalance in regional development in China has led to an imbalance in the development of e-commerce between provinces in China. On this basis, this paper verifies the differences in the level of e-commerce development in China's provinces, and analyzes the specific impact of the “Belt and Road” initiative on the level of e-commerce development in 18 provinces and cities along the Chinese route, and summarizes its influencing factors to form the “Belt and Road” initiative The vigorous development of e-commerce in China provides a theoretical basis.

2. LITERATURE REVIEW

With the development of e-commerce, scholars have begun to enrich their research on the level of e-commerce, mainly focusing on e-commerce development strategies, e-commerce development level measurement, e-commerce spatial differences, and factors affecting e-commerce development level.

In terms of development strategy, with the implementation of the “Belt and Road” strategy, the academic community is also paying close attention to the development of e-commerce and cross-border e-commerce under the “Belt and Road” strategy. Wang Juanjuan and Qin Wei (2015) believe that the development of e-commerce in the Belt and Road strategic zone is very uneven, fails to fully reflect regional characteristics, and lacks sustainable development capabilities. In order to better promote the new normal of e-commerce in the Belt and Road strategic zone, it is necessary to base itself on "market leadership and government participation", encourage self-built e-commerce operation platforms, make clear that e-commerce is a business opportunity to reduce regional disparities, develop specialized cloud logistics, Improve the quality of e-commerce development, give full play to the role of finance in guiding e-commerce, and ensure that the new normality of e-commerce can continue to be promoted by institutional gaps^[1]. Du Yonghong (2016) combines cross-border e-commerce with the “Belt and Road” strategy, and believes that cross-border e-commerce has accelerated the pace of foreign trade and injected new vitality into “Made in China”. The “Belt and Road” strategy can eliminate trade barriers, optimize services, and promote the development of cross-border logistics. The development strategy of cross-border e-commerce under the background of the "Belt and Road" strategy is to establish a "Belt and Road" regional e-commerce platform, build a cross-border e-commerce ecosystem, and strengthen international coordination in the cross-border e-commerce field of countries in the "Belt and Road" To improve the cross-border e-commerce credit system under big data, promote the large-scale development of cross-border e-commerce logistics, and change from manufacturing in China to creating in China^[2].

In terms of measurement, Tang Yingwen (2015) believes that the development of e-commerce is based on the use of the Internet, selects some indicators that reflect the development level of domestic e-commerce, and constructs an index system with dimensions of the macro level, enterprise level, and micro level. , And cluster measurement by factor analysis^[3]. Hao Longfei (2016), Liu Xiaoyang et al. (2018) and Zhao Jianwei et al. (2019) used the e-commerce development index, online shopping index and online merchant index published by Alibaba to measure China's e-commerce development level^{[4] [5] [6]}. Xu Tongsheng (2016) established an e-commerce development level indicator system with transaction level index, infrastructure index, human capital index, development potential index, and industry prosperity index as dimensions, and 13 indicators as three-level indicators. The entropy method was used to measure China. The level of e-commerce development^[7].

Yao Huili (2019) constructed an index system using e-commerce transaction index, informatization index, and e-commerce manpower cost as a first-level indicator, as well as eight second-level indicators to measure the level of e-commerce development, and determined the weight of each indicator using the analytic hierarchy process^[8].

In terms of spatial differences, Hao Longfei (2016) based on the county data and based on the global Moran index, found that there is a significant spatial concentration of the development level of county e-commerce in the Northeast^[4]. Tang Yinghan (2015) found through cluster analysis and factor analysis that the level of e-commerce development in China is extremely uneven, showing a phenomenon of polarization. The level of e-commerce in the eastern coastal areas is higher than that in the western inland areas. There is a certain correlation between the level of e-commerce and the economy, but it is not completely related^[3]. Liu Xiaoyang et al. (2018) analyzed spatial differences in e-commerce using spatial interpolation, coefficient of variation, and exploratory spatial data analysis methods. It was concluded that the internal differences between the Yangtze River Delta, the Pearl River Delta and the western region are large, and the internal gaps between central and northeastern provinces are small. . From the provincial scale, the level of e-commerce in China's provinces generally shows a downward trend in the Yangtze River Delta to the west inland. From the perspective of city and county scales, China's level of e-commerce development in the city has a large spatial difference^[4].

In terms of influencing factors, Hao Longfei (2016) found that the level of e-commerce development in counties in Northeast China was greatly affected by the level of economic development, the degree of informatization, and the war environment. The population size and education level did not affect the level of e-commerce development. obvious^[4]. Research by Liu Xiaoyang et al. (2018) shows that the contribution to the level of e-commerce development is the balance of savings deposits of urban and rural residents> urbanization rate> GDP per capita> proportion of non-agricultural industries> per capita disposable income of urban residents> mobile phone users> Internet users> Landline users^[5]. Zhao Jianwei et al. (2019) used spatial data to analyze the factors affecting the development of rural e-commerce in Jiangsu Province, mainly the manufacturing industry foundation, policy elements, transportation and logistics infrastructure, agricultural industry foundation, resource endowment, and Internet infrastructure^[6]. Mu Yanhong et al. (2016) found based on literature review and field investigations that the influencing factors of rural e-commerce can be summarized as infrastructure factors, external environmental factors, endogenous factors, e-commerce platform factors, and supply-demand transaction factors^[9].

To sum up, in the development strategy, most of the existing researches are based on the strategic level, and there are few empirical studies on the development of e-commerce under the “Belt and Road” initiative. In the measurement of e-commerce development level, existing studies are mostly based on evaluation methods suitable for cross-section data, such as principal component analysis, analytic hierarchy process, and entropy weight method. Although the objectiveness of evaluation is guaranteed, it is not suitable for multi-period panel data indicators. hehe. Based on this, this paper improves the evaluation method, adopts a dynamic evaluation method suitable for multi-period panel data to measure the level of e-commerce development, and uses the propensity score matching double difference method (PSM-DID) to obtain The impact of the “Belt and Road” policy on the level of e-commerce development in the provinces and cities along China ’s roads provides a necessary reference for improving the development of e-commerce in China ’s provinces and cities along the “Belt and Road” initiative.

3. CONSTRUCTION AND MEASUREMENT OF E-COMMERCE DEVELOPMENT LEVEL

3.1 Index system.

This article refers to the e-commerce indicator systems of Yao Huili (2019), Tang Yinghan (2015) and Hao

Feilong (2016)^{[8][3][4]}, and builds e-commerce with three dimensions of development potential, logistics system, and infrastructure, and 12 indicators as specific measurement standards. Development level indicator system. Among them, the secondary indicators of development potential are: the number of e-commerce application enterprises, e-commerce sales, the proportion of companies with e-commerce transactions, and the level of household consumption. The number of e-commerce application enterprises and e-commerce sales indicate the e-commerce market. The scale, the proportion of companies with e-commerce transactions and the level of household consumption indicate the market potential of e-commerce; the secondary indicators of the logistics system are: the number of employees in the wholesale and retail industry, the area of land for logistics and warehousing, the income of express delivery services, and investment in fixed assets in the transportation industry. The number of employees in the wholesale and retail industry and the area of logistics and storage land indicate the size of the logistics market. The revenue from express services and the investment in fixed assets in the transportation industry indicate the development of other markets driven by the logistics market. The secondary indicators of infrastructure are: railway Total mileage, total highway mileage, number of websites, and Internet broadband access ports. The total mileage of railways and roads indicates the infrastructure of land transportation, and the number of websites and Internet broadband access ports represent the network infrastructure. The 12 indicators are all positive, that is, the larger the value, the better the measured level of e-commerce development.

3.2 Evaluation method.

Evaluation of indicators is generally divided into two categories: subjective and objective. The subjective method is based on human judgment, and the objective method is based on the structure of the data itself. The former generally includes analytic hierarchy process, simple arithmetic average method, etc.; the latter includes principal component analysis method, entropy method, TOPSIS, etc. The latter has the advantage over the former that it can perform objective calculations. However, in the face of multi-period dynamic data, the principal component analysis method, entropy method, and TOPSIS applicable to cross-section data are no longer applicable. Therefore, this article attempts to use the horizontal and vertical extension method proposed by Guo Yajun (2002) to evaluate^[10]. This method is an evaluation method based on the time-series three-dimensional data table. And the evaluation and ranking are based entirely on the data itself without subjective colors.

First of all, because the dimensions of the data are different and the direct measurement error is large, the data needs to be dimensionlessly processed. The positive index adopts the processing method of formula 1 and the reverse index adopts the processing method of formula 2.

$$\varphi_{ij} = \frac{x_{ij} - \min\{x_{1j}, \dots, x_{nj}\}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}} \quad (1)$$

$$\varphi_{ij} = \frac{\max\{x_{1j}, \dots, x_{nj}\} - x_{ij}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}} \quad (2)$$

It is assumed that comprehensive evaluation is required for the evaluation objects and evaluation indexes, and the time sequence is T. The running status at is characterized by the evaluation index vector, and a linear comprehensive evaluation function is constructed from:

$$p_i(t_k) = \sum_{j=1}^m w_j \varphi_{ij}(t_k), k = 1, 2, \dots, T; i = 1, 2, \dots, n \quad (3)$$

Among them is the comprehensive evaluation value of the first evaluation object in the period, and is the weight of each indicator. The principle of determining the weighting coefficient is that the difference between the evaluated objects is most likely to be reflected on the time-series three-dimensional data table. This

difference can be summed by the sum of the squares of the total deviations, as described in Equation 4.

$$e^2 = \sum_{k=1}^T \sum_{i=1}^n (\varphi_i(t_k) - \bar{\varphi})^2 \quad (4)$$

Due to the standardized processing of the original data, $\bar{\varphi} = \frac{1}{T} \sum_{k=1}^T \left(\frac{1}{n} \sum_{i=1}^n \sum_{j=1}^m w_j \phi_{ij}(t_k) \right) = 0$. Thus there is a formula 5:

$$e^2 = \sum_{k=1}^T \sum_{i=1}^n (\varphi_i(t_k))^2 = \sum_{k=1}^T [W^T H_k W] = W^T \sum_{k=1}^T H_k W = W^T H W \quad (5)$$

3.3 Descriptive statistics.

The data used in this study are mainly from the National Bureau of Statistics, mainly related to "China Statistical Yearbook", "China Environmental Statistics Yearbook", "China Labor Statistics Yearbook" and so on. It should be noted that the research samples in this article do not include data from Hong Kong, China, Macau, and Taiwan. Missing data for a few provinces in individual years are supplemented using interpolation.

The sample data of 31 provinces between 2012 and 2017 was finally formed, as shown in Table 1.

Table 1. E-commerce development level indicator system

First-level indicators	Secondary indicators	Unit	Indicator Direction	Weight	Mean	Standard Deviation
Development potential (0.0753)	Number of e-commerce application companies	Each	Forward	0.3089	54410.53	24247.96
	E-commerce sales	100 million yuan	Forward	0.2224	53.894	7.67523
	Proportion of companies with e-commerce transactions	%	Forward	0.2343	88079.34	113056.4
	Household consumption level	yuan	Forward	0.2344	20410.07	38743.37
Logistics system (0.4778)	Employees in Wholesale and Retail Trades	Ten thousand people	Forward	0.3587	0.6806	0.5169843
	Land area for logistics storage	Square kilometers	Forward	0.3238	13.15187	3.243826
	Express business income	100 million yuan	Forward	0.1061	274.2027	178.4101
	Investment in fixed assets in the transportation industry	100 million yuan	Forward	0.2114	.3088667	0.1042296
Infrastructure (0.4469)	Total railway mileage	Ten thousand kilometers	Forward	0.1853	10.50653	2.150311
	Total highway mileage	Ten thousand kilometers	Forward	0.3696	664.1955	209.9442
	Websites	Ten thousand	Forward	0.1400	45.42033	12.80024
	Internet broadband access port	Ten thousand	Forward	0.3051	187.0952	153.8755

3.4 E-commerce development level score.

This article uses Matlab 9.1 to write the program of the horizontal and vertical extension method, and

calculates the development potential of primary indicators, the weights of logistics systems and infrastructure are 0.0753, 0.4778, and 0.4469. And then get the comprehensive score and average value of the e-commerce development level of 31 provinces in China from 2012 to 2017, as shown in Table 2. As can be seen from the table, the level of e-commerce development in most provinces is increasing year by year. In the 6-year average score of e-commerce development levels in 31 provinces and cities in China, Guangdong, Shandong, Jiangsu, and Zhejiang rank in the top four, and Tibet, Ningxia, Qinghai, and Hainan rank in the bottom four.

Table 2. E-commerce development scores of 31 provinces and cities in China

Province	2012	2013	2014	2015	2016	2017	Mean	Rank
Beijing	0.2580	0.2996	0.3546	0.4055	0.4454	0.4891	0.3754	6
Tianjin	0.1357	0.1452	0.1671	0.1925	0.2046	0.1861	0.1719	25
Hebei	0.2470	0.2712	0.2884	0.3006	0.3467	0.3327	0.2978	10
Shanxi	0.1602	0.1607	0.1754	0.1947	0.2146	0.2034	0.1848	24
Neimenggu	0.1946	0.1982	0.2181	0.2317	0.2680	0.2706	0.2302	16
Liaoning	0.2221	0.2456	0.2606	0.2737	0.2760	0.2643	0.2571	14
Jilin	0.1270	0.1275	0.1400	0.1570	0.1834	0.1871	0.1537	26
Heilongjiang	0.1940	0.2042	0.2196	0.2287	0.2526	0.2489	0.2247	17
Shanghai	0.2844	0.3032	0.3736	0.4150	0.3994	0.4164	0.3653	8
Jiangsu	0.3587	0.4281	0.4896	0.5325	0.5494	0.5652	0.4873	3
Zhejiang	0.2951	0.3690	0.3975	0.4580	0.4987	0.5096	0.4213	4
Anhui	0.1939	0.2114	0.2543	0.3086	0.3361	0.3394	0.2740	12
Fujian	0.2021	0.2177	0.2474	0.2861	0.3277	0.3392	0.2700	13
Jiangxi	0.1565	0.1499	0.1725	0.2168	0.2227	0.2317	0.1917	21
Shandong	0.3878	0.4260	0.4682	0.5133	0.6017	0.6460	0.5072	2
Henan	0.3021	0.3114	0.3417	0.3871	0.4402	0.4482	0.3718	7
Hubei	0.2673	0.2832	0.3154	0.3515	0.4035	0.4088	0.3383	9
Hunan	0.2467	0.2359	0.2658	0.2854	0.3274	0.3258	0.2812	11
Guangdong	0.4322	0.5469	0.5995	0.6743	0.7593	0.7757	0.6313	1
Guangxi	0.1488	0.1609	0.1878	0.2094	0.2522	0.2502	0.2016	20
Hainan	0.0436	0.0572	0.0816	0.1140	0.1334	0.1205	0.0917	28
Chongqing	0.1452	0.1497	0.1829	0.2142	0.2565	0.2673	0.2026	19
Sichuan	0.2653	0.2953	0.3471	0.3814	0.4672	0.4974	0.3756	5
Guizhou	0.1323	0.1353	0.1639	0.1920	0.2387	0.2484	0.1851	23
Yunnan	0.1864	0.1920	0.2253	0.2514	0.3036	0.3213	0.2467	15
Tibet	0.0332	0.0352	0.0621	0.0860	0.1161	0.0994	0.0720	31
Shanxi_	0.1654	0.1715	0.1974	0.2279	0.2733	0.2816	0.2195	18
Gansu	0.1115	0.1087	0.1379	0.1579	0.1861	0.1727	0.1458	27
Qinghai	0.0660	0.0611	0.0771	0.1023	0.1228	0.1155	0.0908	29
Ningxia	0.0504	0.0485	0.0681	0.0864	0.0997	0.0922	0.0742	30
Xinjiang	0.1444	0.1508	0.1756	0.1977	0.2083	0.2408	0.1863	22

This article refers to Wang Bin (2019) to divide China into five regions to observe the trends and differences in e-commerce development^[11]. As shown in Figure 1, it can be seen that the level of e-commerce development in the eastern region is higher and the growth rate is faster. The regional e-commerce development

level is second, but its growth rate is not as good as the southwestern region. Northeast China's e-commerce development ranks fourth with the smallest growth rate. The northwestern region has the lowest level of e-commerce development, but its growth rate is greater than that in the northeast. This is quite consistent with the actual situation. At the same time, this shows that the impact of the development level of e-commerce in various provinces and cities in China is multiple, laying a foundation for the analysis of the factors affecting the development level of e-commerce.

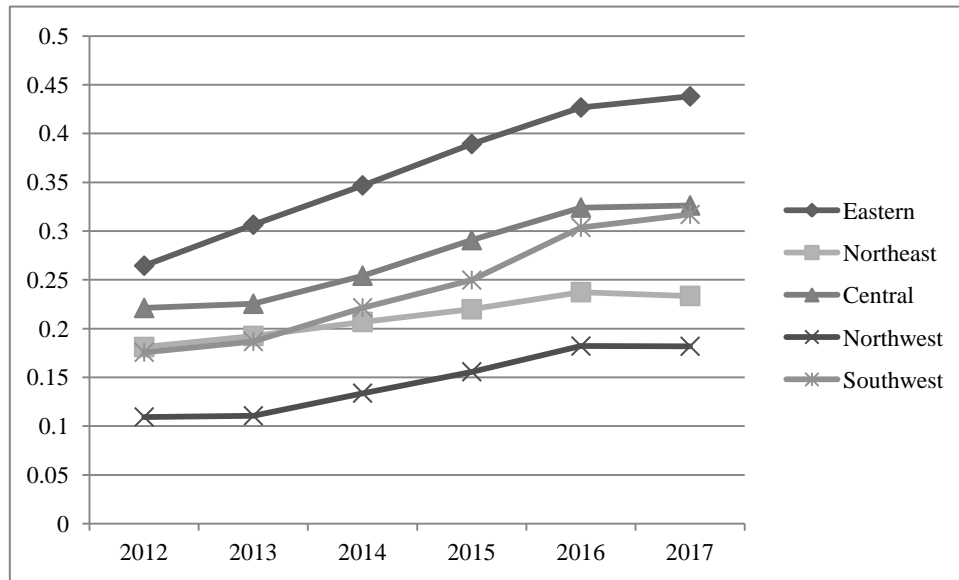


Figure 1. E-commerce development trends and differences in the five regions from 2013 to 2017

4. MODELS AND ESTIMATION METHODS

4.1 Propensity score matching DID model.

The common method for identifying policy effects is the double difference model DID. In order to study the impact of the “Belt and Road” initiative on the level of e-commerce development, the corresponding processing group and reference group were selected and processed using a double difference model. The basic idea is: take the 18 provinces and cities along the “Belt and Road” China as the processing group, and calculate the 13 levels of the e-commerce development level of the processing group before and after the implementation of the policy in order to refer to the 13 provinces and cities along the “Belt and Road” China. The difference is calculated at the same time, the difference of the e-commerce development level of the reference group before and after the implementation of the policy is calculated. Then the two differences are differentiated to eliminate the increment of time change. effect. The specific formula is as follows:

$$Y_{it} = \beta_0 + \beta_1 treated_{it} + \beta_2 time_{it} + \beta_3 treated_{it}time_{it} + \beta_4 X_{it} + \beta_5 \sum year_{it} + \varepsilon_{it} \quad (6)$$

Among them, the value of i is 0 or 1, when $i = 1$, it means that the provinces and cities along the “Belt and Road” in China, and $i = 0$ means that it is not the provinces and cities along the “Belt and Road” in China. The value of t is 0 or 1, $t = 1$ means after the policy is implemented, and $t = 0$ means before the policy is implemented. Y indicates the level of e-commerce development of the explained variable, $treated$ indicates the dummy variable of the policy implementation area, and $time$ indicates the dummy time variable of the policy. Because the policy has a delay effect, the time dummy variable is added to the year, and X indicates other control variables affecting the level of e-commerce development. ε represents a random interference term.

However, the use of DID must meet the assumptions of randomness and common trend, that is, the treatment group and the control group before and after the implementation of the policy have a common trend.

The “Belt and Road” initiative was proposed randomly. The specific time cannot be known before the proposal was made, so the randomness assumption is satisfied; however, the 18 provinces and cities along the “Belt and Road” in China are countries based on the Silk Road Economic Belt and 21st Century Maritime Silk. The macro-control of the road is determined and does not meet the randomness assumption. It can be seen from the above that the development of e-commerce in different provinces is quite different. Shanghai, Guangdong, and Zhejiang in the “21st Century Maritime Silk Road” have developed well, and are in line with Tibet, Ningxia, Qinghai, Hainan, Gansu, and Jilin in the northwest. It differs greatly from Xinjiang's development, so the assumption of common trends is not satisfied. The application of DID under the condition of not meeting the common trend will lead to the bias of selectivity, so this article finds a reference group similar to the level of e-commerce development in 18 provinces and cities through the matching of propensity scores, so that the processing group and the control group meet the assumption of the common trend, making the result more precise.

First, the tendency matching scores of the treatment group and the reference group are calculated by the Logit model. After obtaining the tendency scores, a balance test is performed, that is, the test tendency scores no longer have a significant difference between the treatment group and the reference group. Since it is difficult to find two provinces and cities with the same propensity score in reality, this paper uses propensity matching-k-nearest neighbor matching in calipers. The basic idea is that for processing group i , suppose i has N_i^C matching objects. If $j \in C(j)$, its weight is $W_{ij} = 1/N_i^C$, otherwise its weight is 0. For the treatment group with a total of N_t observation variables, the average treatment effect is:

$$ATT = 1/N_t \sum_{i \in t} Y_i^1 - 1/N_t \sum_{j \in t} w_j Y_j^C \quad (7)$$

Then, using the DID model, we obtain the changes in the level of e-commerce development of the processing group before and after the implementation of the “Belt and Road” initiative policy. $\Delta Y_t = \beta_2 + \beta_3$. $\Delta Y_0 = \beta_2$. $\Delta \Delta Y_t = \Delta Y_t - \Delta Y_0 = \beta_3$ is the net effect of the “Belt and Road” initiative policy on the level of e-commerce development in 18 provinces and cities along China's route. If β_3 is positive, it means that the “Belt and Road” initiative has promoted the level of e-commerce development in 18 provinces and cities along China.

4.2 Data source and processing.

Because the “Belt and Road” initiative was proposed in 2013, but the effect of the policy is generally delayed by one or two years, so this article uses 2015 as the first year after the policy is implemented. The treatment group and control group are divided into time and area. Four groups. This article refers to the research by Liu Xiaoyang (2018), Tang Yingwen (2015), Zhao Jianwei, etc. (2019) [5] [3] [6], and selects regional GDP, GDP per capita, end-users of fixed telephones, Internet users, and mobile phones Per capita disposable income of users and cities, GDP of the primary industry, GDP of the secondary industry, GDP of the tertiary industry, and GDP of the transportation industry were used as control variables. The data source is China Statistical Yearbook 2012-2017. Table 3 lists the variable names, data processing methods, and descriptive statistics.

Table 3. Variable descriptive statistics

Variable name	Variable meaning	Calculation	Mean	Standard Deviation
ecommerce	E-commerce development score	-	0.2621	0.1408
treated	Policy dummy	treated=0 1	-	-
time	Time dummy	time=0 1	-	-
did	Interaction term	treated*time	-	-
lngdp	GDP	GDP logarithmic	9.6790	0.9665

Variable name	Variable meaning	Calculation	Mean	Standard Deviation
lnpergdp	GDP per capita	GDP per capita logarithmic	10.7707	0.4114
gphone	Landline users	-	766.6392	599.3119
interuser	Internet user	-	790.2091	657.9114
yphone	Mobile phone users	-	4106.43	2893.454
inconme	Urban disposable income	-	28867.75	8365.897
findustry	GDP of primary industry	Primary industry / GDP ratio	0.0992	0.0503
sindustry	GDP of secondary industry	Secondary industry / GDP ratio	0.4442	0.0825
tindustry	GDP of tertiary industry	Tertiary industry / GDP ratio	0.4566	0.0925
tafindustry	GDP of transportation industry	Transportation industry / GDP ratio	0.0483	0.0146

Note: The score of e-commerce development level has been obtained above, which is dimensionless data. gphone, interuser, yphone, and income are standardized by Z-score. The mean and standard deviation in this table are before normalization, and the mean and standard deviation are all 0 and the standard deviation are 1.

5. ANALYSIS OF EMPIRICAL RESULTS

5.1 Propensity score matching and balance test.

This paper uses propensity score matching-k-nearest neighbor matching in calipers to make the treatment group and reference group comparable, and to overcome the bias of sample selection. First, treat was used as the explanatory variable, lngdp, lnpergdp, gphone, interuser, yphone, inconme, findus, sindustry, tindustry, and tafindustry were used as covariates. Logit model and stepwise regression were used to observe the significance of covariates. Table 4 shows. As can be seen from the table, lngdp, lnpergdp, gphone, interuser, yphone, inconme, findry, industry, and tafindustry have significant effects on treated. Among them, the coefficients of lnpergdp, gphone, interuser, yphone, inconme, findry, and industry are positive, which indicates that per capita GDP, fixed telephone users, Internet users, mobile phone users, disposable income of urban residents, and total production of primary industry Value and the GDP of the secondary industry have a significant positive effect on the "Belt and Road" initiative.

Table 4. Logit model estimation results

Variable name	Coefficient	Standard Deviation	t value	p value
lngdp	-18.7961***	3.1160	-6.03	0.000
lnpergdp	13.4507***	2.2680	5.93	0.000
gphone	4.0701***	0.9703	4.19	0.000
interuser	1.6100**	0.7071	2.28	0.023
yphone	2.2116***	0.8230	2.69	0.007
inconme	4.2112***	0.9358	4.50	0.000
findustry	125.2187***	21.2091	5.90	0.000
sindustry	37.0749***	7.1770	5.17	0.000
tafindustry	-78.7413***	25.9741	-3.03	0.002

Note: *** means significant at 1% level, ** means significant at 5% level, * means significant at 10% level. The tindustry variable is automatically deleted because of collinear regression.

Then check the variable matching effect and balance test, and find that tafindustry fails the balance test, so delete it. The matching effect and balance test of the remaining variables are shown in Table 5. As can be seen

from Table 5, only the control variables *lnpergdp*, *income* and *industry* satisfy the test of the treatment group and the reference group without significant difference before matching. After matching, except that *tafindustry* does not satisfy the treatment group and the reference group, there is no significant difference. Therefore, this paper deletes this control variable at this step. The remaining variables *lngdp*, *lnpergdp*, *gphone*, *interuser*, *yphone*, *inconme*, *findry*, and *industry* all meet the test of no significant difference between the treatment group and the reference group, and the *p* values are all greater than 0.1, indicating that the post-matching treatment group and the reference group meet the common trend assumption of double difference. . In addition to *lnpergdp*, the absolute values of the standard deviation of the remaining variables are all reduced by more than 50%. In addition, according to Rosenbaum and Rubin (1985), the absolute value of the standard deviation after matching needs to be less than 20% to achieve the matching effect^[12], it can be known from Table 5 that the absolute values of the standard deviations after the matching are all less than 15%, which indicates that the characteristics of the post-matching processing group and the reference group have been very close and passed the balance test.

Table 5. Variable matching effect and balance test

Variable	Sample	Mean		Standard deviation (%)	Absolute standard deviation reduction	t value	p value
		Treatment group	control group				
<i>lngdp</i>	Unmatched	9.3511	10.133	-92.0	89.4	-5.93	0.000
	matched	9.8937	9.7	9.7		0.77	0.446
<i>lnpergdp</i>	Unmatched	10.7560	10.7910	-8.2	11.1	-0.56	0.575
	matched	10.9150	10.9460	-7.3		-0.31	0.760
<i>gphone</i>	Unmatched	-0.1639	0.2270	-40.6	84.2	-2.67	0.008
	matched	-0.1185	-0.1804	6.4		0.32	0.750
<i>interuser</i>	Unmatched	-0.2374	0.3287	-58.6	79.7	-3.96	0.000
	matched	-0.0825	-0.1976	11.9		0.60	0.550
<i>yphone</i>	Unmatched	-0.2309	0.3197	-58.5	87.8	-3.84	0.000
	matched	-0.1082	-0.1753	7.1		0.43	0.671
<i>inconme</i>	Unmatched	-0.0312	0.0432	-7.4	57.8	-0.50	0.618
	matched	0.2608	0.2294	3.1		0.15	0.881
<i>findustry</i>	Unmatched	0.1065	0.0891	35.8	86.2	2.36	0.019
	matched	0.0891	0.0867	5.0		0.20	0.844
<i>sindustry</i>	Unmatched	0.4370	0.4541	-20.7	73.7	-1.40	0.164
	matched	0.4491	0.4446	5.4		0.26	0.793

5.2 DID model.

After matching, double-difference model regression was performed, with *ecommerce* as the explanatory variable, *did*, *treated*, *time*, control variable set *X*, and *year* as the explanatory variables. The mixed panel regression was performed. The results are shown in Table 6. As can be seen from Table 6, the coefficient of *did* is 0.0171 (*p* = 0.007), which is significant at the level of 1%, which also shows that the “Belt and Road” initiative has significantly promoted the level of e-commerce development in 18 provinces and cities along China, with a promotion effect of 1.71% . Among other control variables, the GDP per capita, Internet users, mobile phone users, and per capita disposable income of cities and towns can also significantly positively affect the level of e-commerce development. Increasing the per capita disposable income of cities and towns promotes the vigorous development of e-commerce.

Table 6. Regression results of the double difference model after matching

Variable	Coefficient	Standard Deviation	t value	p value
did	0.0171***	0.0063	2.72	0.007
time	-0.0947***	0.0293	-3.23	0.002
lngdp	0.3625**	0.1569	2.31	0.022
lnpergdp	-0.2353	0.1586	-1.48	0.140
gphone	-0.0178	0.0113	-1.58	0.115
interuser	0.0407***	0.0078	5.23	0.000
yphone	0.0933***	0.0186	5.01	0.000
incomme	0.0514***	0.0100	5.15	0.000
findustry	0.2079	0.2450	0.85	0.398
sindustry	-0.0752	0.1181	-0.64	0.525
2013.year	-0.0235***	0.0073	-3.24	0.001
2014.year.	-0.0311**	0.0128	-2.43	0.016
2015.year	0.0487***	0.0119	4.08	0.000
2016.year	0.0422***	0.0074	5.70	0.000
_cons	-0.6627	0.4160	-1.59	0.113

$$N = 186, R^2 = 0.7619, F(14,141) = 96.03, p = 0.000$$

Note: *** means significant at 1% level, ** means significant at 5% level, * means significant at 10% level. The treated and 2017.year variables are automatically deleted due to collinear regression.

6. CONCLUSIONS AND RECOMMENDATIONS

In this paper, from the three dimensions of development potential, logistics system and infrastructure, an e-commerce development level indicator system with three first-level indicators and 12 second-level indicators has been established. The city's e-commerce development level is measured. Since then, we have analyzed the impact of the “Belt and Road” initiative on the level of e-commerce development in 18 provinces and cities along China's borders using the propensity score matching double difference method (PSM-DID). Draw the following conclusions and recommendations:

First, China's e-commerce development level is extremely uneven. Among them, the development of the provinces is uneven, and the levels of e-commerce development in Guangdong, Shandong, Jiangsu, and Zhejiang are relatively good. The levels of e-commerce development in Tibet, Ningxia, Qinghai, and Hainan are relatively poor. And the growth rate is relatively fast. The development level of e-commerce in the western region is lower, but the growth rate is slower. Therefore, the development of e-commerce should focus on regional coordination, and adjust such imbalances through policies, so that areas with better development can lead to areas with poor development, and achieve a synergy effect.

Second, per capita GDP, fixed telephone users, Internet users, mobile phone users, urban per capita disposable income, GDP of the primary industry, and GDP of the secondary industry have a significant positive effect on the Belt and Road Initiative. . Therefore, the implementation of the “Belt and Road” policy can be promoted by improving the national economy, Internet development and informatization.

Third, the “Belt and Road” initiative can significantly promote the level of e-commerce development in 18 provinces and cities along the Chinese route, with a promotion effect of 1.71%. Therefore, China should pay attention to the implementation effect and conversion efficiency of the “Belt and Road” policy, evaluate the development of provinces and cities along the route, and improve the contribution of the “Belt and Road” policy

to the level of e-commerce development. And the GDP, mobile phone users, Internet users, and urban per capita disposable income can significantly promote the level of e-commerce development. This shows that the national economy, Internet development and informatization are also important factors affecting the development of e-commerce. Therefore, it is possible to promote the vigorous development of e-commerce by increasing regional GDP, increasing mobile phone users and Internet users, and increasing per capita disposable income in cities and towns.

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The influence of Product Photo display on Purchase intention in Cross-border E-commerce

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Abstract: Nowadays, cross-border e-commerce (CBEC) has become an important channel for promoting international trade. There are many factors that influence consumer participation in CBEC, including the display of product images in the product search list. Excellent and appropriate product photo display can not only attract more consumers, but also stimulate consumers' willingness to buy. However, few studies have focused on the specific elements that should be included in a product photo in a CBEC setting. Based on cue utilization theory and ELM model, this study constructs a research model of consumer purchase intention under the background of CBEC from the perspective of task-relevant cues and affection-relevant cues. In addition, we explore the choice pattern of customers during online shopping by using the decision tree model, and then investigate the influence of specific elements in product photo on sales volume by using hierarchical regression. The data will be obtained from a well-known CBEC platform in China, using clothing products as key words to gather the three factors that consumers will normally first encounter in the search results: the price of goods, number of orders, and a photo of the merchandise. Results will have important theoretical and practical implications for CBEC researchers and practitioners.

Keywords: cross-border e-commerce , product photo display, purchase intention, elm model, cue utilization theory

1. INTRODUCTION

Cross-border e-commerce (CBEC) has become an important channel for promoting international trade. It provides opportunities to both developing and developed countries to achieve benefits from global transactions^[1]. In 2018, the total amount of CBEC transactions worldwide reached 13 trillion yuan. Van Heel^[2] predict that by 2025, annual global cross-border e-commerce revenues will be between 250 and 350 billion US dollars, with China and other Asia countries accounting for 40% of this total amount. In China, there were over 5,000 CBEC platforms, and more than 200,000 enterprises involved in CBEC through various platforms, by 2020, the growth rate of cross-border e-commerce is expected to be twice that of domestic e-commerce^[3]. The CBEC platform has been booming all over the world. Therefore, many e-commerce companies attach importance to cross-border e-commerce (CBMC).

How to attract consumers' attention and stimulate consumers to buy is a constant topic for sellers^[4]. Usually, when customers search for products on the e-commerce platform, the first thing that enters the consumer's field of vision is the pictures of various products in the product search list. Online images are commonly used as a visual clue to draw consumer's visual attention to enhance their perception of product understanding, which plays an important role in consumers' purchasing decisions^[5]. Therefore, how to effectively design product display pictures and make clear the impact of the specific attributes in the product photo on the sales should become the focus of CBEC platform sellers. An effective product picture display will produce the following two results. First of all, reflect the online store differentiated marketing strategy, with its unique characteristics to attract potential customers. Secondly, it will be easier for customers to find their favorite products faster and better according to their cultural background and behavior habits. Therefore, pictures of goods with appropriate content can break down barriers and shorten distance between buyers and sellers, which will be more likely to lead to positive outcomes^[6].

So far, academic research on CBEC mainly focuses on the field of goods transportation^[7], commodity after-sales service^[8] and cross-border payment^[9]. Few studies have involved the display of product photos on CBEC. On CBEC platform, the appropriate product picture display involves three fields: marketing, consumer psychology and information system. This is because product information has a potential impact on consumers' purchasing decisions. Our study attempts to address this research gap by investigating the following two key research questions.

1. In cross-border e-commerce, do the specific attributes in the product photos affect the purchase intention of consumers from different regions?
2. In cross-border e-commerce, in order to increase the purchase intention of consumers in different countries and regions, which attributes should be highlighted in the product photos?

Based on this, this study takes the product photos in the commodity search list as the research object, combines the cue utilization theory and the ELM model, divides the decision-making cues provided by commodity pictures to consumers into Task-relevant Cues and Affection-relevant cues, and uses the central route and peripheral route of the ELM model to analyze the impact of the information displayed by these two types of cues on consumers' purchase intention. The anticipated contribution of this study is that based on this research model, we can analyze whether the specific elements contained in product photos will affect consumers' willingness to buy in CBEC. At the same time, in order to improve the sales performance of sellers from different regions on CBEC platform, two different theories are combined to help sellers optimize the specific attributes that should be included in the product photo so as to attract more buyers, and help CBEC researchers understand the importance of appropriate product picture display.

The remainder of this paper is organized as follows. First, we review the literature related to purchase intention in CBEC. Second, we propose a research model and hypotheses based on the theoretical foundations found in the literature. Third, we describe the research methodology. Finally, we present the implications and further research directions.

2. PRIOR LITERATURE AND THEORETICAL FOUNDATION

2.1 Purchase intention in CBEC

Since 2000, research on consumers' purchasing intention has been started in the field of electronic commerce, such as Wu K^[10] pointed out that in the online market environment, how to be selected by consumers in the list of search results is extremely important for sellers. Gu^[11] found that the sales volume and low price of products positively affect the customer's purchase intention when exploring the influencing factors of the customer's purchase intention in online shopping. And when the web design is not exquisite, the customer's purchase intention will be significantly reduced. Gefen^[12] proved that trust has a significant positive effect on purchase intention. Zhou et al.^[13] proved that perceived risk reduces consumers' willingness to buy.

With the increasing popularity and rapid development of CBEC, scholars have begun to consider new factors that affect consumers' purchase intention in CBEC. For example, Hsiao et al.^[14] uses partial least squares and designs a text mining tool to analyze the key factors that affect consumers' satisfaction with cross-border logistics services. Han^[15] uses a research model to analyze the factors that affect consumers' purchase intention in CBEC, and finds that consumer information has a positive impact on consumers' purchase intention. Wenlong^[16] constructed a three-stage model to assess consumers' purchase intention in CBEC. The results show that product description and product awareness have a positive impact on trust belief, while platform lasting participation and platform situational participation have a positive impact on trust. The purchase intention is subject to the positive impact of platform situational involvement.

By reviewing the literature related to purchase intention of CBEC, we find that there are more researches in

the field of domestic e-commerce than CBEC, and more importantly, there is less research on the impact of specific attributes in product photos on purchase intention. Therefore, we decided to study the impact of product photos on consumers' purchasing behavior in the CBEC context. The study contributes to the extant literature in the following two aspects. First of all, based on the cue utilization theory, in the aspect of product photos display on the CBEC platform, we explore consumers' perception of goods from two perspectives: task-relevant cues and affection-relevant cues. Secondly, based on ELM model, we propose the influence of specific elements in product photos on consumers' purchase intention according to the difference in information processing degree between people's central route and peripheral route. As prior research has shown that sales are impacted by product prices and orders^{[17][18]}, this study also takes these two confounding factors into consideration.

2.2 Cue utilization theory

Eroglu^[19] proposed Clue utilization theory applicable to e-commerce environment, which defined stimulus as "all the clues that online consumers can see or hear", and divided online product display cues into two types: task-relevant cues and affection-relevant cues. Task-relevant cues refer to "all descriptions to promote consumers to complete shopping goals". They are functional clues that are oriented to effectively complete consumers' shopping tasks and can provide consumers with information supporting task decision-making. And affection-relevant cues are very important to create an environment for consumers' shopping experience, enhance user experience and create a pleasant shopping atmosphere, improve consumers' mood and awaken consumers' attention, so as to form a good shopping experience, which is relatively secondary to promote consumers to achieve their shopping goals.

This study believes that the product photos on the CBEC platform also contain the above two clues. The task-relevant clues of product photos refer to the information contained in the picture that can promote consumers' understanding of the goods, such as the brand of the goods and the specific attributes of the goods, such as the fabric and size of clothing. Emotion-related clues of commodity pictures refer to the aesthetic feeling and visual attraction of commodity pictures. By attracting the attention of consumers, they can generate pleasant experience of browsing pictures, arouse the positive emotions of consumers, and thus stimulate the desire for shopping. On the CBEC platform, models can be divided into two situations: fully showing their faces and not fully showing their faces. Therefore, we take the product photos containing models as emotional clues, believing that they can increase consumers' purchasing intention.

2.3 ELM model

ELM model is an effective tool to analyze online user information processing and decision-making process. The model holds that individuals will process information through the central route and peripheral route respectively because of the different motivation and ability of information processing. The central path means that when an individual has the motivation and ability to focus on information, he or she carefully thinks about persuasive information and forms an attitude of approval or disapproval. Peripheral route means that individuals are unwilling or do not have the ability to think carefully, but are influenced by peripheral clues to form corresponding attitudes. In the center path and peripheral path, the most common components are the quality and source of information^[20]. Based on the central path and peripheral path of the ELM model, this study specifically analyzed the influence mechanism of the specific element information in the product pictures of online stores on customers' purchase intention according to the difference of the transmission mode of information quality.

3. HYPOTHESIS AND RESEARCH MODEL

3.1 Influence of task-relevant clues on consumers' purchase intention

In the process of completing the shopping, consumers can use the information of Task-relevant clues to judge the quality of the product. On CBEC platforms, logo is one of the most important brand elements of a product. It can convey the brand image and attract consumers' attention, affect consumer's attitude and "brand attachment", and help consumers understand product information^[21]. The source of information is a common clue of the peripheral route of ELM model. When the customer thinks that the source of the information is more reliable, the more likely the customer is to be persuaded to accept the information. In the CBEC context, commodity brands come from all over the world, customers are relatively unfamiliar with brand information, and they will have some doubts about the source of product information. Therefore, customers will deal with product information more through the peripheral route. Therefore, we hypothesize as follows:

H1a: In the CBEC context, by controlling the price and the quantity of orders, a product photo containing a brand logo has a certain positive impact on the consumers' purchase intention.

The attribute information of goods, such as product size and material, are the main variables for consumers to evaluate products and make purchase decisions. In the context of e-commerce, the display of commodity information helps customers understand and believe the quality and performance of products sold online. From the perspective of signal theory, Braddy^[22] found that when consumers are not directly exposed to a product, they usually derive inferences from the available signals to form cognitive perceptions. In other words, knowing the attribute information of goods can eliminate consumers' uncertainty about online goods. According to the central path of the ELM model, information quality is an important factor affecting individual information processing and attitude formation. The higher the quality of the product description, the higher the consumers' psychological acceptance of the product. In this case, consumers will have more psychological activities related to the product, including purchase intention. Therefore, we propose the following hypothesis:

H1b: In the CBEC context, by controlling the price and the quantity of orders, a product photo contains commodity attribute has a significant positive impact on consumers' purchasing intention.

3.2 Influence of affection-relevant cues on consumers' purchase intention

Affection-relevant cues indirectly promote the realization of shopping goals by improving consumers' shopping experience. In the CBEC context, despite consumers' different cultural backgrounds, visual attractiveness has a similar impact on consumers' psychological perception and behavior intention^[23]. Existing literature shows that product displays with higher visual appeal can attract consumers' attention and provide more information clues.

In the online shopping environment, because customers are unable to try on clothes, models wearing goods in product photos become an important signal affecting consumers' perception. When the cognitive experience is weakened, knowing "someone is shopping for me (represented by the model)" can produce a sense of social presence, generating trust and pleasure, leading to the ultimate purchase behavior. On CBEC platforms, models displaying goods can be divided into two categories, one is those who fully show their faces, and the other is those who do not fully show their faces. According to the ELM model, the more vivid and attractive the product description, the better the consumer's understanding of the product. Therefore, we assume that:

H2a: In the CBEC context, by controlling the price and the quantity of orders, the product photos contain models with full faces, which has a significant positive impact on consumers' purchase intention.

H2b: In the CBEC context, by controlling the price and the quantity of orders, the product photos contain models with incomplete faces, which has a certain positive impact on consumers' purchase intention.

3.3 Moderating effect of knowledge heterogeneity on consumers' purchase intention

In the study of consumer behavior, knowledge heterogeneity plays an important role in explaining consumer decisions and responses to products. Knowledge heterogeneity is an important dimension of cognitive structure, which reflects that individuals have different characteristics in knowledge structure, knowledge type, knowledge content and knowledge level^[24]. Due to the difference of individual cognitive level, some studies show that the information conveyed by the picture belongs to weak information relative to the text content, it can not be denied that the picture can still convey different degrees of stimulating shopping information to the individual, which will eventually affect the purchase intention of consumers^[25]. Therefore, this paper proposes:

H3a: Knowledge heterogeneity plays a positive moderating role in the influence of logo information contained in product photos on consumers' purchase intention.

H3b: Knowledge heterogeneity plays a positive moderating role in the influence of product photos including product attribute information on consumers' purchase intention.

H3c: Knowledge heterogeneity plays a positive moderating role in the influence of product photos contain models with full face on consumers' purchase intention.

H3d: Knowledge heterogeneity plays a positive moderating role in the influence of product photos contain models with incomplete faces on consumers' purchase intention.

The model of this paper is shown in Figure 1.

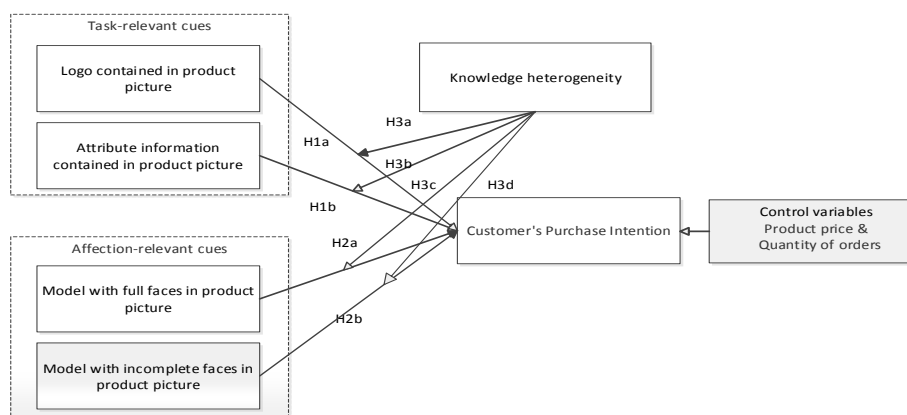


Figure 1. The research model

4. METHODOLOGY

The data will be obtained from a well-known CBEC platform in China. DHGate.com, is the first online platform to provide B2B cross-border transactions for China's small and medium-sized enterprises. According to PayPal data, in 2013, DHGate.com was the number one online foreign trade platform in Asia Pacific and the sixth in the world. DHGate.com has 19 million registered buyers from 222 countries and regions around the world, and the platform is authoritative and representative.

This study will take clothing (jacket) as an example to analyze the impact of specific attributes in product photos on consumers' purchase intention. Firstly, enter keywords on the CBEC platform to search, and then obtain the product photos of the search results page through the web crawler as the data sample of this study. Then identify the specific elements in the picture through deep learning, that is, whether the picture contains product logo; whether it contains attributes such as product size and material, and whether it includes models who fully show their faces and models who do not fully show their faces. After the data collection is completed, the characteristic matrix is formed and input into the decision tree machine learning model to verify the research hypothesis from the perspectives of information gain and regression coefficient.

In this study, the C5.0 algorithm in SPSS Modeler14 is used to model the discretized trading volume through six variables: the discretized price, the quantity of the order and whether the marked picture contains logo, whether it contains the basic attributes of the commodity, whether it includes the model that fully shows the face and the model that does not fully show the face. The results are shown in figure 2. And the main rules of the decision tree model for commodity sales are shown in Table 1.

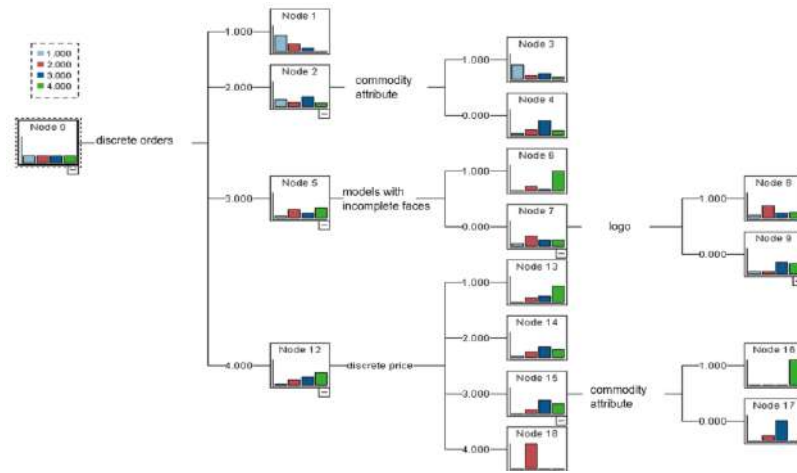


Figure 2. Decision tree model of commodity sales

Table 1. Main rules for the decision tree model of commodity sales

Rules	
1	$\text{count}(d_vol \geq 3 d_orders = 4 \wedge d_price \leq 2) > \text{count}(d_vol \geq 3 d_orders = 4 \wedge d_price \geq 3)$
2	$\text{count}(d_vol \geq 3 d_orders = 3 \wedge Vif = 1) < \text{count}(d_vol \geq 3 d_orders = 3 \wedge Vif = 0)$
3	$\text{count}(d_vol \geq 3 d_orders = 4 \wedge d_price = 3 \wedge Va = 1) < \text{count}(d_vol \geq 3 d_orders = 4 \wedge d_price = 3 \wedge Va = 0)$
4	$\text{count}(d_vol \geq 3 d_orders = 3 \wedge Vif = 0 \wedge VI = 1) > \text{count}(d_vol \geq 3 d_orders = 3 \wedge Vif = 0 \wedge VI = 0)$

Note: count is a count function, d_vol, d_orders, and d_prc are the discrete monthly sales, the quantity of the order, and prices, respectively. Vif refers that the product photo contains the model that does not fully show the face. Va refers that the product photo contains the basic attributes of the Commodity.

From the above results, in the context of cross-border e-commerce, consumers from different regions pay more attention to the number of commodity orders in the product search results list. When the number of orders is basically the same, those with lower prices are more likely to get high sales (as shown in Rule 1 of Table 1); when there are models in the product photos, customers prefer to include incomplete models in the pictures (as shown in Rule 2 of Table 1). When the commodity price is basically the same, the commodity picture does not contain the basic attribute information of the commodity can get better sales than the basic attribute information in the commodity picture (as shown in Rule 3 of Table 1). When the commodity picture contains logo information, it can get higher sales than not including logo information (as shown in Rule 4 of Table 1).

5. CONCLUSIONS

In this study, we propose a research model based on the ELM model and Cue utilization theory to study the impact of product photos display on consumers' purchase intention in the CBEC context. Our study can make both theoretical and practical contributions. Theoretically, this study enriches the theoretical research of picture information in online marketing and deepens the influence mechanism of picture information on customers'

online consumption behavior. Firstly, based on the Clue utilization theory, we divide the information conveyed by commodity pictures into task-relevant cues and affection-relevant cues. Secondly, this study uses the central route and peripheral route of the ELM model to explain the information processing process when customers face online merchandise photos, and to explore the impact of specific elements of product photos on customers' purchase intention in the CBEC context. Practically, this study provides practical suggestions for the development of marketing strategies, which can help online sellers optimize product photos design to attract more buyers and create more profits on the CBEC platform, and help CBEC researchers to further understand the importance of product photos in sales.

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Analysis of Influencing Factors of Tablet Consumer Satisfaction

Based on Online Comment Mining

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Abstract: How to extract effective information that affects consumer satisfaction from online comments has become a hot issue for customer behavior. This article is based on the data mining of online comments and the research object are the top-selling tablets on the JD platform from October to December 2018. We started by analyzing influential factors such as goods, after-sales service, and logistics, and crawled online review information of nearly 3,000 tablet computers from five major brands. We first use the jieba word segmentation tool to process the user comments, and use TF-IDF to calculate the frequency of different words in the comments to determine the main keywords of the comments. Secondly, we set up a user's sentiment dictionary to determine the sentiment index of the review, and combined the keywords and sentiment index to get the degree of consumer satisfaction on different influencing factors. Finally, we imported the quantified characteristic factors into Clementine 12.0, and established a Bayesian network model of customer satisfaction, thereby obtaining a ranking table of the importance of each factor to product sales. To improve the model robustness, we adopt a multivariate linear model to check the accuracy of the output results. Our research can not only formulate effective product service sales strategies for merchants, but also guarantee customers to experience better products and services.

Keywords: online comments, consumer satisfaction, sentiment dictionary, TF-IDF

1. INTRODUCTION

According to the "China E-Commerce Report 2018" issued by the Ministry of Commerce of 2019, the number of Internet customers who use the Internet for shopping and consumption in China has reached 569 million, an increase of 5.7% compared to 2017 and accounting for 71% of the total number of Internet customers. The number of mobile online shopping customers reached 557 million, an increase of 12% compared to 2017 ^[1]. Driven by factors such as new retail formats and capital markets, the online retail development index in the first quarter of 2018 maintained a relatively stable development trend.

The above data indicates that more consumers will choose to online shopping. However, due to the time difference between the online and offline B2C business models and the asynchronous nature of the information, customers cannot distinguish the authenticity of the product information described by the seller, and can only rely on the sellers' product descriptions, other customers' post-purchase evaluations, and their own judgments. The online post-purchase comment mechanism of the B2C online shopping platform can provide customers with strong protections and effective solutions of information asymmetry in the development of the digital economy ^[2]. Online comments are not only an effective feedback method for measuring product sales, but also an important method for customers satisfaction feedback of e-commerce companies and their products or services ^[3].

In summary, mining product-related quality information or merchant service information from online comments of consumers can effectively measure consumer satisfaction with different aspects of the product and improve product services.

In this research, we use python to crawl the online comment data of five major brands of tablets which have higher sales on JD.com in 2018. The initial data crawled 3087, and the final retained 2912 data. Then we

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use jieba word segmentation package and TF-IDF method to quantify online comment data. We attribute factors that affect tablet customer satisfaction into ten aspects to build a corpus of attribute features. By regarding the ten quantified factors as input variables, and customer ratings as output variables, we establish Bayesian network models to test the correlation between online comment content and online customers satisfaction reflected in online comments during consumer purchasing decisions.

2. LITERATURE REVIEW

Many foreign scholars have done many studies on consumer comment mining from different aspects. Some scholars have researched from the perspective of comment content. Kim S et al. ^[4] used the SVM regression analysis method to evaluate the usefulness of comments from the aspects of comment structure, vocabulary, syntax, semantics and metadata. Chevalier et al. ^[5] analyzed the emotional expression of the text in the comment information, and found that online comments exerted influence on customers' perception of online comments. Moghaddam ^[6] proposed the problem of predicting the quality of online comments of personalized features, and established a complex probability map model based on matrix factorization and variable factorization. Other scholars have analyzed the impact of online comments on the shopping environment. Adomavicius ^[7] obtained the customer's true shopping experience by scoring the characteristic attributes of the product and built a customer preference model to analyze the customer's preference characteristics. Dwikesumasari et al. ^[8] used regression analysis to explore the impact of the functions, innovations, and consumer inertia of travel apps on customer satisfaction.

The domestic academic scholars also make many studies on the issue of online comments. Hao ^[9] found that more positive emotional expressions and longer comment lengths have a prominent positive impact on the usefulness of comments. Li et al. ^[10] analyzed the content of online comments, and believed that online comments are the most direct real feedback and needs of customers for products and services. Yan et al. ^[11] found that the length of comments had a significant impact on the sales of non-hot brands.

In addition, many scholars have analyzed online comments from the perspective of customer satisfaction. Cheng ^[12] built a TAM model to conduct an empirical analysis of the main factors affecting customer satisfaction with online shopping, and solved the two key factors of perceived usefulness and safety. Li ^[13] research shows that the number of customer evaluations, the level of product sales, and the evaluation time have a positive correlation with customer satisfaction, but the tendency of positive and negative emotions is difficult to affect customer satisfaction. Lu et al. ^[14] constructed a gray evaluation model of customer satisfaction, and established customer online comments based on product and object satisfaction evaluation indicators. Wang ^[15] analyzed the satisfaction degree of each attribute concerned by App usage from the perspective of customer comments through the VIKOR multi-attribute decision-making method.

Many scholars started with sentiment analysis of online comments for customer satisfaction. Shi Wei et al. ^[16] proposed an emotional computing method from sentence level to document level based on the established fuzzy emotional ontology to calculate the sentiment tendency of Chinese online reviews. Wang et al. ^[17] based on HowNet semantic similarity polarity calculation method and adverb the magnitude division method analyzes the sentiment polarity and intensity of online comments.

In general, the current research on online reviews mainly focuses on the content mining of online reviews themselves, the impact on product sales, and the impact on other users and consumers' purchasing decisions. Many studies by scholars at domestic and abroad show that online product reviews have a very significant positive impact on product sales and user satisfaction.

3. METHODOLOGY

We crawl customers' online comments through using the jieba word segmentation tool to perform Chinese word segmentation on the customer's online comments, which are text segmented. The stop words are removed according to the stop word list to avoid irrelevant vocabulary interference. Cut online customer comments into vocabularies to form bags of words. Then we establish a corpus that can describe the factors affecting consumer satisfaction in terms of different aspects of the product. The TF-IDF method is used to traverse the bag of words, record the words and their weights in the bag of words, and obtain the characteristics of the factors affecting customer satisfaction of online comments texts vector. Based on the word frequency and weight in the customer's online comments, determine the comment keywords involved in the comment. The keywords are compared with the corpus of consumer satisfaction influencing factors to determine the product influencing factors in this comment. Moreover, we create an emotional vocabulary that can describe the factors affecting consumer satisfaction of product characteristics. Then we form an emotional dictionary that can describe consumer satisfaction by using machine learning method to obtain new customer satisfaction emotional words. The sentiment dictionary is used to perform sentiment calculation on the text content of online comments to judge its sentiment tendency and degree, and obtain the customer satisfaction sentiment index of the influencing factors. According to the customer's sentiment index, determine the customer's satisfaction with this aspect of the product.

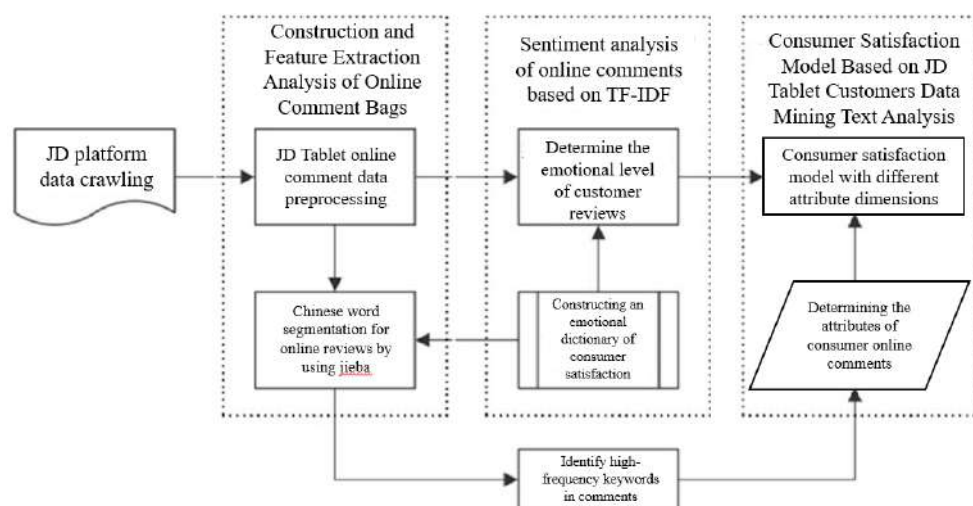


Figure 1. Research framework

We regard the total star rating of the consumer as the dependent variable and ten aspects of the influencing factors as independent variables. We establish the Bayesian network model to analyze the factors affecting the consumer satisfaction of this type of product.

4. RESEARCH CONTEXT

4.1 Data collection

We use python to crawl the customer's online comment data about major brands' tablets on the JD platform and finally chose Online comment data of 5 high-selling tablets including Lenovo Miix 520, ipad 2018, Xiaomi 4, Honor Water play and Microsoft Surface Pro6 from October 2018 to January 2019.

Online comments also contain a lot of redundant information, which does not rule out comments that merchants scramble for sales or comments that are maliciously discredited by competitors. This information will affect the customer's emotions and cause deviations in shopping decisions. For invalid or malicious information, it is eliminated in the comment data acquisition stage to avoid affecting the final result. Finally, we crawl 3087 pieces of initial data and retain 2912 pieces of filtered data. On this basis, we carry out a text

analysis and summarize the high-frequency words for each tablet. We extract and retrieve the high-frequency words of each product in the database and count the occurrences.

Table 1. Overall data description

product name	Praise degree	Praise	Average	Bad comment	Crawls number
Lenovo Miix 520	98%	15,000+	100+	100+	492
ipad 2018	99%	780,000+	2700+	4200+	862
Xiaomi 4	99%	91,000+	300+	300+	969
Honor Water play	99%	43,000+	100+	100+	490
surface pro5	99%	42,000+	100+	200+	274

4.2 Data quantization

Although some feature information of the tablet has been summarized in online comments by customers, some of the features of these frequently-occurring data information are redundant and repeated, and the product features expressed by many keywords are semantically close. And there may be some keywords with the emotional characteristics of the commenter. Simply extracting the keywords will weaken their emotional characteristics to some extent. Therefore, we need to further summarize the synonyms, based on the analysis and summary of the factors affecting customer satisfaction, the above high-frequency words are grouped into 10 categories, respectively: logistics, price, appearance, physical attributes, models, Operation, battery, picture quality, sound quality, and merchants. These factors are important feedback that customers will refer to when making a tablet purchase. This information may affect customer satisfaction more or less. we use TF-IDF method to count the word frequency of keywords in each category

Table 2. Variable setting

variable	Meaning	Key words
Logistics _i	Customer i 's satisfaction with the product logistics	Logistics, courier, packaging, delivery
Price _i	Customer i 's satisfaction with the price of the product	Cost-effective, price, cheap, expensive
Exterior _i	Customer i 's satisfaction with the appearance of the product	Appearance, beauty, workmanship, grade, compact
property _i	Customer i 's satisfaction with the physical property	Weight, thin, light, size
Model _i	Customer i 's satisfaction with the product appearance	Screen, feel, portable, buttons, comfortable
Operation _i	Customer i 's satisfaction with the operation of the product	fever, stable, smooth, fast, sensitive, system, simple,
Battery quality _i	Customer i 's satisfaction with the product's battery life	Endurance, durability, charging
Picture quality _i	Customer i 's satisfaction with the quality of the product	Clear, pixel, picture quality, resolution
Sound quality _i	Customer i 's satisfaction with the sound quality	Sound quality, noise
Services _i	Customer i 's satisfaction with this product merchant service	After sales, service, customer service

Based on online comment data, customers express their emotions with adjectives when expressing their satisfaction. Words such as "very", "special", "very" all express the customer's inner satisfaction to a certain extent. We establish a sentiment dictionary for customer comments and use TF-IDF method to calculate the word frequency and weight. Different thresholds are set for different scores. This scores ten factors for each comment.

$$Y_{rank_i} = X_{Logistics_i} + X_{Price_i} + X_{Exterior_i} + X_{Physical_i} + X_{Model_i} + X_{Operation_i} + X_{Battery_i} + X_{Picture_i} + X_{Sound_i} + X_{Services_i} \quad (1)$$

According to the scoring table established above, each variable can be quantified and scored by comparing each comment information. In the scoring process, the scoring is based on the emotional tendency of the modifiers. It should be noted that the Chinese words have corresponding synonyms, such as very beautiful and beautiful, so the

corresponding synonyms are converted during the quantification process. For the scores of variable factors that do not appear in the comment information, this article is uniformly identified as 3 points, that is, the emotional color of this variable is average. The figures obtained after the above rules serve as the data for this characteristic factor. At the same time, each comment of JD has an overall score, which has been collected at the time of data collection. The overall score represents the overall customer satisfaction with the purchase, so this score is used as the overall customer satisfaction score for this purchase. Quantify all the data and strictly follow the scoring rules in the processing process to obtain online comment quantification data for analyzing product sales.

5. MODEL RESULTS ANALYSIS

5.1 Results

The processed data was imported into Clementine 12.0 software. After removing invalid content such as member name and comment content, the evaluation star was used as the output variable, and ten factors were used as the input variable. By calculating the importance ranking of each characteristic factor and the conditional probability of each node output by the model.

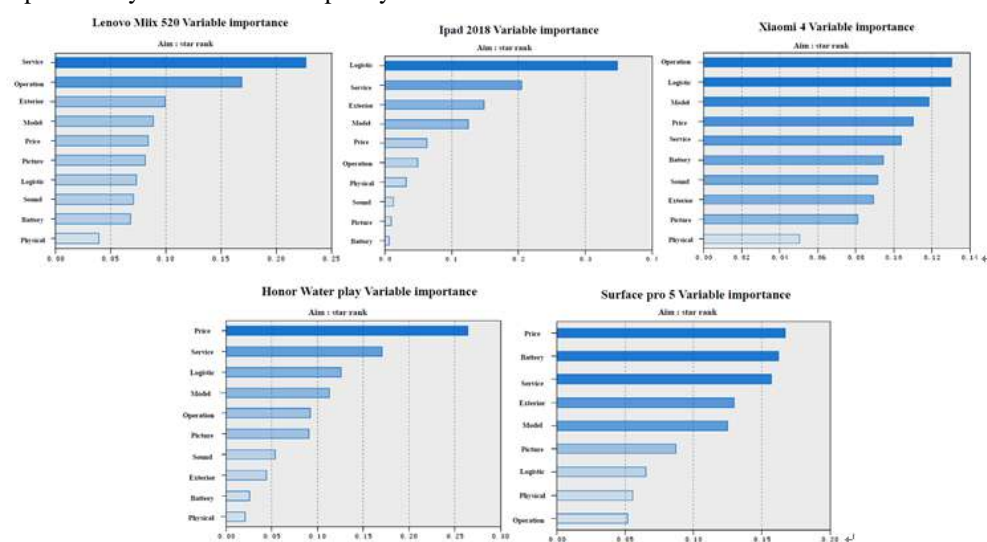


Figure 2. Research output

According to the results of the Bayesian network model, we can see the importance and ranking of ten characteristic factors. The more important the ranking of the characteristic factors, the more it can affect the sales of the product. The importance of the ten characteristics of the five major brands is shown in the following table.

Table 3. Variable importance coefficient output

Independent variable	Lenovo Miix 520	ipad 2018	Xiaomi 4	Honor Water play	surface pro5
Logistics	0.0732	0.348	0.1301	0.08	0.0654
Price	0.0839	0.063	0.1101	0	0.1437
Exterior	0.0992	0.148	0.0894	0.095	0.1204
Physical property	0.0394	0.032	0.0504	0.114	0.0514
Model	0.0885	0.125	0.1184	0.281	0.1203
operation	0.169	0.049	0.1304	0.325	0.0495
Battery quality	0.0681	0.006	0.0946	0.025	0.1565
Picture quality	0.0817	0.01	0.0811	0	0.1184
Sound quality	0.0704	0.013	0.0916	0.043	0.0197
Services	0.2267	0.205	0.1039	0.036	0.1548

5.2 Test of accuracy evaluation

According to the results of the Bayesian network model, we can see the importance and ranking of ten characteristic factors.

Table 4. Multiple regression coefficient output

Independent variable	Lenovo Miix 520	ipad 2018	Xiaomi 4	Honor Water play	surface pro5
Logistics	0.071	0.017	0.044	0.117	0.024
Price	0.064	0.033	0.038	0.170	0.322
Exterior	0.069	0.048	0.025	0.038	0.132
Physical property	-0.013	0.009	-0.056	-0.042	0.029
Model	0.089	0.257	0.130	0.077	0.206
Operation	0.024	0.039	0.064	0.139	0.099
Battery quality	0.134	0.022	0.005	0.031	0.066
Picture quality	-0.028	-0.034	0.009	0.143	0.007
Sound quality	-0.047	-0.008	0.007	0.098	-0.027
Services	0.386	0.362	0.232	0.294	0.398
R ²	0.968	0.920	0.992	0.988	0.957
Adj-R ²	0.964	0.914	0.988	0.985	0.955
F-value	12.903	22.552	8.632	12.951	16.078
p-value	0.000	0.000	0.000	0.000	0.000

According to the results of multiple linear regression, R² and adjusted R² are an explanation of the model fitting effect. The corrected goodness of the model is above 0.9, indicating that the model has a strong ability to interpret; the probability P values corresponding to F are 0.000 < 0.01, indicating that the 10 independent variables of the five major tablet computers introduced had a significant effect on the dependent variable at a significant level of 0.01.

Secondly, in the coefficients presented, we can see that for Lenovo miix520, the more important factors are merchants, batteries, and models; for iPad, the more important factors are merchants, models, and appearance. For Xiaomi 4, the more important factors are merchants, models, and logistics; for Glory, the more important factors are merchants, prices, and operations; for the surface, the more important factors are merchants, prices, model. In general, although the importance ranking of some factors may be slightly different, the top five factors output by the major models are basically similar, indicating that the results of the two models are basically the same. On this basis, we compare the accuracy of the models. The relevant results are shown in the following table:

Table 5. Model accuracy comparison

	Lenovo Miix 520	ipad 2018	Xiaomi 4	Honor Water play	surface pro5
Accuracy	97.35%	98.21%	95.63%	97.94%	96.52%
Average accuracy	0.984	0.986	0.973	0.975	0.954
	0.881	0.967	0.882	0.913	0.946
Accuracy above 2.0 folds	98.91% of observation	91.89% of observation	94.47% of observation	96.23% of observation	93.42% of observation
Multiple linear regression model accuracy	97.41%	97.63%	96.98%	974.29%	97.65%

As can be seen from the above table, the accuracy rate of Bayesian network models of major brands is above 95%. Among them, the accuracy of the iPad is the highest, which is 98.21%. It will improve the accuracy

by more than 2.0. Many changes indicate that it is more feasible to use Bayesian network models to explore user satisfaction factors.

6. DISCUSSION

In this research, we use the text analysis method to mine the online comments of tablet products on the JD platform, and construct a Bayesian network model to analyze the main consumer influence factors affecting tablet of different brands, to provide manufacturers with a reasonable response to increase consumer satisfaction.

In terms of Lenovo miix520, improve the service quality of merchants. When a new product is listed, it is important to focus on the early quality evaluation and improve the quality before promoting it to the shelves. Manufacturers should increase investment in technology research and product maintenance, and further improve the smoothness of CPU processing on the operating system.

In terms of iPad 2018, speed up logistics and distribution, strengthen the efficiency of order and inventory management. They should implement real-time logistics solutions simultaneously, reduce the picking area, speed up transportation, and enhance customer service capabilities.

In terms of Xiaomi 4, enhance customer service capabilities. Combine the types of refunds to determine the core of the problem and improve yourself. For the design of the appearance, it is necessary to consider the experience of most customers more closely and be practical.

In terms of Honor water play, optimize the appearance of the tablet, and further adjust the physical properties of the tablet to make it more convenient and compact, while also maintaining high running smoothness and cost performance.

In terms of surface pro6, improve the battery life of the tablet and choose a battery with a higher storage capacity. Meanwhile, it is also necessary to optimize the power consumption of the tablet application to improve the durability and use time of the tablet.

To achieve differentiated marketing of tablets products, companies should learn from the marketing experience of smart phones. It's conducive to accelerate the establishment and improvement of unique application software stores, increase the quality management of the plant, and implement detailed project management in the manufacturing process. Companies should improve their after-sales service capabilities and focus on efficient and timely logistics distribution. For some tablet PC series mainly promoted, companies should formulate a clear pricing strategy. Some complementary products can be bundled and presented at the same time. The outstanding advantages of their own products should be emphasized for publicity and word of mouth marketing.

7. FUTURE WORK

This research provides a reference for the future development for tablet manufacturers. At the same time, we point out the weaknesses in this research and the feasible development directions in the future.

The amount of sample crawl data is not representative, and the accuracy of the model needs to be improved. We will crawl larger and more comprehensive online review data to further improve the accuracy and comprehensiveness of the customer satisfaction model.

Characteristic factors are not comprehensive enough. Due to the large amount of data, it is easy to ignore certain feature factors or directly combine two different feature factors into one when summarizing and extracting feature factors. Extracting slightly subjective features may lead to the omission of features that affect customer satisfaction, which will leave the model itself inaccurate.

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Exploring Factors Influencing Showrooming Behavior in Multi-Channel

Shopping: A Cognitive Appraisal Theory Perspective

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Abstract: Multi-channel shopping keeping consumers from changing retailers during the channel conversion process has become an important issue. Showrooming, one of the increasingly popular form of multi-channel behavior, brings different influences to retailers. This paper focuses on how to keep consumers loyal to retailer of showrooming behavior during the channel conversion process, and explore its influencing factors from the perspective of cognitive appraisal theory. Three hundred and ten questionnaires were collected to conduct empirical analysis by structural equation modeling (SEM). The empirical research results show that information availability, price comparison, and after sales service positively affect perceived fluency and perceived value, but interaction service has no significant effect on perceived fluency and perceived value, and that perceived value and perceived fluency further promote the appearance of showrooming behavior. The research results improve the existing showrooming research system, and provide suggestions for retailers on how to improve the channel characteristics to promote positive showrooming.

Keywords: showrooming, multi-channel, cognitive appraisal theory

1. INTRODUCTION

With the rapid development of information technology, enterprises have expanded their marketing channels from single-channel to multi-channel. Cross-channel consumer behavior becomes very common, consumers can use different channels to make purchases at different shopping decision-making stages to obtain the required information and shopping experience. Showrooming, one of the increasingly popular form of cross-channel behavior, brings different influences to enterprises in different forms^[1]. Some consumers may switch retailers from offline to online in a cross-channel, and online competitors benefit from it. On the other side, consumers may choose the same retailer both online and offline. How to keep consumers loyal to retailer during the channel conversion process is a question worth pondering.

Prior researches on showrooming have focused on its behavioral outcomes and influencing factors. Some studies regard showrooming as a competitive behavior, and the behavior of consumers switching the retailer's during the purchase process is unethical, which negatively impact on the self-efficacy and business performance of the physical store sales staff^[2]. Some researches view showrooming as a positive behavior. If the retailers fully consider the experiential aspects of their decision-making activities and emotions, they will better understand the potential opportunities^[3]. For the influencing factors of showrooming behavior, scholars also explore the antecedents of showrooming from the perspective of channel attributes^[4] and consumer personal characteristics^{[5][6]}.

Most of the existing studies viewed showrooming as the behavior of consumers changing retailers from offline to online during the shopping process, and less consider the behavior of consumers using the same retailer from offline to online channels. In the exploration of the antecedents of behavioral, most studies only analyzed the direct effects of antecedent variables on showrooming behavior, and ignore the psychological

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process of consumers from cognition to behavior. This paper will focus on the showrooming behavior of consumers changing different channels of same retailer, introduce psychological characteristics as variables to explore the formation mechanism of showrooming. The research results will improve the existing showrooming research system, and provide suggestions for retailers on how to improve the channel characteristics to promote positive showrooming.

2. LITERATURE REVIEW

2.1 Showrooming

showrooming refers to that consumers view in physical stores, collect product information, and then purchase products through retailers in online channels. Unfortunately, some consumers may change brands during the channel conversion process, which not only reduces the self-efficacy and motivation of sales staff, but also damages business performance^[7]. Therefore, for the initial research on cross-channel buying behavior of showrooming, scholars mostly viewed the adverse effects caused by this phenomenon from the perspective of enterprises. With the continuous development of the O2O business, online and offline collaboration has become a way of competition for retailers. Some e-commerce retailers have opened physical stores offline, and pay more attention to their service and consumer experience. Compared with the behavior of changing brands during the process of consumer channel conversion, the proportion of customers retaining across channels is close to 70%^[8].

In recent years, scholars have started research on the mechanism of consumer showrooming behavior both from perspective of channels and the individual level. From the perspective of channels, Kim and Park measured the antecedents variables of showrooming that are consistent with the push, pull and mooring effects in the O2O business environment^[9], Chiu et al. discussed the causes of showrooming behavior from the advantages and disadvantages of online and offline shopping channels^[4]. From the individual consumer level. Burns et al. tested their tendency of participating in showrooming behavior from the perspective of consumer shopping^[10], Dahana et al. explained whether and to what extent consumers are participating in showrooming behavior from the perspective of personal characteristics^[6]. In addition to the above direct influence factors, some moderators also affect consumer behavior, such as differences in product type, gender, age, and income^{[5][11]}.

Most of researches on the influence mechanism of showrooming only test the direct factors and lack the consideration of the psychological perception response of consumers to the evaluation of channel attributes. Therefore, based on the cognitive appraisal theory, this paper will conduct research from different decision-making stages.

2.2 Cognitive appraisal theory

Cognitive appraisal theory was originally proposed by Deci and Ryan in 1975 to evaluate the motivational response of employees in an organization. Later it developed into a cognitive theory of emotion-led consumer behavior. The process of cognitive appraisal is like the cognitive information processing mechanism discussed in the marketing literature. The whole process is mainly divided into three stages, first is the evaluation of the external environment, second is the impact on psychological emotion after the evaluation, and finally the generation of behavior.

Cognitive appraisal theory has been applied to consumer behavior research^[12]. Combined with the research scenario of this paper, the layout of retailer physical stores and online stores brings consumers different effects in the search and purchase process. Consumers evaluate different channel characteristics, and these environmental factors further affect consumers' psychological perception and attitude towards choosing multi-channel shopping. Although channel conversion requires a certain amount of time and energy from

consumers, consumers' positive emotional attitude towards the channel services provided by retailer is an important reason for showrooming.

2.3 Perceived fluency and perceived value

Perceived fluency (PF) refers to the degree of difficulty an individual feeling when perceiving and recognizing the physical characteristics of an object^[13]. It is commonly used to study aesthetics and advertising to explore how the design of things affects the perceived fluency of individuals. In consumer behavior, prior studies on perceived fluency have mostly focused on single-channel backgrounds. Im et al. proposed that fluency measured with a visual interface affects consumers' sense of pleasure on the Internet, thereby helping consumers to buy products^[14]. In a multi-channel context, people are more willing to do relatively easy things, and have a greater preference for external stimuli that don't require much effort. So perceived fluency is an important factor in measuring cross-channel shopping behavior.

Consumers' evaluation of channel characteristics is also an evaluation of the value brought by channels. Perceived value (PV) will be transformed into consumer ideas and perspectives, which will have a significant impact on consumer behavior, and it will also be a key factor affecting their purchasing behavior and satisfaction. Some studies have divided the value into utility value and hedonic value^[15]. Utility value emphasizes the physical or functional value of the product, and the hedonic value emphasizes the sense of pleasure and fun that consumers perceive during the purchase process. Both have a differential impact on consumers' information search and purchase frequency^[16].

3. CONCEPTUAL FRAMEWORK AND HYPOTHESES

We divide the consumer's multi-channel shopping process into three stages. The first is that the different channels characteristics stimulate consumers, forming an evaluation of showrooming. Secondly, consumers' perception of the channel will form a psychological perception. Finally, psychological perception will form showrooming. This paper proposes a hypothetical model, as shown in Figure 1.

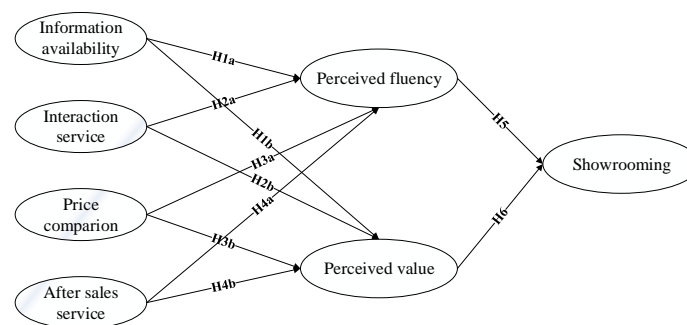


Figure 1. Conceptual model

3.1 Information availability

Information availability (IA) refers to the ability of consumers to perceive product quality, quantity, and availability of information to compare attributes between products. The source of product information provided by online channels is mostly website introductions and user reviews, which are mostly presented to consumers in the form of text, pictures and videos. After the beautification and processing of this information, it will inevitably be different from the actual situation. Consumers need to spend a certain amount of energy and effort when processing this information. Overly detailed images increase complexity and reduce consumer fluency^[17], offline brick-and-mortar stores are better at measuring the quality of the products, services and brands they actually come into contact with. Therefore, the perceived fluency of offline channels is higher.

The phenomenon of slipping orders on the Internet makes consumers distrustful of the content of some buyer reviews. Compared with information provided by traditional channels, online channel information is more

asymmetric and imperfect^[18], this directly leads to consumers' perception of greater uncertainty in the purchasing behavior of online channels. Offline channels make up for the intuitive experience that online stores cannot bring, and it is easier to obtain information that online channels cannot bring. Consumers don't have to worry about errors in the information provided online, such as the color of pictures and the authenticity of reviews. This can greatly reduce the risk of shopping and thus increase the perceived value of consumers. Therefore, we propose the following hypothesis:

H1a: Compared with online stores, information availability in offline physical stores has a positive impact on perceived fluency.

H1b: Compared with online stores, information availability in offline physical stores has a positive impact on perceived value.

3.2 Interaction service

The significant difference between online channels and offline channels is interaction service (IS). Most of the interactions provided by online channels for customers are online dialogues, and the customer service staff's dialogue responses are not timely. The cumbersome consultation process makes the quality of online interactive services low. The services of offline physical stores make up for this shortcoming. The staff in the physical stores use their expertise to explain product information to consumers, and provide them with shopping suggestions and other services in accordance with consumer needs in a timely manner, thereby improving consumers' handling of products speed and accuracy, increasing their fluency.

The service-led logic shows that the interaction between the company and the customer has always been the key to creating value together, and the salesperson is the first and only interaction between the company and its customer^[19]. Brick-and-mortar stores are more prominent in emphasizing consumers' experience. The services in the physical stores not only provide consumers with task-oriented interaction, but also meet consumers' spiritual and emotional interaction needs. Through different forms of interaction, it creates sensations and perceptions for customers, thereby forming subjective evaluations, helping customers to more accurately judge value and purchase decisions, and enhancing customer perceived value. Therefore, we propose the following hypothesis:

H2a: Compared with online stores, interaction service in offline physical stores has a positive impact on perceived fluency.

H2b: Compared with online stores, interaction service in offline physical stores has a positive impact on perceived value.

3.3 Price comparison

Previous studies have repeatedly suggested that the price factor is the most important factor that causes consumers to showrooming^[1]. Price comparison (PC) is the motivation to compare the price of a product or service in a retail environment^[16]. When choosing a purchase channel, consumers tend to prefer online channels, as online store prices are generally lower than experience store prices. Therefore, the information about the price promotion of these products and the presentation of price information clues will affect the smoothness of purchase^[20]. Most online store platforms can directly display the price savings when the consumer purchases an order, and it is easier for consumers to calculate the normal price and discount differences, and improve the fluency of price information processing.

Although the price difference between offline and online has gradually narrowed in recent years, due to the high rents of physical stores and high operating costs, consumers are more inclined to buy online to obtain lower prices. More importantly, online stores provide more price clues, and online store prices on different platforms also vary greatly^[21]. In this case, it is easier for consumers to compare product prices and make purchasing decisions^[22]. This gives consumers more decision-making opportunities to monetize and increases perceived

value. Therefore, we propose the following hypothesis:

H3a: Compared with online stores, price comparison in offline physical stores has a positive impact on perceived fluency.

H3b: Compared with online stores, price comparison in offline physical stores has a positive impact on perceived value.

3.4 After sales service

After sales service (ASS) refers to activities that occur after the initial sales transaction. After sales activities play a key role for businesses, mainly including delivery after product purchase, problem resolution, return and refund policies, etc. In the past, not being able to get products in time has been one of the criticisms of online shopping and a driving factor for consumers' tendency to buy offline, but with the continuous improvement of the logistics system, the time urgency of online shopping has been greatly solved. Online purchases can be delivered home, eliminating the inconvenience of buying heavy products offline.

In addition, online purchase products can provide home delivery service, high convenience and efficiency of online return and exchange, short refund response time^[23]. And if there is a problem with the use of the purchased product, consumers can timely communicate with customer service personnel across the time and space boundaries online. Therefore, the quality of after sales service determines the perceived fluency and value of consumers. Therefore, we propose the following hypothesis:

H4a: Compared with online stores, after sales service in offline physical stores has a positive impact on perceived fluency.

H4b: Compared with online stores, after sales service in offline physical stores has a positive impact on perceived value.

Finally, as we mentioned in 2.3 above, both perceived fluency and perceived value have an impact on multi-channel shopping behavior. Therefore, we propose the following hypothesis:

H5: perceived fluency has a positive impact on perceived fluency.

H6: perceived value has a positive impact on perceived value.

4. EMPIRICAL STUDY

4.1 Sample

We adopted a questionnaire survey to obtain data. The questionnaire is divided into two parts: the first part is the demographic information of the interviewees, and the second part measures all latent variables in the research model. We borrowed from existing mature items and used the seven-point Likert scale as a measure of latent variables in the text. In order to ensure the accuracy of the measurement items, we conducted a pre-survey before issuing the formal questionnaire to improve the quality of the questionnaire items.

384 questionnaires were recovered in the end, and invalid questionnaires with incomplete answers or obvious random filling were excluded. The final valid questionnaires were 310. Among the valid samples, men accounted for 45%, the age group was mainly concentrated in the age of 18-25, accounting for 77% of the total, the academic background is mainly undergraduate students (68%), the monthly income is mostly 4000-6000 yuan.

4.2 Data analysis

4.2.1 Reliability and validity testing

We combine SPSS 25.0 and AMOS 22.0 for reliability and validity tests. The analysis results showed that the Cronbach's α and CR values of all variables exceed 0.7, and the AVE values exceed 0.5, indicating that the data have good reliability and convergence validity. The test of discriminant validity is obtained by comparing the square root of AVE with the correlation coefficient of each variable. The results show that the correlation

between perceived value and online shopping is high, but the discriminant validity of the overall variables is good, and the model can be used as valid sample data for structural equation modeling. The detailed reliability and validity test results are shown in Table 1.

Table 1. Reliability and validity analysis

variables	α	CR	AVE	IA	IS	PC	ASS	PF	PV	showrooming
IA	0.778	0.778	0.540	0.735						
IS	0.804	0.814	0.597	0.668	0.773					
PC	0.832	0.831	0.554	0.631	0.578	0.744				
ASS	0.865	0.870	0.691	0.130	0.137	0.266	0.831			
PF	0.796	0.792	0.561	0.497	0.528	0.547	0.371	0.749		
PV	0.854	0.848	0.584	0.566	0.580	0.615	0.264	0.707	0.764	
showrooming	0.808	0.804	0.578	0.653	0.591	0.682	0.255	0.666	0.775	0.760

Note: The diagonal values represent the square root of AVE.

4.2.2 Hypotheses testing

We use AMOS 22.0 for structural equation modeling. First, the overall model fitting degree is tested, and the following model fitting degree indicators are output: $\chi^2/d.f.=2.239$; GFI=0.875; CFI=0.935; TLI=0.922; IFI=0.935; RMSEA=0.063. It shows that the model has good adaptability. The final hypothesis test results are shown in Table 2. All path coefficients are positive numbers showing the positive relationship between the variables, but interaction service as independent variable has no significant effect on perceived fluency and perceived value, and H2a and H2b are not valid. We think the current online interactive services are becoming more and more perfect, and the differences between online and offline are gradually narrowing. Perceived fluency and perceived value both positively affect showrooming, and P values are less than 0.001, showing that the psychological variables of perceived fluency and perceived value have a significant positive effect on showrooming. In the other path results, information availability, price comparison and after sales service are positively affecting perceived fluency and perceived value, which are consistent with our expectations.

Table 2. Data analysis result

Paths	Estimate	S.E.	C.R.	P
information availability ---> perceived fluency	0.250	0.124	2.014	0.044**
interaction service ---> perceived fluency	0.127	0.090	1.412	0.158
price comparison ---> perceived fluency	0.238	0.087	2.745	0.006**
after sales service ---> perceived fluency	0.174	0.033	5.233	***
information availability ---> perceived value	0.232	0.122	1.894	0.058*
interaction service ---> perceived value	0.116	0.089	1.310	0.190
price comparison ---> perceived value	0.443	0.090	4.942	***
after sales service ---> perceived value	0.069	0.032	2.123	0.034**
perceived fluency ---> showrooming	0.326	0.076	4.297	***
perceived value ---> showrooming	0.813	0.082	9.979	***

Note: *** significant at $p < 0.001$; ** significant at $p < 0.05$; *significant at $p < 0.1$.

5. CONCLUSION

This paper builds a model of influencing factors of showrooming based on cognition appraisal theory. Testing by structural equation modeling, the research results show that information availability, price comparison, and after sales service can affect consumers' perceived fluency and perceived value, while perceived fluency and perceived value significantly affect showrooming. Accordingly, the implications of this

study are as follows.

5.1 Theoretical implications

This paper focuses on consumer loyalty in the multi-channel shopping process, that is, using the same retailer's offline and online channels to purchase products.

First, in the existing researches on showrooming, most of them regard showrooming as a negative behavior, and define it as the behavior of consumers changing retailers at the same time as channel conversion. The research results complement the existing showrooming research and provide a way for retailers to enable consumers in the process of channel conversion.

Secondly, the cognitive appraisal theory is applied to the showrooming behavior, and the forming process of the showrooming behavior is divided into three stages. Different from the previous literature, which directly studies the influence of channel characteristics on showrooming, this paper introduces perceived fluency and perceived value as important psychological variables, revealing the influence mechanism of the formation process of showrooming.

5.2 Practical implications

In terms of how to improve the perceived fluency and value of consumers, according to the results of this article, retailers can improve the following measures.

An important reason why consumers choose offline channel search is the authenticity of the product's touch. When retailers provide consumer services in physical stores, they can better display product information to consumers and list product parameter information. Under the trend of combining online and offline channels, product barcodes can be scanned on the spot and product details can be viewed on mobile phones, so that consumers can not only understand product information, but also actually feel it at the touch; at the same time, it can be provided to consumers online price information and discount information, and provide online ordering services. This promotes consumers' shopping opportunities at the same retailer and effectively prevents consumers from searching for other retailers through their mobile phones. For after sales service, online delivery can be provided, but some return and exchange policies need to be improved, and retailers can provide humanized services for online shopping and offline return to reduce consumer's perceived risk.

In short, through the improvement of product information, prices, and after sales services, retailers can provide consumers with more perceived fluency and perceived value, in order to promote consumers to switch channels instead of switching retailers.

5.3 Limitations and future research directions

There are some limitations in this paper. First, most of the samples are from surveys of young people, and data from other ages are lacking. Second, product involvement may affect showrooming behavior. This article will explore the moderating role of product involvement in the future.

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Impacts of Social Media Usage in Cross-cultural Social Commerce: the roles of cultural intelligence and cultural distance

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Abstract: In spite of the increasing significance of social commerce, social media usage does not necessarily generate user's intention to purchase on social commerce websites, particularly in cross-cultural environment marked with cultural dissimilarities and uncertainties. The current research clarifies the mechanism through which social media usage affects individual's intention to purchase on social commerce websites. The findings demonstrate that two dimensions of social media usage positively increase user's intention to purchase on social commerce websites via cultural intelligence and cultural intelligence responds as an effective conduit partially mediating the relationship between informational social media usage and user's purchase intention, whilst fully mediating the relationship between socializing social media usage and user's intention to purchase. Furthermore, cultural distance plays as a noisy channel to attenuate the positive effects of social media usage on individual's intention to purchase. The implications and limitations of this research are also discussed.

Keywords: Social commerce, social media usage, cultural intelligence, cultural distance, cross-cultural context

1. Research background and questions

Although social commerce has been identified as an effective channel to impact business practice models over the years^[1], individuals' intention to purchase on social commerce websites is not necessarily generated because of potential risks and inaccurate information existing in social media and fraud on consumers^[2]. The mission to expand social commerce becomes particularly hard when social commerce is exposed to an international environment which is characterized with cultural dissimilarities and uncertainties^[3, 4].

In order to fill in the gaps of previous research and investigate how to increase customers' intention to purchase on social commerce websites in a foreign environment, the current research raises the following questions:

1. How do two dimensions of social media usage exert respective impacts on customers' intention to purchase on social commerce websites in cross-cultural context?
2. What is the underlying mechanism driving customers' intention to purchase on social commerce websites from social media usage?
3. What role does the boundary condition (cultural differences) play in influencing customers' intention to purchase on social commerce websites cross-cultural contexts?

Based on the research framework, the current research examines the direct and indirect relationships between two dimensions of social media usage and individuals' intention to purchase on social commerce websites, the mediating role of cultural intelligence^[5] (individual's key capability to deal with cross-cultural issues) and moderating role of cultural differences^[6].

2. Research methodology

A final total of 342 questionnaires were collected back with a response rate of 85.5%. Two unqualified questionnaires were removed and the final list of 340 questionnaires was used for the current research. A regression analysis was conducted to examine the related hypothesis. All the predictions were supported well by

the regression analysis of the data collected from 340 international students.

3. Research findings

The research confirmed that two dimensions of social media usage both generate user's intention to purchase on social commerce websites. In addition, the research unveiled that in cross-cultural environment, social media usage helps develop user's cultural intelligence, thereby enhancing user's intention to purchase on s-commerce sites. Furthermore, the research discovered that cultural distance negatively moderates the relationship between social media usage and user's cultural intelligence.

4. Theoretical and practical implications

To the best of our knowledge, this study is among the first trials exploring the unique functionalities of two different dimensions of social media usage influencing user's intention to purchase on social commerce websites in cross-cultural environment, which contributes to the literature of information management studies. Further, cultural intelligence was found to play different mediating roles in the relationships between two dimensions of social media usage and user's intention to purchase on social commerce websites. More importantly, the results indicate that cultural intelligence plays different roles mediating the relationships between two dimensions of social media usage and user's intention to purchase on social commerce websites in such a way that cultural intelligence partially mediates the relationship between informational social media usage and user's intention. The research findings make contribution to cross-cultural studies as well by combining the research perspectives of information management, social commerce and cross-cultural studies. Finally, we found that cultural distance attenuates the effectiveness and gratifications of social media usage on the user's cultural intelligence. Furthermore, it is interestingly noted that cultural distance operates differently as a boundary condition and exerts more negative effects on socializing social media usage than on informational social media usage.

The current research findings also offer managerial implications. First, social business practitioners should highlight the significant roles of social media usage in promoting user's intention to purchase on social commerce sites. Second, cultural-related training or familiarizing programs pertaining to cultural knowledge related to company's online products should be regarded as complimentary measures of marketing strategy to develop cultural intelligence of targeted international users to generate their motivations, interests and intention to purchase on s-commerce sites for online shopping. Finally, social commerce business practitioners should be fully aware of the negative effects of cultural distance in cross-cultural environment.

5. Limitations and future research

Despite important contributions, the study also has some limitations that offer prospective avenues for future research efforts. First, we conducted the survey with samples of international students studying in Chinese universities, who receive less attention for s-commerce research. However, the majority of students are from African and Asian countries. Second, more empirical research is necessary to further investigate other potential mediators and situational factors to elaborate on the relationships between social media usage and user's online shopping intention. Finally, the research adopted cross-sectional design which presents less possible causal relationships between variables.

6. Conclusion

Taking the perspective of uses and gratifications, we conducted an empirical study to extend social commerce research into much more complicated cross-cultural context by examining the effects of two

dimensions of social media usage on user's intention to purchase on s-commerce websites via cultural intelligence and the moderating effects of cultural distance attenuating the relationships between social media usage and cultural intelligence. This research is one of the first trials with attempt to advance our understandings about how s-commerce is conducted in cross-cultural environments.

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Social Network Analysis for Online Knowledge Exchange Platform: Evidence from Zhihu

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Abstract: The knowledge exchange platform is an innovative way that empowers online learning for the Internet users to utilize their spare time slots for knowledge sharing and seeking. Many researchers have conducted research on the user interaction and content of the knowledge payment platform. This paper analyzes the user interaction and user comments by analyzing the data of Zhihu live, a major online knowledge exchange platform in China. We employ social network analysis and deep learning method to explore the users' interaction structure in Zhihu live platform and their emotional tendency for knowledge exchange. Particularly, we use social network analysis theory supplemented by social analysis tools Gephi and neural network algorithm, LSTM to achieve our goals. We propose a set of hypotheses from the perspective of a small world phenomenon and users' social engagement in the platform. Our results show that there is a small world phenomenon on core topics and the more frequent users interaction is, the more positive the users' comments are. Theoretically, this study explores the users' knowledge seeking and sharing behavior from the perspective of user interaction and user emotion. Also, our research offers implications to practice that enhancing sociality can be an effective strategy to motivate the desirable users' paid knowledge sharing behaviors in the platform.

Keywords: knowledge payment; social network; sentiment; empirical study

1. INTRODUCTION

In the past few years, knowledge-paying communities have emerged and are growing rapidly. The knowledge-paying community is a mode of content payment. Maxhuni (2016)^[1] believes that the development of technology and the emergence of knowledge payment platform promote the spread of knowledge and broaden people's vision. Zhang(2017)^[2] investigates the willingness of users to pay for knowledge, and believes that it is affected by many factors such as utilitarian value and hedonic value. Therefore, the success of online education business model and the development of paying users are the key points of industry development. After the knowledge sharing has experienced static knowledge acquisition 1.0 and dynamic knowledge update 2.0, under the dual role of knowledge redundancy and fan economy, enter the knowledge sharing 3.0 stage of paid question and answer and subscription. In China, as of May 2019 the number of Himalayan FM activation users has exceeded 500 million, with 4 million paid users, and Zhihu user base has reached 200 million. The knowledge-paying platform can make full use of people's fragmentation time and achieve the full use of resources. Users can

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participate in content creation and information sharing. The characteristic of payment content is to screen out valuable information and construct a new system of knowledge dissemination. From the perspective of the entire content industry, the knowledge payment market is gradually maturing.

The typical operation process of the knowledge payment platform is as follows. People use the form of paid questions to consume content. The author uses his own fragmented time to share his knowledge and get the corresponding reward. On the platform, people can still use it. The columns are commented on, and others use these comments to understand the quality of the program, and the platform can also make recommendations through comments. If the user feels that a particular section is useful to them, then they can pay for it.

We want to solve two problems. First, what is the user interaction situation of the knowledge paying platform, especially those who publish paid content and get revenue. Here we use the method of social network analysis. Second, what is the commentary on the knowledge-paying platform, and whether it is related to interaction and could affect interaction. Here we use the method of machine learning.

The rest of the article is constructed as follows. First, we review the literature on knowledge payment and commodity comments. Secondly, we explain in detail the limitations of the current research and propose our methods to improve the current research. Finally, we describe our data, analyze the results, and draw conclusions.

2. RELATED LITERATURE

2.1 Knowledge payment

Because of its popularity, knowledge payment has attracted the dual attention of the academic community and the industry.

The first is to study the development of knowledge payment. Zhang (2017)^[3] divided the development of knowledge payment into three stages: knowledge sharing stage, knowledge payment embryonic stage and knowledge payment development stage. Sun (2019)^[4] believes that technology is the main driving force to promote the development of knowledge payment industry.

The second is the study of the content of the knowledge payment platform. Song(2017)^[5] believes that the core of knowledge payment platform is knowledge itself. Wang (2013)^[6] further explores the topics in the platform and discovers through Quora that the rich diversity of platform topics and answers attracted users to participate spontaneously in topics of interest or popularity. In terms of research on the relationship between content and users, Sharoda (2015)^[7] uses quantitative analysis methods to study the user's reputation evaluation method for the Quora platform, and then gives corresponding suggestions for the platform to develop reputation mechanism and produce high-quality topic content. Similarly, Wang (2017)^[8] explores the role of incentives, and believes that high-quality knowledge can easily be buried in the shared knowledge of homogenization, which greatly dampens the creative enthusiasm of knowledge producers, and the knowledge sharing without effective incentives eventually tends to be low-quality. Therefore, the development of knowledge payment effectively stimulates knowledge producers, and the production and realization of supply-side cognitive surpluses are positively feedback.

The third is the study of the willingness of users of knowledge payment platform to pay. Work(2007)^[9] and Kim(2009)^[10] find that perception level of convenience and price would affect users' willingness to use the

knowledge payment platform. Many scholars have also made a fine-grained analysis of it. Li (2014)^[11] points out in the research on the influencing factors of free customers' willingness to pay for instant messaging value-added services, that network externalities and virtual social capital can directly affect customer perceived value, which indirectly affects customers' willingness to pay, while perceived value has a direct positive impact on customers' willingness to pay. Li (2018)^[12] found the willingness to pay is directly affected by the paid attitude, subjective norms and the control factors of perceived behavior; the paid attitude is perceived by quality, experience and trust.

At present, most of the research on the users of knowledge payment platform focuses on the willingness of users to pay. However, the knowledge payment platform has been developing, and the interaction between users is also increasing, which directly affects the choice of knowledge payment products. Because users with similar hobbies tend to be connected. For example, if one of them tends to pay for a certain type of knowledge, the person associated with him will be influenced by him to be interested in such products or buy them directly. Then the user interaction of knowledge payment platform and the purchase of knowledge payment products by user interaction need to be paid close attention to by researchers.

2.2 Online reviews

Knowledge-paying product is a kind of commodity sold online, which is regulated by the demand and supply of both suppliers and demanders. The demands of users are largely affected by commodity reviews. Reviews of online goods have been studied by a lot of people. Pee(2016)^[13] believes that reviews of online goods are conducive to information dissemination and promoting user purchase decisions. And also, according to a survey, Stefan(2019)^[14] think online merchants are paying more and more attention to online reviews. Many researchers look at online reviews from a variety of fields. Zhang (2001)^[15] studies the comments of ordinary customers and industry experts respectively, the results show that the online comments of ordinary customers are more likely to be trusted by consumers and show a positive correlation, while the comments of industry experts show the opposite trend. Lin et al.(2007)^[16] analyzes and explores the interaction between book comments and purchase intention, and the conclusion shows that the comprehensiveness and integrity of book comments are positively related to purchase intention. Liu(2015)^[17] investigates the factors influencing the perceived usefulness of review and considers that qualitative reviews are very important. Through text mining and sentiment analysis, Cheng(2019)^[18] find that Airbnb users make reservation decisions through comments from others, among which "location", "amenities" and "host" are the three most important attributes for users. Besides, Saba(2016)^[19] interviews people and even find that the more negative the comment, the more useful it is.

Although the knowledge payment platform is in a period of rapid development, but the current development is not mature enough, the quality of the knowledge products or services provided by the platform is difficult to guarantee, the user experience is poor, and the piracy problem is serious. The content of the platform is vulgarized, homogenized, over-commercialized and so on, which is caused by the simple pursuit of short-term benefits. Among them, user comments can solve the product problems on the platform to a certain extent, and users who have used paid products can make corresponding evaluations of the products according to the advantages and disadvantages of the products. Users who have not purchased the product can refer to these comments before purchasing. The emotional tendency of product comments represents the degree of user love for the product. We believe that the relevant comments on the knowledge payment platform need to - paid attention

to by researchers.

3. MODEL BUILDING

In this article, we try to solve this problem: the influence of user interaction and comments on knowledge diffusion efficiency of knowledge payment platform.

Exploring the user interaction of knowledge payment platform can be divided into two aspects. One is to explore whether there is a small-world phenomenon in the user interaction of the knowledge payment platform as a whole, and whether the user interaction is the same for different knowledge payment products. The small world phenomenon shows that there is a close connection in the network structure. The most famous experiment is a six-degree separation experiment, which shows that there are at most five people between any two people in the world (Peter et al.2003)^[20]. The small world network has two basic characteristics: a short characteristic path length and a high average aggregation coefficient and it can promote corporate innovation, information flow diffusion, and personal creativity(Verspagen et al.2004; Schilling et al.2007; Uzzi et al.2005)^[21,22,23]. Therefore, the small-world phenomenon can be used to explore the dynamic attributes, structural characteristics and evolution mechanism of the knowledge payment network.The second is to explore whether there are opinion leaders in user interaction and what characteristics these leaders have. Lazarsfeld(1948)^[24] points out that opinion leaders are active elements in social networks. They influence the behavior of other users and thus promote the evolution of the network structure. Therefore, it is necessary to care about opinion leaders in the network. Thus we have hypotheses H1a and H1b.

H1 a: there is a small-world phenomenon on the knowledge payment platform and the interaction between users of different knowledge payment products is different.

H1 b: community opinion leaders have an impact on the knowledge product demand of other users.

Kim (2004)^[25] believes that emotional (opinion) can be described by four parts: theme, intention holder, emotion description term and praise and criticism tendency, that is, opinion holders express some kind of praise and criticism tendency for the theme of emotional description. The user comments of knowledge paying products can affect the behavior of users to a certain extent, that is, affect the interactive behavior of users. emotional analysis can be carried out through online comments, and the tendency of users to comment can be measured from the results of emotional analysis. Based on this, we propose H2.

H2: the user's comments represent their emotional preference for the product and affect user interaction.

In order to describe the emotional tendency of user comments, we use the LSTM model in machine learning to perform the operation on the content of the comments.

The long-short term memory model was proposed by Hochreiter and Schmidhuber to improve the traditional recurrent neural network model^[26]. The model is a special recurrent neural network model, based on the standard recurrent neural network model and adds long and short time memory cells. The adoption of the LSTM model is better in terms of text classification (Graves et al. 2005)^[27] and handwriting recognition (Graves et al. 2009)^[28] than simple recurrent neural networks.

As shown in the Figure 1 below, we first convert the text into a word vector. For Chinese, we first use the jieba package for word segmentation, use the word2vec algorithm to convert them into vectors, input these

vectors into the LSTM model, after neural network training, finally get the value.

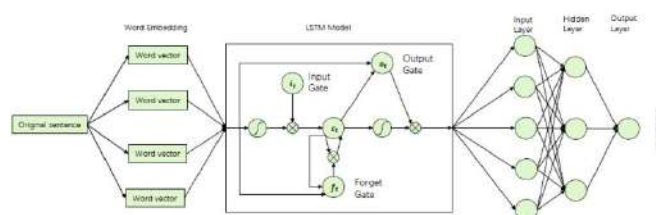


Figure 1. LSTM schematic diagram

4. EMPIEICAL STUDY

4.1 Data

The data comes from zhihu live, which is a very hot knowledge payment platform. We write the python program and use the API of the website to get the corresponding data. We obtain information about the all the columns on the zhihu live platform, including the price of the column, the content of the column comments, the number of column comments, and the following relationship of anchors. As of November 21, 2018, there were 17 fields in the live, 6554 columns, and 2,875 speakers in Table 1.

Zhihu live anchors will pay attention to each other, and this kind of attention behavior produces the social interaction on the platform, and we can explore the social scene in the knowledge payment platform by analyzing the interaction behavior among them. Platform users can pay to listen to the live columns, and make corresponding comments. Other users can refer to these comments when purchasing the column. We believe that these comments represent the emotional tendency of users to the column, and this emotional tendency will in turn affect their buying behavior.

Table 1. Overall parameters

Number of topics	Number of columns	Number of anchor s	Number of comments
17	6554	2875	183674

The Zhihu live section has different themes. Specifically, there are 17 topics on the platform in Table 2. We get the corresponding user interaction information, column information and corresponding comment information according to different topics. We use the social network analysis tool Gephi to analyze user interactions and use LSTM to analyze comments.

Table 2. Different topics parameters

Topics	Number of columns	Topics	Number of columns	Topics	Number of columns
Legal	159	Food	55	Medical health	254
Internet	773	Business	141	Art	260
Education	1325	Design	197	MMT	411
Financial economy	588	Lifestyle	529	Reading writing	262
Science & Technology	265	Physical education	160	Career	852
Travel	132	Psychology	191		

4.2 Results

We use Gephi, a visual tool for social network analysis. The nodes represent the anchors on the platform, and the connections between the nodes represent the mutual attention between the anchors. The corresponding social network diagram is drawn and the corresponding parameters in the network are obtained. We have a social network map of 17 fields and a maximum k-core map. Parameters such as the number of nodes, the number of edges, the average, and the network diameter in the network are obtained. As shown in the following Figure 2 to Figure 5, the social network map corresponding to the legal and Internet fields and the maximum k-core map are shown. In a k-core network, the minimum degree of each node is k. The largest k-core of the social network formed by the columns in the legal field is 3, and the Internet domain is 8. The larger the k-core, the more compact the network structure and the more frequent the user interaction. Correspondingly, the user interaction in the field of Internet is more frequent than that in the field of law.

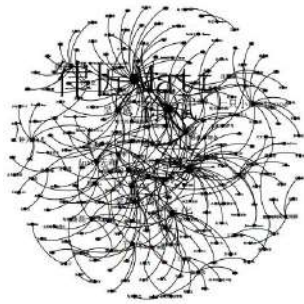


Figure 2. Global topology in legal topic

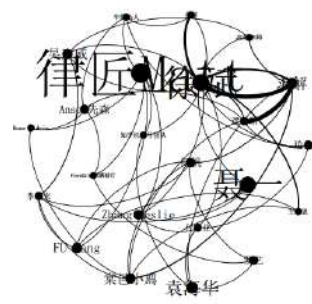


Figure 3. The largest k-core network in legal topics

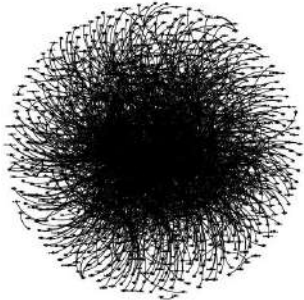


Figure 4. Global topology in Internet topics

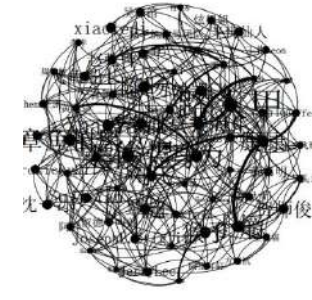


Figure 5. The largest k-core network in Internet topics

The corresponding parameters in the social network diagrams in various fields are shown in the Table 3.

Table 3. Social network parameters of different topics

Topics	Node	Edge	Average degree	Network diameter	k-core
Legal	231	288	1.247	5	3
Internet	872	2181	2.501	13	8
Education	1366	3437	2.516	14	7
Financial economy	618	1294	2.094	11	8
Science & Technology	494	881	1.783	12	5
Travel	338	519	1.536	7	5
Food	170	194	1.141	3	3
Business	277	353	1.274	4	3
Design	372	588	1.581	8	5

Topics	Node		Edge	Average degree	Network diameter	k-core
Lifestyle	786	1676	2.132	13	5	
Physical education	289	450	1.557	5	4	
Psychology	306	625	2.042	13	7	
Medical health	347	598	1.723	10	4	
Art	380	607	1.597	7	4	
MMT	555	1134	2.043	17	5	
Reading writing	397	612	1.542	8	4	

The number of nodes represents the number of lives in this field. The larger the number of nodes, the more the number of lives in this field. Edge and average degree are used to measure interactions in the network. For a given number of nodes, the greater the number of edges, the higher the interaction in the network. The higher the average, the more frequently the nodes in the network interact. The network diameter represents the farthest distance between two nodes in the network.

As can be seen from the above table, the number of lives in education and career is the highest, exceeding 1,000. Explain that these two areas on the platform are hot. On average, the links in Internet, education, financial economy, lifestyle, psychology, MMT, and career are more closely related and the average value exceeds 2, indicating that one node is connected to two nodes on average. For the rest of the field, the network average is over 1, indicating that there is a small world phenomenon on the platform. For the indicator of network diameter, the fields of education, internet, financial economy, science and technology, lifestyle, psychology, MMT and career are large, and to some extent, the interaction between these fields is relatively close.

Our results show that the Internet, education, financial economy, lifestyle, psychology, MMT and career are core topics in the Figure 6 to Figure 12. Because the networks indicator in these areas are larger than other areas. These areas interact more frequently, indicating that these areas are hot topics that users are currently paying close attention to. In order to explore whether there are opinion leaders in the network, we analyze these core topics and choose the k-core network for exploring opinion leaders.

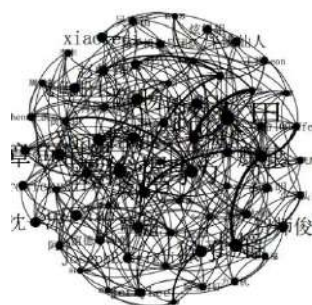


Figure 6. The largest k-core network in the Internet topics

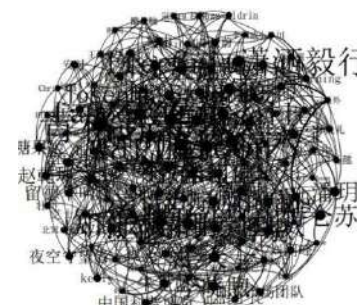


Figure 7. The largest k-core network in the education topics

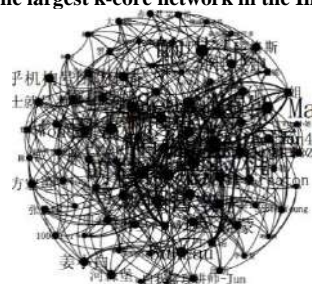


Figure 8. The largest k-core network in the career topics

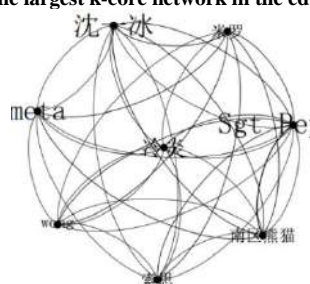


Figure 9. The largest k-core network in the financial topics

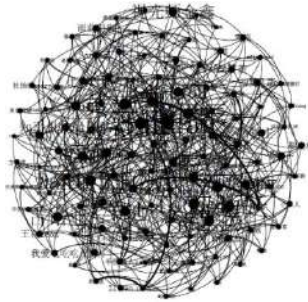


Figure 10. The largest k-core network in the lifestyle topics

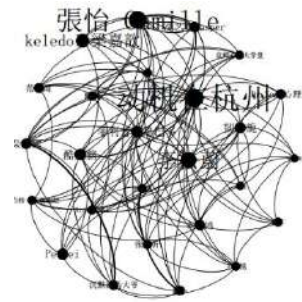


Figure 11. The largest k-core network in the psychology topics

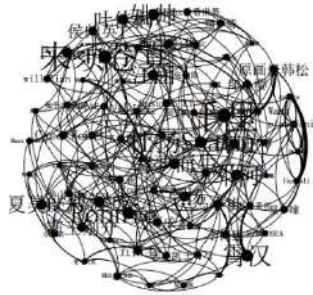


Figure 12. The largest k-core network in the MMT topics

For these core topics, the results show that some of the k-core networks are more intensive and some are sparse. In order to better explore the opinion leaders in the network, three relatively sparse networks, networks in the Internet, financial economy and psychology topic, are selected and analyzed. The top three nodes of the size of the degree in the networks and the relevant data is shown in the Table 4 to Table 6.

Table 4. The top five nodes in the Internet topic

ID	In-degree	Out-degree	Degree	Closeness centrality	Betweenness centrality
passerby	10	41	51	0.319	32162.948
horsepower	24	23	47	0.248	17908.959
bei-ming	26	16	42	0.275	22539.686
passerby	10	41	51	0.319	32162.948
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passerby	10	41	51	0.319	32162.948
horsepower	24	23	47	0.248	17908.959
bei-ming	26	16	42	0.275	22539.686

Table 5. The top five nodes in the financial economy topic

ID	In-degree	Out-degree	Degree	Closeness centrality	Betweenness centrality
sgt-pepper	6	6	12	0.875	13.166
shen-yi-bing	6	4	10	0.636	6.5
leng-yan	2	7	9	1.0	2.666
sgt-pepper	6	6	12	0.875	13.166
shen-yi-bing	6	4	10	0.636	6.5
leng-yan	2	7	9	1.0	2.666
sgt-pepper	6	6	12	0.875	13.166
shen-yi-bing	6	4	10	0.636	6.5
leng-yan	2	7	9	1.0	2.666

Table 6. The top five nodes in the psychology topic

ID	In-degree	Out-degree	Degree	Closeness centrality	Betweenness centrality
dong-ji-zai-han	13	10	23	0.8125	63.316
fei-li-pu-jin-ba	16	1	17	1.0	4.583
lisongwei	12	4	16	1.0	13.0
dong-ji-zai-han	13	10	23	0.8125	63.316
fei-li-pu-jin-ba	16	1	17	1.0	4.583
lisongwei	12	4	16	1.0	13.0
dong-ji-zai-han	13	10	23	0.8125	63.316
fei-li-pu-jin-ba	16	1	17	1.0	4.583
lisongwei	12	4	16	1.0	13.0

We can see from the above table that in these three fields, the degree of nodes in the k-core network is much larger than the average degree of nodes in the overall network. Further, we find that the size of each degree is ranked in each field. The degree of the top five nodes is much larger than the node average in the overall network. This shows that there are opinion leaders in these nodes. These nodes are closely related to other nodes and have significant influence in the network. The closeness centrality and betweenness centrality of these nodes are also larger than other nodes, indicating that these nodes occupy a more important position in the network. On the one hand, this is inseparable from the expertise they possess, and on the other hand, their activity on the platform. They can spread knowledge in specific areas for users, and they are also very enthusiastic about the dissemination of knowledge, that is, they are very active on the platform. Therefore, the platform administrator should strengthen the tracking and management of this part of the node users, so as to enhance the activity of other users through them, thereby gaining more profits for the platform.

Combining the data from the diagram and the table above, we conclude that hypotheses H1a and H1b are correct.

To explore the content of the comments on the platform, we employ the LSTM model for sentiment analysis and use Word2vec/Skip-Gram with Negative Sampling (SGNS) to convert words into vectors, which use a widely used hotel review set. This corpus is a real-world data collected from the network platform and is labeled. Therefore, it's appropriate for the sentiment analysis task. The results are shown in the Table 7.

Table7. Social network parameters of different topics

Topics	Emotion score	Topics	Emotion score	Topics	Emotion score	Topics	Emotion score
Legal	0.614	Science & Technology	0.613	Design	0.603	Medical health	0.589
Internet	0.608	Travel	0.607	Lifestyle	0.587	Art	0.620
Education	0.627	Food	0.572	Physical education	0.594	MMT	0.608
Financial economy	0.609	Business	0.598	Psychology	0.582	Reading writing	0.609

When the emotional score is less than 0.5, it indicates that the attitude of people is negative. When the emotional score is greater than 0.5, it indicates that it is positive. The higher the emotional score is, the more positive the attitude is. As can be seen from the above table, in each field, users have a positive attitude towards them, because the emotional scores are greater than 0.5. The emotional scores of the core topics are higher than the rest of the themes, while the emotional scores of other non-core topics are lower, indicating that the emotional scores have a certain relationship with the level of user interaction. The results show that when the interaction of anchors is more frequent, the users' evaluation of the field is higher. Because people can learn more about the

field through the programs of anchors attention. In other words, people can use anchors to find more high-quality programs and give a higher rating. Among them, the educational subject has the highest emotional score of 0.627, indicating that the person is most satisfied with the field. Besides, the accuracy of this model is 0.82. It indicates that this model is suitable. Hence, the last hypothesis has been supported.

5. CONCLUSION

The research on user interactions of knowledge payment platform is a breakthrough to promote the development of the platform. We mainly focus on social network and comment emotion in knowledge payment in this paper. We take Zhihu live as an example, and do the structural analysis and semantic analysis. Empirical study have proved that there is a small world phenomenon on the knowledge payment platform. Through social network analysis, we define the core topics of Zhihu live. Subsequently, we use the sentiment analysis to verify the relationship between user comments and user interactions. The study found that users are better rated for those areas where users are closely related. We believe that this article contributes two points: First, we have studied and visualized the social network of the knowledge payment platform, which was lacking in previous research. Second, we analyze the emotional sentiment of users on the platform and filled in the corresponding gaps. Our research serves the purpose of not only optimizing knowledge repositories but also enhancing social engagement.

However, our research contains several shortcomings. First, we only focus on user interaction within the same topic, ignoring user interaction between different domains. Secondly, we do not describe the users' profile of the opinion leader. We believe that the user interaction on Zhihu has an impact on the user interaction of Zhihu live. Last but not least, in the LSTM analysis, we are using a commonly used corpus, but there are only 10,000 statements. So in the future work, we could collect more user data and do deeper analysis, and use a larger corpus to make the results of sentiment analysis more accurate.

6. ACKNOWLEDGEMENT

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Exploring the Digital Transformation Based on Big Data with Ubiquitous Internet of Everything

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Abstract: Digital technologies present both game-changing opportunities for and existential threats to companies. Digital services in consumer-facing organizations offer novelty value propositions, closer consumer relationships and higher automation of consumer-facing processes. Facing big digital data streams generated by ubiquitous Internet of Everything(IoE) and savvy customers with mobile computing and social media, this paper focuses on digital transformation journeys seeking digital capabilities and digital leadership to upgrade organizational performance, one is discovering big data value, the other is dual methods with agile. The finding provides practical implications that can help guide practitioners in digital transformation.

Keywords: Internet of Everything(IoE), big data, analytics capabilities

1. INTRODUCTION

In a new era of low-cost, small electronic devices with sensing, communications and computing capabilities, commonly known as the "Internet of Things" (IoT), integrate connected devices and people into the Internet of Everything(IoE), make it possible to explore big data analytics opportunities for leveraging wearables in organizations. In particular, the Digital Data Streams(DDSs) generated by the widespread adoption of IoT devices will create opportunities to transform the business competitive landscape in many industries.

Facing considerable challenges, organizations with long-established processes and legacy systems should combine information from diverse sources(e.g. IoT and IoE) and develop new digital capabilities to derive value, such as successfully introducing Big Data Analytics(BDA) capabilities to create knowledge, make better predictions and tailor services, namely digital transformation. The key is to shift the focus from technology to business values. As a result, transforming to fully digital services requires an organization to acquire specific capabilities, listed as Table 1 and Table 2 in the perspective of Chief Digital Officers(CDOs).

Table 1. Digitalization capabilities^[1]

Connect capabilities	Intelligence capabilities	Analytic capabilities
IoT(e.g. 5G, RFID, Bluetooth, GPS, WSN, PI)	Cloud computing	BDA
	Embedded system	CPS(Cyber-Physical Systems, e.g. digital twin)
	Smart sensors as an actuator	AI technology
	Edge computing	AR(Augmented Reality)

Table 2. Digital capabilities in the perspective of CDOs

Digital capabilities	CDOs type ^[2]	The role of CDOs ^[3]
Digital innovation	Digital accelerators	Collaboration direction (inwards vs. outwards)
Data analytics	Digital marketers	Data space (traditional data vs. big data)
Customer engagement	Digital harmonizers	Value impact (service vs. strategy)

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Weak digital capabilities may limit the effectiveness of managerial improvisation, as many organizational structures and culture. To move into the digital age, a globally operating company needs to have in place a value-adding operational backbone, but many of them struggle with achieving this and the associated transformation program. Consequently, business digitalization requires substantial organizational transformation and new organizational structures and business processes. To address unexpected events rapidly and creatively, organizations increasingly are required to rely on their ability for managerial improvisation. A literature-based framework of MIS Quarterly Executive within five years, this study makes a theoretical perspective to digital transformation research that explains how organizations transition with ubiquitous IoE and in the big data era. And for enhancing enterprise capabilities for digital leadership, the finding provides further practical implications that will guide practitioners in digital transformation.

2. DIGITAL DATA STREAM(DDS) DRIVEN BY BIG DATA

Digital transformation has been defined as the use of new digital technologies, such as mobile, artificial intelligence(AI), cloud, blockchain, and IoT technologies, to enable major business improvements to augment customer experience, streamline operations, or create new business models. The key long-term technological trends are the increasing capability of the firm with customers to communicate, collect, store and analyze information. IT-driven smart Product-Service Systems (smart PSS) evolvement and implementation as Figure 1. With digital sensing ability(digital scouting, digital scenario planning, digital mindset crafting) to realize digital seizing(such as rapid prototyping, balancing digital portfolios, strategic agility), then take advantage of internal enablers(cross-functional teams, fast decision-making, and executive support by example) and overcome internal barriers(rigid strategic planning, change resistances and high level of hierarchy for instances), finally achieve digital transforming(such as navigating innovation ecosystems, redesigning internal structures and improving digital maturity).

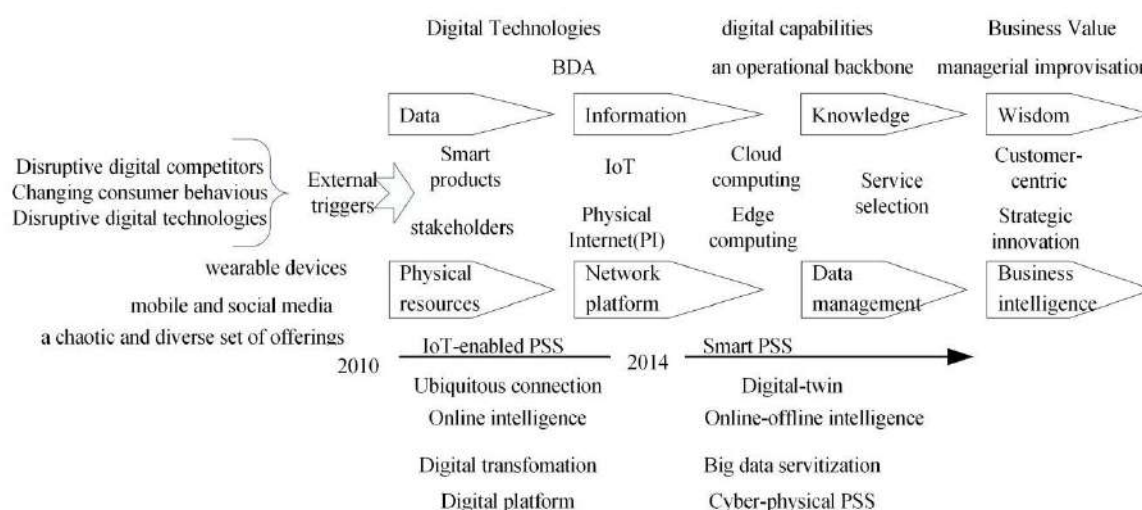


Figure 1. IT-driven smart PSS evolvement and implementation

The use of BDA and cognitive computing help to reframe marketing decision making, to understand the main levers to attain marketing goals, such as the enhancement of relationship with customers, continuous learning and development of new products and potential innovation^[4]. Digital transformation is an ongoing process of using modern digital technologies in everyday organizational life, which recognizes agility as the core mechanism for the strategic renewal of an organization's business model, collaborative approach and eventually the culture^[5].

2.1 DDSs from IoT to IoE driven by customers

2.1.1 From IoT to IoE improving organizational performance

The rapid development of information and communication technologies has enabled the prevailing digital transformation (i.e. digitalization), where physical products can be digitized in the virtual space and seamlessly interconnected. Meanwhile, industries are ever increasingly adopting service business models (i.e. servitization), offering not only physical products but also services as a solution bundle to meet individual customer needs. Such convergence of both digitalization and servitization (i.e. digital servitization) has triggered an emerging IT-driven business paradigm, smart PSS. And self-adaptiveness with sustainability, advanced IT infrastructure, human-centric perspectives, and circular lifecycle management are the core future perspectives to explore^[1].

Digital servitization has cyberspace and the counterpart physical space with physical resources, the former including cloud computing like Pass, Saas, Iaas and edge computing; the latter involving co-design, co-implementation, logistics service, value recreation.

When physical objects are connected to the Internet, they can identify themselves with other devices and exchange data automatically and seamlessly. When people adopt emerging wearable devices that are attached to the Internet, opportunities are created for organizations and individuals that can surpass the impact of even the most significant technologies of the Industrial Revolution and its aftermath. This convergence of connecting people and devices is termed as the IoE^[6]. For example, firms can eliminate residual operational risks through different types of data flows and can overcome performance bottlenecks by extending naturally degrading organizational capacities through wearable technology. By equipping workers with such technology, firms can elevate competencies and capabilities which improve organizational performance.

2.1.2 DDSs generated by IoE to realize business value

Digitally savvy customers are demanding more while threats of digital disruptions from recent entrants are rising. For example, DBS(<https://www.dbs.com.sg/index/default.page>), a large Asian bank, responded to digital threats and opportunities by adopting a digital business strategy^[7]. Another example, organizations apply the customer service life cycle framework to harness the IoT to enhance customer experience^[8].

To effectively harness the DDSs flowing from their digitized industrial products to create innovative data-driven services, a capability framework and actions is provided^[9], which guide original equipment manufacturers as they progress through a stepwise evolution of six strategic service stages based on the digitization journeys of Thyssenkrupp(<http://www.thyssenkrupp.com.cn/>) and SIEMENS.

Value realization is improved when the agility of the resource allocation process is appropriate for the levels both of DDS platform maturity and commitment from data-driven top management^[10].

2.2 Mobile computing and social media driven by customers

In the early stage of an agile software development project, customer representatives have explicit and implicit responsibilities that facilitate the creation of software to meet evolving customer needs promptly^[11]. Overcome the challenges, Hummel(<https://hummel.net/>), a European sports fashion company, successfully transitioned to omnichannel retailing^[12].

With the phenomenal growth of mobile and social media, many organizations are realizing they need an online presence to reach out to digitally savvy customers. However, delivering seamless customer experience across various online and offline channels is increasingly challenging. With the trend that online reviews of services and products are increasingly posted via mobile devices rather than a website^[13], a social media strategy to make capital out of the chaos is shaped^[14], including a mix of four tactics(namely, listening and branding, mining and deciding, conversing and sharing, and co-creating and innovating). A platform-independent framework for considering the effects of social media on enterprises is provided^[15], which also identifies the implications for managers as they consider the design decisions for an enterprise social media platform. The framework comprises the fundamental capabilities (establishing social networks and accessing digital content) of social media and the impacts (on organizations-employee performance and user behavior) these capabilities have.

3. DIGITAL TRANSFORMATION JOURNEYS TO MAINTAIN DIGITAL LEADERSHIP

Digital leadership defines as doing the right things for the strategic success of digitalization for the enterprise and its business ecosystem^[16]. Digital leadership means thinking differently about business strategy, business models, the IT function, enterprise platforms, mindsets and skill sets, and the workplace. For example, leveraging digitalization is one of the LEGO Group's (<https://www.lego.com/zh-cn>) four strategic priorities and is fundamental for it to become a world leader in its industry.

3.1 Traditional companies seeking to discover big data value

Traditional manufacturing organizations can successfully introduce BDA and master related organizational transformations. Recommendations built on the three-stage evolution of BDA capabilities at AUDI are provided^[17]. Four key lessons are drawn with a Swiss electricity utility conducted a seed project-a bottom-up initiative to develop an analytics ecosystem of business, organizational and technological capabilities.^[18] Lufthansa(<https://www.lufthansa.com/cn/zh/homepage>) exploit big data as the basis for renovating its traditional business model to one that embraces customers as value co-creators^[19]. To deliver a superior customer experience, USAA(<https://www.usaa.com/?akredirect=true>) re-architect its business by redesigning structures, roles, incentives, processes, and IT systems, integrating its previously separate insurance, banking, and investment products around customer life events (e.g., buying a car or a house, getting married)^[20].

Four BDA actualization mechanisms are identified^[21], namely enhancing, constructing, coordinating and integrating, which is implemented an automotive manufacturing company, i.e., establishing customer-centric marketing, provisioning vehicle-data-driven services, data-driven vehicle developing, and optimizing production processes.

3.2 Prime transformation journeys success in the digital era

The industrialized transformation approach of UPM(<https://www.upm.com/>), a Finnish forest industry company, is underpinned by five principles-template-based, business-driven, matrix-organized, tight supplier steering and cascaded planning^[22]. Taking account of the greater use of agile development methods, guidelines for improving IT project estimation are provided^[23], rather than traditional waterfall. And a digital services capability model is present that allows an organization to assess its current capabilities and identify gaps.^[24]

Table 3 summarize dual methods for digital transformation journeys. Depending on the type of unexpected event, two digital capabilities are identified^[25]: a flexible IT infrastructure and a well-developed information management capability-that organizations can use to foster managerial improvisation and can leverage. And two digital strategies and two technologies are identified^[26], the former are customer engagements and digitized solutions; the latter are operational backbones and a digital services platform, which enabled assets are essential for executing those strategies. How work is done to create digital workplaces and improve employee experience, transforming is focused^[27], which entails addressing two dimensions-responsive leadership and employee connectedness-with three design levels for each dimension. Here introduced the bimodal IT archetypes^[28], which decompose the IT function into two modes: (1)traditional focused on stability; (2)and agile focused on the speed and experimentation necessary to support innovative uses of IT in a digital business context.

Table 3. Dual methods for digital transformation journeys

Paper	Dual mode	Detail
[25]	Digital capabilities	Flexible infrastructure and a well-developed information management capability
[26]	Digital strategies	Customer engagement and digitized solutions
	Technologies	An operational backbone and a digital services platform
[27]	Dimensions	Responsive leadership and employee connectedness
[28]	Bimodal	Traditional and agile

4. CONCLUSIONS

Here identifies the capabilities needed and provides lessons for organizations looking forward to a successful digital business strategy. In the digital economy, deploy an architecture for participation that makes the best of digital technologies by harnessing the power of users. Such user-driven innovation has accelerated a dramatic advancement of the internet that, in turn, has accelerated the co-emergence of subtle innovation resources in the marketplace. However, big data as an industry, not a technology, many ethical issues arise, such as reselling consumers' data to the secondary market, it's important to foster a sustainable big data industry.

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Research on the Adoption Intention of Users' Knowledge Payment: the Integrated Model of UGT and TAM

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Abstract: Knowledge payment based on social media has become a new business model. The research on adoption intention of users could help the users recognize the influence of knowledge payment. Meanwhile, the research is helpful for the suppliers to standard and develop this business model further. According to the social media nature of knowledge payment, use and gratification theory and technology acceptance model were chosen as the theory basis to build the research model of users' adoption intention on knowledge payment. 315 valid samples were collected from questionnaire. Structural equation model was used as the model analysis tool. It is found that the main motivations and purposes of users' adoption on knowledge payment are the willingness to get cognitive gratification, hedonic gratification, and convenience gratification of the users. Meanwhile, in order to increase the users' adoption intentions, knowledge content represented by perceived usefulness is critical, operation process represented by perceived ease of use is the method, but perceived payment price is not the key factor.

Keywords: knowledge payment, adoption intention, use and gratification theory, technology acceptance model

1. INTRODUCTION

With the rapid development of China's economy and mobile Internet technology, the method of knowledge acquisition has gradually changed from free acquisition through various channels to active and paid acquisition of more personalized and customized high-quality content. In this context, the concept of "knowledge payment" has emerged. According to a survey conducted by China youth daily, 63.6 percent of the participants believed that they should be paid for providing high-quality knowledge, while 73.9 percent had paid for the answer to a question. And knowledge payment platforms emerge in endlessly, such as Dedao, Zhihu, Qianliao, etc. Such knowledge payment platform not only has a large audience, but also receives multiple rounds of financing from several venture capital groups. This shows that knowledge payment has gradually formed a mature business model, which will attract more and more users to participate in it. However, the research on knowledge payment is only at the beginning stage, and there is no in-depth research on the definition, characteristics and adoption mechanism of knowledge payment. And for a long time, Chinese people have been deeply rooted in the idea of "borrowlism" of knowledge. How to make users willing to pay for knowledge has become a key issue in the implementation of the knowledge payment platform.

Meanwhile, although knowledge payment is a new business model, it still relies on social media tools in essence. Using this kind of tool can make it easy for users to search, find and pay for the knowledge they need on a specific platform, and can also build their own social network in the knowledge field. Therefore, this paper examines the use of knowledge payment for the present situation, then choose to use and gratification theory (UGT) to explore what practical functions and needs knowledge payment can bring to users under the role of social media, finally combining with the technology acceptance model (TAM) to research why the users will be

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willing to pay for knowledge.

2. THEORETICAL MODEL AND HYPOTHESES

2.1 Definition of knowledge payment

At present, there is no unified understanding of the definition and boundary of knowledge payment. Zhang et al. believe that knowledge payment is a form of sharing economy. Therefore, they believe that knowledge payment refers to "an economic phenomenon in which the public share their idle resources (cognitive surplus) with others through Internet platforms to obtain income", which is a new model of information interaction^[1]. Quan and Xie think that in knowledge payment, the concept of knowledge is broadened to cover all skills and information, which can be regarded as information payment^[2]. Song pointed out that knowledge payment is actually a sharing economy feast of "knowledge sharing and content realization". The process of knowledge payment is to share fragmented knowledge with consumers who have leisure time and seek knowledge satisfaction through Internet platforms^[3]. Through the above definitions of knowledge payment, it can be found that knowledge payment is a new business model, and the process of payment is the embodiment of knowledge value.

2.2 Adoption of knowledge payment

No matter what kind of knowledge payment platform, its founders and knowledge providers hope that users are willing to use the platform and pay for knowledge. However, different from other traditional payment products, knowledge products have the following characteristics that make it difficult to pay: first, knowledge is intangible and the judgment of knowledge value is highly subjective. Therefore, how to price knowledge has become the primary problem of knowledge payment. Second, China's intellectual property awareness is still in the process of building up gradually, and users have certain feelings of resistance and rejection to the form of knowledge acquisition through payment. Third, the knowledge payment platform is a new type of business model platform, how to pay and how to use the knowledge after paying have also become the problem that users worry about in the process of paying.

Therefore, it is necessary for academia to study the adoption of knowledge payment in the context of knowledge payment. As knowledge payment is an emerging business model, there are few researches on it. For example, Zhang et al. used qualitative research to extract 7 main factors influencing users' online knowledge payment behavior from a qualitative perspective, including individual demand, individual cognition, information quality, subjective norms, convenience, substitutes and economic factors^[1]. On the other hand, based on unified theory of acceptance and use of technology (UTAUT), Quan and Xie studied users' specific usage behaviors of the Dedao APP from a quantitative perspective^[2]. The results showed that performance expectations, social influences and perceived playfulness have significant effects on users' intention to use. Liu mainly commented on the influence factors of knowledge payment behavior, including content value, professional authority, brand trust, word of mouth, price and so on. And he proposed relevant development suggestions from the perspective of content provision, users and third-party supervision^[4].

According to the research of the above scholars, it can be found that at present, the research on users' knowledge payment adoption behavior is still relatively scattered. Most researchers have roughly discussed the factors that affect knowledge payment, and at the same time, there are few relevant empirical studies based on real data. At present, the factors influencing the development of knowledge payment mainly focus on the user's demand, the use of the platform and the price of knowledge. Therefore, based on the nature of social media of knowledge payment, this paper uses TAM model and UGT to study the adoption intention of knowledge payment.

2.2.1 Use of the payment platform and perceived price

Based on social media technology, knowledge payment platform is a medium for users to communicate with knowledge providers and complete payment behaviors. Whether the platform is accepted by users directly determines whether users are willing to pay for knowledge. Therefore, this paper chooses TAM model to explain users' usage attitude towards the platform.

In TAM model, intention of use, perceived usefulness (PU) and perceived ease of use (PEOU) are the three most important variables. Intention of use refers to the possibility that the user anticipates that he or she will produce usage behavior in the future if certain conditions permit^[5]. Based on the research background in this paper, the intention of use refers to the possibility that users are willing to use knowledge payment if relevant conditions are met. PEOU refers to the perceived ease of understanding and use of a technology. PU refers to the degree that people can perceive to benefit from a particular technology in the process of using it, namely the usefulness of the technology^[6]. Knowledge payment, which includes new payment products and models, is a new technology. Whether a user is willing to use a new technology depends first of all on how difficult the process is and whether the technology is useful for their work and life. For example, when Deng et al. studied the use of SMS in China, they believed that whether users' perceived SMS operation was easy to use and whether it was helpful for users' communication directly determined their usage attitude towards SMS^[7]. In their study on the role of social media tools in higher education in Malaysia, Al-rahmi et al. also found that the perceived ease of use and perceived usefulness of social media tools directly determine whether students are willing to use social media tools in the learning process^[8]. Therefore, in the process of using knowledge payment, if the knowledge payment service can help users to track the knowledge providers they care about, find the knowledge fragments they need, solve the difficulties in users' work or life, and make users feel that the service is really useful, users will be more willing to complete the knowledge payment behavior. And if the payment platform and the payment process are easy for users to master and get familiar with, users will be more willing to pay for knowledge if they do not need to spend a lot of time on getting used to it and feel easy to use. Moreover, an easy-to-use knowledge payment service can promote users' perception of its usefulness. Conversely, if the service is cumbersome and tedious to complete, the user will not find the service useful. To sum up, this paper proposes the following hypotheses:

H1: perceived ease of use of knowledge payment services positively affects users' intention to pay for knowledge.

H2: perceived usefulness of knowledge payment services positively affects users' intention to pay for knowledge.

H3: perceived ease of use of knowledge payment services positively affects its perceived usefulness.

Although knowledge payment service is essentially a kind of social media technology, its essential difference from many social media (such as WeChat) lies in its payment behavior. Although WeChat also has a payment function, payment in WeChat is an additional function, while the core function of WeChat is still social and entertainment. However, the payment in knowledge payment is its core function, and the service is completed only when the payment behavior is achieved. In view of the particularity of knowledge payment service, another variable -- perceived price is added into TAM model in this paper.

In our study, perceived price refers to the price situation perceived by users in the process of paying for knowledge. Each user has his or her own price range and judgment on the value of a knowledge point. Users are more likely to pay for knowledge if they believe their judgment of the value of that knowledge matches the price demanded by the provider. On the contrary, if the perceived price is too high and the user thinks that the knowledge block is not worth the money or the user is not willing to pay too much for the knowledge block, the

user will not pay for the knowledge block. In the article of Lu et al., it was also demonstrated that users' perception of the service price of SMS has a significant impact on the usage behavior of SMS^[9]. And this perception of price will also affect users' judgment of the service itself. The higher the price perceived by users, the less able they feel to complete the payment. Even if the platform can provide rich and useful knowledge, it is impossible to help users, and users will not consider the service useful. Based on the above analysis, this paper proposes the following hypotheses:

H4: perceived price of knowledge payment service negatively affects users' intention to pay for knowledge.

H5: perceived price of knowledge payment service negatively affects its perceived usefulness.

2.2.2 User demand gratification: use and gratification theory

Since most knowledge payment platforms are established based on social media technology, the platform itself has both the functions of knowledge search and payment and users' social communication, which have the dual attributes of media and tools. Therefore, this paper chooses UGT to discuss users' motivations.

UGT can be used to explain the use and choice behavior of individuals, to explain why individuals use such media from psychological needs, and to think that individuals can use the same media for different purposes. At the beginning of the theory, UGT was a typical communication theory, which was mainly used to study the use of traditional media, such as newspapers and television. With the emergence of new information technology and providers of various technical services paying more and more attention to the personalized demands of users, UGT is no longer limited to the study of traditional media, and the adoption of various new technologies and service modes such as E-mail and information system can be studied based on UGT. Ali-hassan et al. studied the impact of social media on employee performance^[10]. Based on UGT, they divided employees' demands for social media into three types: social demands, hedonic demands and cognitive demands. And they found that these three types of demands affect employees' daily work performance and innovative work performance through social capital. Chaouali divides user gratification into two dimensions: content obtaining gratification and opportunity obtaining gratification, and believes that these two dimensions of user gratification can affect users' gratification with mobile SNS websites, thus influencing their continuous use behavior^[11]. In China, Li et al. applied the UGT to study the intention of continuous use of WeChat public platform. In their study, they identified three types of user gratification: utility, social, and pleasure. These three types of gratification replace each other and have a positive impact on users' continued use of the WeChat public platform. Users will consider continuing to use the platform if they meet one kind of demand^[12].

As can be seen from the above literature, UGT is generally used to explain the research on the relationship between users and media from the perspective of individual demands. However, the disadvantage of UGT is that it pays too much attention to the gratification of individual demands and ignores other external factors such as the use experience of the system itself in the selection and acquisition of media. TAM model is to explore the user's adoption behavior from the perspective of system use. Although PU and PEOU variables in TAM model can well explain why users use a certain system, a certain product or a certain service, studies on the antecedent variables of PU and PEOU are still insufficient. In their research on the use of smart phones in South Korea, Joo and Sang divided the user's use motivation into habitual use motivation and purposeful use motivation based on UGT, both of which had significant influence on PEOU and PU variables in TAM model^[13]. The research of Joo and Sang provides the basis for this paper, but their classification of use motivation does not go deep into specific user demands. Considering the knowledge characteristics in knowledge payment and the social media attributes of the payment platform, this paper chooses the gratification of cognitive demand, the gratification of hedonic demand and the gratification of convenience demand as the purposes that users wish to meet after paying for knowledge. Therefore, this paper takes UGT as a supplement to TAM model, and uses the above three specific demands to explain the antecedent of TAM model, so as to jointly understand the user's intention

to adopt the new business model of knowledge payment.

The cognitive demand for knowledge payment emphasizes that users believe that the knowledge acquired through payment can help them improve their knowledge reserve and solve problems that cannot be understood in a certain business^[10]. Users pay to get the answer to a difficult problem or an academic paper they cannot find. Such paid results can improve users' perception. If the user's cognitive demands are met, he or she will find the payment system useful^[13]. Wang et al. also pointed out in their study on employees' use of social networks at work that the gratification of cognitive demands can make users think that the system they choose can help them achieve the purpose of use, thus influencing users' attitude towards use^[14]. Therefore, this paper proposes the following hypotheses:

H6: the gratification of cognitive demands can positively affect the perceived usefulness of knowledge payment services.

The hedonic demand of knowledge payment thinks that buying knowledge can not only help users to improve the work effect, but also bring enjoyment and fun to users^[13]. This is because the object of knowledge payment also includes hedonic knowledge, such as buying a film or a novel. This kind of hedonic knowledge can naturally bring the gratification of users' hedonic demands. If users believe that the knowledge payment service can meet their hedonic demands, users will think that the payment service can help them achieve the purpose of leisure and enjoyment, and its usefulness is confirmed. Alghawi et al. studied CEOs' use of their microblogs and found that one of the most interactive demands for CEO to use microblogs was the fun-oriented demand, which led them to believe that microblogs can help them relax in the intense work, which is useful^[15]. At the same time, hedonism makes knowledge payment service less serious and boring, and this relaxed mentality can make users find the whole service and operation process more interesting. Moreover, the social media attribute of knowledge payment service can also make users feel relaxed and comfortable in the process of using it. For example, the diversification of payment objects and forms, a variety of small games and benefits after payment, etc., can bring users more interesting and relaxed use experience, making them feel that the service is easy to use. Through the research on online game system, Li et al. found that hedonic demand will affect users' evaluation of whether the system is easy to use^[16]. Based on this, this paper proposes the following hypotheses:

H7: gratification of users' hedonic demand can positively affect the perceived usefulness of knowledge payment service.

H8: gratification of users' hedonic demand can positively affect the perceived ease of use of knowledge payment service.

The use convenient demand of knowledge payment think knowledge payment service should meet users convenient search, pay and access to knowledge, such as providing to the PC and the mobile payment platform, various channels of payment (bank cards, WeChat payment, Alipay, etc.), the more diverse knowledge search methods (according to the theme, time, knowledge, etc.). If the user's demands are met, it will increase the user's evaluation of the ease of use of the system. Chaouali believes that convenience directly determines whether users are satisfied with the use of social networking sites^[11]. The research on online education by Gallego et al. also pointed out that the convenience of online education platform determines whether the platform is easily accepted by users^[17]. Based on the above analysis, this paper proposes the following hypotheses:

H9: gratification of users' convenience demand can positively affect the perceived ease of use of knowledge payment service.

To sum up, the research model of this paper is shown in figure 1:

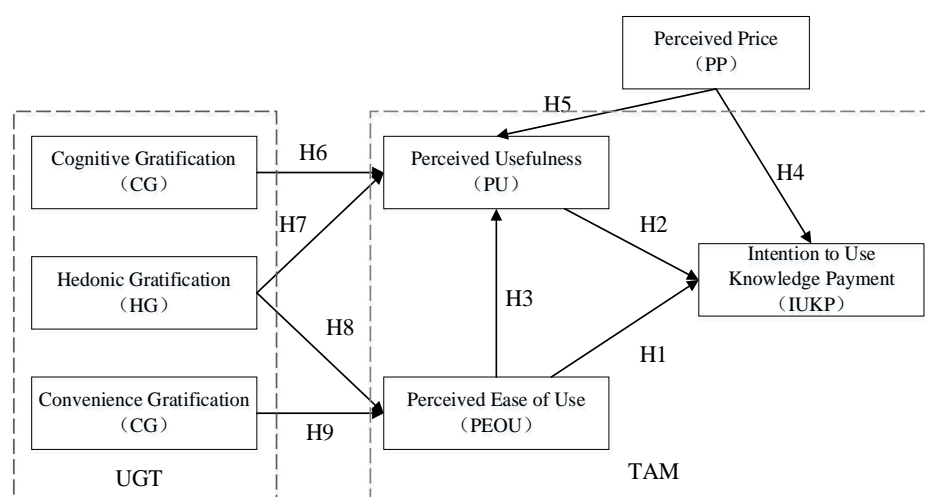


Figure 1. Research model

3. QUESTIONNAIRE DESIGN AND DATA COLLECTION

In this study, questionnaires were used to estimate the variables. The eight variables in this paper were all measured from mature scales used by researchers. For cognitive gratification and hedonic gratification of measurement refers to the Ali Hassan et al. and others research results^[10], convenience gratification of measurement refers to the measurement of "convenience" in the paper of Gallego et al^[17]. For the measurement of perceived usefulness, perceived ease of use and intention to pay for knowledge, refer to the scale in the study of smart phone adoption in Joo and Sang's article^[13]. The measurement scale of perceived price derived from the paper of Lu et al.^[9]

Since all the measurement scales of variables refer to English literature, this paper uses the two-translation method to ensure the accuracy of the questionnaire translation process. The questionnaire is mainly composed of three parts. In the first part, there is only one question, asking the subjects to choose whether they have ever paid for knowledge. Only by choosing "yes" can they enter the following survey. The second part is the investigation of the current situation of knowledge payment, including the platform used, frequency and time of use. The third part is the measurement of 7 variables in the research model. All the questions are expressed in the 5-point Likert scale, and the subjects are required to choose the appropriate expression of the stated proposition according to their actual conditions. A score of 1-5 means strongly disagree, slightly disagree, unsure, slightly agree and strongly agree. And the initial questionnaire was also pretested by 30 graduate students with knowledge payment experience, and appropriate modifications were made according to the results of the pretest, and the final questionnaire was finally formed.

This questionnaire is distributed electronically through the Internet to teachers, graduate students, researchers and workers in science and technology enterprises in universities in Wuhan and Shanghai. Because the work of universities, research institutes and science and technology enterprises has a more urgent demand for knowledge, it can highlight the importance and value of knowledge payment. And the recipients have certain economic capacity to pay for knowledge. Finally, a total of 315 valid data were obtained. Table 1 summarizes the basic demographic characteristics of the valid sample data.

Table 1. Demographic information

Measure	Items	Frequency	Percent
Gender	Male	161	51.1%
	Female	154	48.9%

Age	≤25	54	17.1%
	26-30	79	25.1%
	31-40	127	40.3%
	≥41	55	17.5%
Type of work	Postgraduate	72	22.9%
	Universities	93	29.5%
	Research institutes	66	21%
	Science and technology enterprises	84	26.6%
Education level	Master degree or above	212	67.3%
	Bachelor degree	87	27.6%
	Junior college and below	16	5.1%
Time to pay for knowledge	Within half a year	53	16.8%
	Half a year to one year	88	27.9%
	One to two years	109	34.6%
	More than two years	65	20.7%
Preferred form of payment	Pay by times	63	20%
	Pay by time period (such as monthly, quarterly and yearly)	92	29.2%
	Pay by objects	160	50.8%
Amount willing to pay each time	≤10 ¥	50	15.9%
	11-50 ¥	34	10.8%
	51-100 ¥	45	14.2%
	≥100 ¥	23	7.3%
	Pay by objects and forms	163	51.8%
Types of knowledge payment (multiple choice)	Question and answer	54	17.1%
	Information access	189	60%
	Lectures	132	41.9%
	Audio and video	279	88.6%
	E-books	202	64.1%

4. DATA ANALYSIS

4.1 Reliability and validity analysis

In this study, the structural equation model was used to analyze and verify the hypothesis. Since the research on knowledge payment is still in its infancy, and Smart PLS 2.0 can effectively explore the causal relationship between potential variables at the initial stage of the research, this software is selected as the tool for analysis and processing in this paper^[18]. Cronbach's alpha coefficient and composite reliability (CR) are commonly used in academia to judge whether the reliability of measured results meets the requirements. As can be seen from table 2, Cronbach's alpha coefficient and CR value of 7 variables were all above 0.7, indicating that the factor has high reliability. Validity means that the scale can truly reflect the characteristics or degree of the thing to be measured, which is usually divided into convergent validity and discriminant validity. The former was measured using the average variance extracted (AVE) of each factor. The latter can be tested by comparing the correlation coefficient of each factor with the square root of the AVE value of the corresponding factor. It can be seen from table 2 that the AVE values of all factors are greater than 0.5, indicating that the factors have good convergent validity. The AVE square root of the corresponding factor is also greater than the correlation

coefficient between it and other factors, indicating that the model has good discriminant validity.

Table 2. Results of reliability and validity

Factor	α	CR	AVE	Correlation matrix						
CG	0.87	0.88	0.75	0.87						
HG	0.92	0.89	0.77	0.53	0.88					
NG	0.93	0.91	0.79	0.56	0.57	0.89				
PU	0.89	0.91	0.72	0.32	0.52	0.23	0.85			
PEOU	0.88	0.87	0.69	0.48	0.33	0.35	0.51	0.83		
PP	0.89	0.92	0.72	0.41	0.43	0.41	0.44	0.33	0.85	
IUKP	0.91	0.90	0.75	0.38	0.46	0.40	0.47	0.32	0.45	0.87

4.2 Model test

In this study, SMART PLS 2.0 was used to test the significance of hypotheses in the model, as shown in figure 3. Six of the nine original hypotheses were supported. Three hypotheses were verified to be insignificant, namely, the influence of H4 perceived price on the intention to pay for knowledge is insignificant, the influence of H5 perceived price on perceived usefulness is insignificant, and the influence of H7 hedonic gratification on perceived ease of use is insignificant. Perceived usefulness, perceived ease of use, and intention to pay for knowledge were accounted for 55.1%, 21.8%, and 32.3% of the changes, respectively, by their antecedent variables.

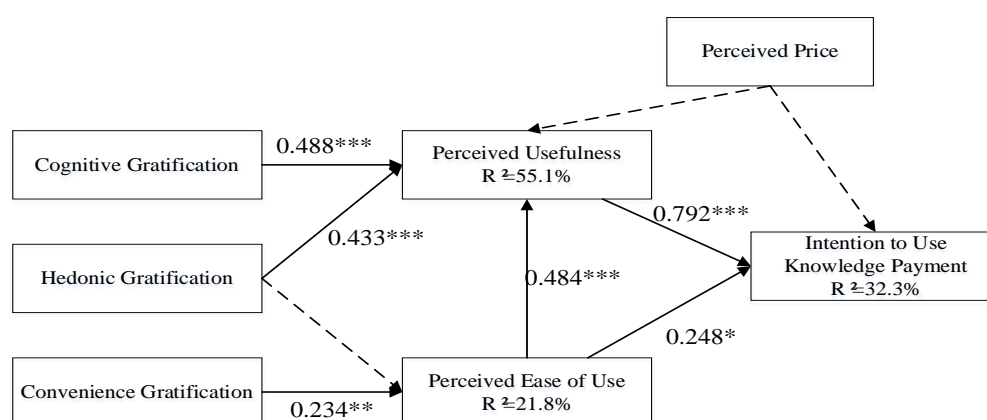


Figure 2. Empirical model

5. RESEARCH CONCLUSIONS AND RECOMMENDATIONS

This study starts from the definition and classification of knowledge payment and builds the user adoption model of knowledge payment platform based on UGT and TAM models. This study can draw the following conclusions and put forward relevant suggestions:

First, to improve the intention to pay for knowledge, knowledge content is the key, the operation process is the means.

This paper selects TAM to build the research model of users' adoption intention of knowledge payment. The research results show that perceived ease of use and perceived usefulness have significant influence on the use intention of knowledge payment, and perceived ease of use also positively affects perceived usefulness. And perceived usefulness is more important than perceived ease of use. This shows that knowledge payment is

essentially a kind of application of social media technology, and it is reasonable to choose TAM to explain its use intention. And all kinds of platforms and means of knowledge payment need to develop around the core content of "knowledge quality". Only when the content of knowledge can truly solve users' problems and difficulties and make them feel useful can users be willing to pay for knowledge. And usability also depends on the user's experience of ease of use. For example, whether it is convenient and quick to search the knowledge required by users, whether the process of payment is safe and reliable, and whether the knowledge obtained after payment can be successfully applied. Therefore, the design of the knowledge payment platform should meet users' demands and operating habits, otherwise users will give up using it because of the tedious operation process or the unsafe payment process, and consider the knowledge payment platform useless.

Second, users use the knowledge payment platform for a clear purpose.

This study found that, based on UGT, with the support of social media technology, social media technology brought about by the media tools and dual attribute can let users get cognitive gratification, hedonic gratification and convenience gratification, and the three kinds of demands gratification is the main motivation and purpose of knowledge payment of users. And the three are also conditioned to become the antecedents of perceived ease of use and perceived usefulness, which expands TAM theory to some extent. On the other hand, H7 proved to be insignificant, suggesting that the user's hedonic gratification did not affect his perception of ease of use. This further demonstrates that the focus of users is on the quality of knowledge, and the use of process is only an auxiliary means. This is also related to the data source of this paper are scientific and technological workers or master and doctoral students. This group already has extensive experience with similar platforms and their processes. And the quality of knowledge has a decisive influence on its work and study. Therefore, even if users want to satisfy their hedonic demands, they will pay more attention to the content of knowledge than to the process of acquisition. This is also one of the limitations of this study.

Third, price is not the decisive factor for the survival and development of knowledge payment platform.

Any payment behavior is inseparable from the consideration of price. However, in this study, the two hypotheses related to perceived price are not valid, which indicates that, based on the data in this paper, perceived price does not affect perceived usefulness, nor does it affect users' intention to pay for knowledge. There are three reasons that may lead to such a conclusion. First, the core of users' concern is still the quality of knowledge. If they think that the quality of knowledge matches the price, they will be willing to pay for knowledge. Secondly, most of the subjects are knowledge workers with certain economic ability, and the current payment price is within their range. Third, the knowledge payment model is still in the stage of development, not mature and standardized. Therefore, most knowledge payment platforms still regard low price as a main means to promote users to pay. However, through the research of this paper, it is found that price is not sensitive to users, and users who are willing to pay for knowledge pursue high-quality knowledge return. To survive and develop, various knowledge payment platforms need to pay more attention to the authority of knowledge providers and the quality of knowledge itself.

Fourth, the timeliness of knowledge payment products is the future research direction.

Generally speaking, there are two different usage patterns after paying for knowledge products. Pattern one is to allow users to use it for life. For example, after purchasing a document, users can download it to their own computer terminal at any time. Pattern two is only available for the duration of the purchase. If you buy a movie on Youku, you can only watch it in two days. With NetEase cloud music changing its paid use of songs from model one to model two, the debate over the timeliness of paid knowledge products has become particularly acute. This study does not involve the timeliness factor, so the influence mechanism of the usage pattern of paid knowledge products on users' adoption behavior will be our future research direction.

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Value Creation of E-commerce Platform Firms in Competitive Dynamics: From a Resource Orchestration Perspective

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Abstract: This study examines the rules of resource combination for e-commerce platform firms value creation in competitive dynamics. Based on the resource orchestration view and competitive dynamics theory, we suggest a configurational analytic framework that departs from the standard linear paradigm to examine how configurations of digital strategic action formed by digital resources creates value through the effect that competitors hard to respond to. In line with this approach, we use fuzzy-set qualitative comparative analysis (fsQCA) to news data from Chinese online tourism industry. Our findings suggest equifinal pathways to gain the effect that is hard to be responded and the specific boundary conditions of our propositions that determine what way digital technologies and partnership resources orchestrate in e-commerce platform firms' creating value. We discuss implications for theory and practice.

Keywords: resource orchestrate, business value of IT, competitive dynamics, digital strategic action.

1. INTRODUCTION

In recent years, digital technologies, such as big data, mobile computing, platform architecture, have facilitated product/service and business model innovation, new digital strategic actions (DSAs) have been formed, providing e-commerce platform firms unprecedented opportunities to create value.

However, the value creation through application of digital innovation is influenced by competition among e-commerce platform firms due to the hyper-competitive and the increasingly transparent digital environment^[1]. DSAs initiated by e-commerce platform firms could be easily imitated or responded by competitors, making value creation not only depend on their own innovative DSAs, but also the responses of competitors. Correspondingly, it is a new challenge for value creation of e-commerce platforms, which should understand how to construct and initiate DSAs effectively so as to cope with competitive interaction.

The literature on business value of IT has mainly considered that the value comes from the exclusive resources of firms, or the abilities transformed from them^[2]. However, today's digital environment has greater openness catalyzed by digital technologies that make the resources e-commerce platform owned highly similar, making it inevitable to be imitated or countered by competitors^[3], and it needs more effective portfolios of internal and external resources to improve the difficulty of imitation. In fact, the researches of IT business value studied in such static perspective have ignored complex and dynamic interaction among firms' resources^[4]. Moreover, in competitive dynamics, the creation of IT business value also depends on the competitors' responses. Prior studies only pointed out that value creation needs to adapt to the dynamic market (such as technology updating, demand's change, etc.) , but they did not consider the dynamic responses from competitors^[5]. Thus, it is difficult to explain the mechanism of value creation of e-commerce platform in the competitive dynamics.

Therefore, in this paper, our motivation is to explore the value creation of e-commerce platform firms in

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competitive dynamics. Specifically, our research taking DSA as the analysis unit, which encodes the digital technologies, partnership resources and responses of competitors through structural content analysis. Furthermore, the fuzzy-set qualitative comparative analysis (fsQCA) is used to explore the rules of combination of digital resources to create business value^[6].

The primary objectives of this study are as follows:

- *To find the digital resources configurations of DSAs launched by e-commerce platform firms.*
- *To explore the rules of value creation based on digital resources configurations.*

This paper is organized as follows. Section 2 presents the literature reviews of competitive dynamics and resource orchestration and proposes the research framework. Section 3 introduces the process of data collection and data coding. The results of set-theoretic configurational analysis are stated in Section 4. The propositions as well as discussions of theoretic and practice significance of this paper are presented in Section 5 and Section 6.

2. THEORETICAL BACKGROUND AND RESEARCH FRAMEWORK

2.1 Competitive dynamics

Research of competitive dynamics originates from the strategic management field, and focuses on competitive actions, specifically on the series of competitive actions firms initiate to enhance their competitive position and improve performance. This theory believes that firms can only seek temporary advantages in the competitive interaction, and the performance of firms depends not only on the static strength between rivals, but more on the competitive interaction, and the effect of competitive strategy depends on the reaction of rivals.

Five distinct research themes have emerged among competitive dynamics scholars over the years, each of which has contributed to our understanding of firm strategy and the behavioral dynamics of competition: competitive interaction (action-level studies); strategic competitive behavior and repertoire (business-level studies); multimarket and multi-business competition (corporate-level studies); integrative competitor analysis; and competitive perception^[7]. Among them, competitive interaction and strategic competitive behavior and repertoire are closely related to this study and are the most core and basic part of competitive dynamics. The former focuses on the “action-response dyad” generated by competitive interaction among firms, and explores how do the action characteristics (e.g., attack visibility and centrality) as predictors of competitive responses (e.g., the number and the speed of responses)^[7]. The latter studies the organizational factors (e.g., TMT characteristics, technology resources, firm governance, etc.) affecting the competitive actions repertoire of firms (e.g., complexity, intensity, diversity) and the performance brought by actions.

Recently scholars in the information systems (IS) field have begun to study the relationships between IT and competitive actions from the competitive dynamics, and considered that IT has played a positive role in developing competitive actions^[8]. Current research has focused on the impact of functional IT support on the static attributes (e.g., quantity, diversity, etc.) and the performance at the combinatorial level of competitive actions initiated by the enterprise. Current research focuses on the functional support of IT for static attributes (e.g., quantity, diversity, etc.) of the portfolio of competitive actions initiated by the firms^[9].

From the above, current research has limited IT support for firms' competitive action to the functional level. However, in the digital environment, the supporting role of digital technologies for e-commerce platform firms is enhanced from the functional level to the strategic level, digital technologies are deeply embedded in the products and services of e-commerce platform firms^[10]. The ubiquity of digital technologies also makes the actions initiated by e-commerce platform firms are bound to be responded by competitors (imitation and counterattack). Therefore, it is necessary to explore the complex characteristics of resources utilization and the effect of external markets when e-commerce platform firms initiate DSAs from a more fine-grained level.

2.2 Resource orchestration

In recent years, resource orchestration theory has attracted increasing attention from scholars in the field of strategic management. On the basis of RBV, this theory explores a more granular logical links between the leverage of firms' resources and the competitive advantages, it believes that it is necessary to effectively orchestrate resources according to the responses of competitors and the changes of market demand rather than merely looking at the resources a firm possesses. In 2007, Sirmon et al. proposed a conceptual framework based on the resource orchestration theory, which defined resource management as the comprehensive process of structuring, bundling, and leveraging the firm's resources with the purpose of creating value for customers and competitive advantages for the firm^[11, 12].

Subsequently, scholars have studied on how specific resource orchestration actions proposed in the resource orchestration theory can bring value to enterprises in different research scenarios (e.g., competitive sports, manufacturing, and supply chain). Besides, several studies have begun to link the resource orchestration theory which focuses on the internal resource combination behavior of the firms in the competitive dynamics theory which focuses on the characteristics of competitive action in the external competitive market of the enterprises, forming a complete logic chain of value creation^[13]. Based on this, it studies how the allocation of internal resources of enterprises affect the formulation and initiation of competitive actions, and how to gain competitive advantages in external markets.

Based on resource orchestration theory, scholars in the field of IS have studied the impact of IT resource orchestration actions on enterprise innovation behavior and performance in the context of enterprise innovation, e-supply chain and e-commerce adoption^[14]. The logic emphasizes that firms need to statically occupy IT resources, more importantly, they need to continuously initiate resource orchestration actions to effectively apply IT resources to achieve their goals.

In general, although scholars in the field of IS have gradually realized that in the dynamic environment, the application of digital technologies are highly transparent, and the internal resources need to be effectively orchestrated to form heterogeneous resource combinations, which is the real source of enterprise competitiveness. However, there are no studies on how to use resource combinations to build resource barriers that are difficult to imitate in a highly competitive dynamic environment, so as to gain competitive advantage for focal enterprises.

2.3 Digital technology and partnership resource as the necessary resources to initiate DSAs

E-commerce platform firms deeply rely on digital technologies to innovation^[15], and use the external partner resources (such as suppliers, partners, etc.) absorbed by the platform network effect to continuously launch new products and services to the market^[16]. However, due to the openness and commoditization of digital technology, coupled with the fact that the external partner resources absorbed by e-commerce platform companies in the same industry are also very similar, the resource differences between enterprises have almost disappeared. Therefore, the logic that enterprises rely purely on acquiring and occupying heterogeneous resources and obtain value by creating resource barriers that competitors are difficult to imitate, is no longer applicable. In fact, in competitive dynamics, the business value of e-commerce platform enterprises comes from more effective internal and external resource orchestration, forming heterogeneous resource combinations, which can build competition barriers, improve the imitation difficulty of competitors^[17].

Based on the above point of view, this study identifies two kinds of advantageous resources, namely, the digital technologies owned by the e-commerce platform enterprises and the partnership resources attached to the platform. When emerging digital technologies becomes the core advantage resource, enterprises can use the network effect to gather a large number of heterogeneous partnership resources (such as strategic investment resources, shopping-unit and inter-industry resources) to launch various digital innovation actions. This

combination of resources can support enterprises to launch a large number of DSAs.

Different from the traditional competitive actions, the DSAs initiated by e-commerce platform firms are distributed innovation driven by competitive actions based on emerging digital technologies with a large number of heterogeneous partner resources^[18]. The unique characteristics of digital technologies (such as reprogrammability and data homogenization) make the innovation present the characteristics of convergence, which means digital innovation converges the past scattered industries and products. For example, Alipay which is a typical digital innovation product integrates more than 70 products and services (such as payment, insurance, wealth management, taxi, movie tickets, etc.). Meanwhile, the convergence of digital technologies has greatly increased the number and heterogeneity of participants in innovation, which enables e-commerce platform enterprises use a large number of heterogeneous partner resources when initiating DSAs^[18-21]. For example, Alipay can continuously converge various services and products to build its ecosystem, and provide these services and products with support from external partner resources, such as banks, insurance and financial companies, etc. The more the services and products converged, the greater the amount and heterogeneity of partner resources needed.

Therefore, in order to present the combination characteristics of digital technologies resources and partnership resources that constitute the DSAs more comprehensively, this study deconstructs the two types of digital resources from the breadth and depth of digital technologies, the number, diversity and relationship strength of partnership resources.

2.3.1 Digital technology

Digital technology based on the von Neumann architecture is an electronic technology that generates, stores and processes data in binary code^[19]. *The breadth of digital technology refers to the number of technical modules that constitute a DSA. The depth of digital technology refers to the maturity of the technical modules that constitute a DSA.* The number and maturity of digital technical modules are key indicators for e-commerce platform firms, which aims to effectively integrate and use digital technologies to respond quickly to market demand and thus gain competitive advantages^[19, 22].

Modularity is one of the salient features of digital technology. In the modular architecture, specific functions are encapsulated into independent modules, and the modules are connected through standardized interfaces. The breadth of digital technology represents the richness of digital technology modules of e-commerce enterprises. In the digital environment, there is a mapping relationship between the modules and business functions of e-commerce platform firms. E-commerce platform firms will divide technology systems according to their own business functions, and assign specific business functions to modules^[22]. Therefore, the combination and recombination of technical modules will bring totally different products and services to e-commerce platform firms. For example, Trip services launched by Airbnb aim to expand the single accommodation booking function to the more extensive destination tourism service function. To initiate this DSA, firms need to integrate multiple technical modules that support short-term family rent, destination guide, catering, car rental and other businesses.

The depth of the digital technology represents the maturity of the digital technical module of the e-commerce platform firms. The higher the maturity, the better the function of the module and the better the cooperation between the modules. Digital technology has a high degree of scalability. After the technical module is designed, it can continuously upgrade and improve the function of the module and the matching degree between modules by means of repeated programming, delayed loading, code reuse, etc., so that the e-commerce platform firms can mix and match the technical modules more flexibly and agilely to quickly respond to market opportunities^[23]. For example, Uber continuously adjusts and optimizes the algorithm of driver's order receiving rules, which enables the order allocation module to realize the real-time order allocation function according to

the passenger position, and enhances the user experience.

2.3.2 Partnership resource

The definition of partner resources in this paper is the external complementary resources obtained by e-commerce platform enterprises through network effect^[24]. This article measures the use of partner resources by e-commerce platform firms from three dimensions: partner quantity, relationship strength, and partner diversity. *Partner quantity refers to the specific number of partners that constitute a DSA. Relationship strength refers to the closeness of the partnership between the partners that constitute a DSA and the e-commerce platform firms. Partner diversity refers to the number of partner types that constitute a DSA.*

The number of partners represents the scale of partner resources owned by e-commerce platform companies. The greater the number of partners is, the greater the endowment of external resources (such as suppliers, etc.) available to e-commerce platform firms tend to be. A large number of partners connected by e-commerce platform firms through digital technologies ensure the stability of the source of product and service innovation in DSAs. As the number of partners in DSAs increases, the utility of consumers through DSAs also gradually increases, which will be likely to attract more consumers. For example, Eleme, a take-away platform, quickly grabbed the market by collecting a large number of catering partners and providing consumers with a variety of online ordering services.

Partnership strength and partner diversity represent the degree of heterogeneity of partner resources owned by e-commerce platform firms^[24]. On the one hand, the strength of partnerships makes it easier for focal firm to obtain the core resources of partners, and the close cooperation of all parties allows resources to flow and match more effectively between the partners, in this case DSAs based on this have more innovative characteristics. On the other hand, diverse partner resources provide the foundation for e-commerce platform firms to build diversified products and services, and the combination of more types of partner resources has increased the difficulty of imitation.

2.4 The responses of DSAs

In the digital environment, as the visibility of innovative sources of products and services launched by e-commerce platform firms increases, competitors can quickly imitate and surpass, resulting in frequent competitive interaction. It can be seen that the DSAs initiated by e-commerce platform firms and the response actions of competitors have jointly determined the degree of value creation. Therefore, this study draws on relevant research in the field of competitive dynamics, and measures the effect of a DSA from the number of competitors' response actions and the response action delay time. Among them, *the number of response actions refers to the number of competitors' actions responding to a DSA*, and *the lag time of response actions refers to the average response delay time of competitors' responses to a DSA*.

The number of competitors' response actions reflects how often DSAs is imitated. The smaller the number of response actions, the smaller the share of competitive advantage eroded by competitors, and the greater the value that companies gain through DSAs. The lag time of response actions reflects the speed at which competitors are mimicking DSAs. The slower the competitors can imitate DSAs, the more focal firms can increase the duration of the first-mover competitive advantage. For example, Ctrip launched business travel services due to the slow response of competitors, Ctrip has successfully become the leader in Chinese business travel market.

2.5 Research framework and approach

Based on the above, this paper proposes a research framework as shown in Figure 1.

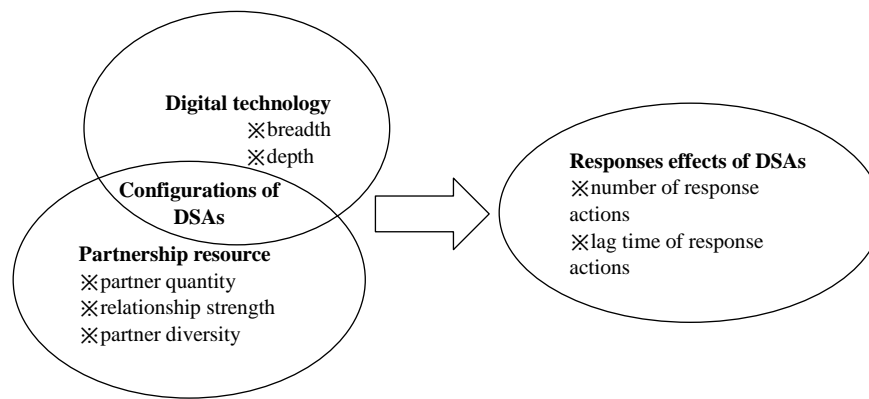


Figure 1. Research framework

Due to the support of digital technology, in addition to the convergence characteristics of DSAs, they also show unprecedented levels of generativity^[18], which means that the boundaries of innovation are highly blurred. This feature allows e-commerce platform firms to dynamically orchestrate digital technologies and partner resources to initiate DSAs based on changes in market demand. It can be seen that the support of digital technologies and partnership resources for DSAs is not a simple linear relationship, but a complex causal relationship that dynamically adapts to each other.

Specifically, on the one hand, the digital technology advantages of e-commerce platform firms can provide partners with quality services such as reconfiguring the supply chain and building brand advantages. Therefore, it attracts a large number of partners to continuously participate in cooperation. On the other hand, a large number of heterogeneous partner resources will in turn promote the breadth and depth of digital technologies. For example, the digital marketing tools provided by Taobao (such as business staff, etc.) continue to increase the stickiness of cooperative merchants. When Taobao has gathered more cooperative merchants and consumers, it has continued to introduce high-quality digital tools in a targeted manner (such as smart recommendation, single product treasure, etc.). Digital technology and partner resources complement each other and adapt dynamically to each other.

The method based on variance theory is difficult to solve the complex relationship of causal asymmetry, while the fsQCA method based on set theory can study the complex interaction between factors through configuration^[25]. The fsQCA method identifies the combination of causes that can produce outcomes of interests based on Boolean operations, that is, the configuration. Through the counterfactual analysis, it further reveals the differences in the importance of the causes in the configuration, that is, the core and periphery causes^[25]. When e-commerce platform firms initial DSAs, due to the mutual causality between digital technologies and partnership resources, the combinations of digital resources are complex and changeable, so it is difficult to show this complex relationship by using the traditional variance methods. Therefore, this paper uses fsQCA method to explore the DSAs' configurations which can bring expected business value.

3. RESEARCH DESIGN

3.1 Sample selection and data collection

3.1.1 Sample industry and enterprises selection

This study selects Chinese online tourism industry as the research scenario. The reasons are as follows: First, the online travel tourism is an emerging industry driven by digital technology in recent years. Most of the competitive actions in this industry are enabled or triggered by digital technology. Second, the online travel firm is the e-commerce platform, which needs to use digital technologies to converge partner resources to initiate

various competitive actions in order to gain a competitive advantage. This feature provides an investigative opportunity for the DSAs' configuration formed by the complex interaction between digital technologies and partner resources. Third, competition in online tourism industry is fierce. In order to expand the market share, the competition between enterprises is very frequent, and they constantly launch DSAs. Therefore, it is very suitable to analyze the competitive situation of this industry from competitive dynamics.

This study further focuses on 9 online tourism enterprises (including Ctrip, eLong, Qunar, Tuniu, LYCOM, Ivmama, Mango, Kuxun and Alitrip) that occupy more than 80% of the market share of China's online tourism market, and selects the DSAs initiated by these enterprises during the most competitive period from January 2012 to December 2014 as research samples.

3.1.2 Data collection

Based on the research paradigm of competitive dynamics, this research used structural content analysis to identify DSAs from public news reports, as well as archives of digital technologies and partnership resources. On the one hand, this study selected the comprehensive database Factiva and CNKI as the main data sources, and on the other hand authoritative industrial medias, such as TravelDaily, ctcn and ebrun, were used as supplementary data sources. In addition, in order to carefully examined the development and application of digital technology in the industry, this study extended the data collection period to the year 2000 when China's online tourism industry was born, and to the year 2015 when Ctrip, eLong and Qunar merged.

As a result, 15170 news reports were collected in this study. Then, this study used NVIVO to clean the data, and made a preliminary classification (including: competitive action, financial statements, entrepreneurs' speeches, the change of personnel, etc.), which was prepared for data coding.

3.2 Coding

Coding work mainly included: identification and classification of DSAs, coding of digital resource elements (including digital technologies and partnership resources), and pairing of DSAs.

3.2.1 Identifying and classifying of DSAs

Due to many sub-businesses of the online tourism industry, this study needed to classify DSAs according to the same sub-businesses.

First, six trained students of this research organization read the news in the news database and extracted the most relevant keywords of DSAs from the news content, and then formulated the coding agreement for DSAs.

Secondly, according to the coding rules and the research period (January 2012 to December 2014), this article identified 599 DSAs from the news database (including: the time when the action was launched, the specific content of the action, etc.).

Third, with further analysis and discussions by trained students, a classification rule has been developed for the DSAs. This classification rule divided 17 types of DSAs according to the businesses involved in DSAs (including: cruise, WIFI, car rental, scenic spots tickets, hotels, air tickets, destination information services, tourism route, train tickets, multi-service portfolios, cooperatively attract traffic, Internet finance, car tickets, tourism catering, visa services, tourism shopping, customer service). Furthermore, in order to verify the effectiveness of DSAs' classification rule, a pre-test was adopted, and the inter-rater reliability reached 95%, which indicated that the classification rule had strong robustness.

3.2.2 Coding of digital technologies resource and partnership resource

This part was divided into three interrelated sub steps: first, coding rule for digital technologies; then, coding rule for partner resources; finally, identifying the digital technologies and partner resources contained in each DSA in the sample according to the coding rules.

(1) Coding of digital technologies

Referring to the previous method^[26], the coding process of digital technologies protocol is as follows:

First, organized trained students to read the news in the news library and identify the digital technologies required by the sample firms to carry out specific business activities. For example, reading the news (titled “LYCOM Layout for Offline Travel Sights and Promote Smart Box Office System”), it could be inferred that “Smart Box Office System” is the digital technology required for ticket business on the LYCOM.

Then, use search engine, this study further enriched the relevant information of the digital technologies, and formed the digital technologies coding protocol of each sample firm (including the relationship between the digital technologies of the sample firm and the business activities carried out by the firm, as well as the information such as the first use time and update of the digital technologies).

(2) Coding of partnership resource

The process of formulating the partnership resources coding rules for this study was as follows:

First of all, the study organized the trained students to read the news about the sample actions and identify the key information of the partners, which was included in the DSAs (such as partner name, number, type, relationship strength, etc.).

Then, based on the identified information and combined with the suggestions of industry experts, this study identified five levels of partnership strength, from weak to strong: in order: ordinary cooperation, ordinary cooperation mentioning specific partner names, strategic cooperation, investment, holding or strategic investment, subsidiaries. At the same time, the types of partners were divided into 16 types, including cruise company, bank, tourism line, car rental firm, Internet platform, scenic spot, third-party payment, hotel, non-profit organization, tourism administration, travel agency, software firm, media firm, traditional manufacturing firm, highway transportation firm, catering firm, etc.

3.2.3 DSAs' pairing

The "action-response dual" pairing of DSAs in this section aims to obtain the action effects (including the number of response actions and the delay time of response actions) generated by the DSAs initiated by firms at the level of competitive action.

Competitive dynamics methodology proposes two ways of identifying competitive responses, both approaches are used in this study. The original method proposed by Chen et al. relies on an explicit reference to an earlier action in the press article^[7]. However, not all articles actually make such references because at the time of their publication, the original action may have been quite evident to readers and so required no additional mention. Therefore, an alternative coding approach is to focus on finding competitive moves that are similar to earlier actions^[27].

This study drew on the above two pairing methods, and based on the established DSAs classification, the pairing was performed in the same action type. In addition, due to the seasonal nature of the online travel industry^[28], three months are defined as the time frame within which we expected a response to occur if it was going to occur. Then, after repeated discussions and modifications, the final DSAs pairing rule was prepared, including three main criteria:

First, matched according to the same business category, similar market and similar solar terms.

Second, if the action explicitly mentions the contents of the rivalry between competitors, matched them according to the description.

Third, for DSAs that do not explicitly mention the content of rivalry, matched them in a three-month window (sliding window), which was the default time window to measure the DSAs' effect. Meanwhile, matched DSAs in an iterative way, which meant DSAs could be used as a response action in an action-response chain, as well as an initiation actions, calculated in another action-response chain.

Based on the above rules, this study identified 409 competitive actions and 1383 competitive responses.

3.2.4 Construct Measures

According to the coding rules, the variables included in the research framework were quantified to provide the basis for the subsequent fsQCA.

(1) Measuring of digital technologies and partnership resources

In the research framework, the elements that made up the DSAs' configurations included digital technologies and partner resources, corresponding to five variables (including technology breadth, technology depth, number of partners, strength of partnerships, and diversity of partners). According to the established coding rules of digital technologies and partner resources, the qualitative data related to the causal variables were translated into quantitative data. The measurement method of each causal variable is shown in table 1.

Table 1. Measurement of digital technologies and partnership resources

Causal variable	Measurement
Technology breadth	The number of digital technologies (including technologies, systems, etc.) invoked by DSAs.
Technology depth	The average days during which the digital technologies had been put into use in the firm up to the initiation of DSAs.
Partner quantity	The number of partners involved in DSAs. In addition, if the number of partners was particularly large, logarithmic conversion was performed with a base of 10 before counting.
Relationship strength	Quantified the strength of partners in DSAs. Specifically, "1" for general cooperation, "1.5" for general cooperation referring to partner name, "2" for strategic cooperation, "3" for investment but not holding partner, "4" for holding or strategic investment partner, and "5" for subsidiary.
Partner diversity	According to 16 types of partner in coding rule, quantified the number of partner types in DSAs.

(2) Measuring of DSAs' effects

The DSAs' effects that this study focused on was reflected in the two dimensions of the number of response actions and the delay of response actions caused by competitors caused by DSAs initiated by focal firms.

The measurement methods of each outcome variable representing the DSAs' effects are shown in table 2 below.

Table 2. Measurement of DSAs' effects

Outcome variable	Measurement
Number of response actions	Total number of competitive response actions elicited by a DSA.
Lag time of response actions	The average of delay days for all competitive response actions elicited by a DSA.

4. SET-THEORETIC CONFIGURATIONAL ANALYSIS RESULTS

Based on the configurational perspective, this study explained the relationship between the complex interaction combination of multiple causal variables and the outcome variables, and used fsQCA to analyze how digital technologies and partner resources form "causal recipe", which made the competitors hard to respond.

4.1 Calibration

Table 3 presents descriptive statistics and correlations for all variables.

Table 3. Means, standard deviations, and correlations

Variable	Means	s.d.	1	2	3	4	5	6
Breadth	4.86	2.93						
Depth	1720.59	950.43	-0.35					

Partner quantity	2.17	2.58	0.12*	0.00				
Relationship strength	1.17	0.92	0.04	-0.03	0.21**			
Partner diversity	1.24	1.16	0.32**	-0.04	0.51**	0.37**		
Number of response actions	3.38	2.54	-0.11*	0.10*	-0.14**	-0.19**	-0.16**	
Lag time of response actions	52.48	43.66	-0.00	-0.11*	0.07	0.22**	0.07	-0.46**

**p<0.01, *p<0.05.

Using fsQCA requires one to calibrate the causal attributes and outcomes into set-membership scores. Calibration defines the extent to which a given case has membership in the set of, for example. Ragin's direct methods of calibration are based on three qualitative anchors: full membership, full non-membership, and the crossover point of maximum ambiguity regarding membership of a case in the set of interest^[29]. We used Ragin's direct method of calibration implemented in the fsQCA 2.5 software package, which transforms a variable into a fuzzy set using the metric of the distance of the variable value from the crossover point with the values of full membership and full non-membership as the upper and lower bounds. The resulting fuzzy membership score is between 0 and 1: 0 indicates a full non-membership and 1 indicates full membership.

With reference to the calibration method of Campbell et al. and Fiss^[25, 30], this study defined these three anchors based on empirical and theoretical knowledge of the context and cases. The three anchors of the causal variable were located at the 90th percentile, mean, and 10th percentile of the sample, and the three reference values of the outcome variable are located at the 75th, median, and 25th percentile of the sample. The values are shown in the following table.

Table 4. The anchors' values of variables

variables		Full membership	Crossover point	Full non-membership
Causal variables	Breadth	9	4.86	2
	Depth	3000	1700	600
	Partner quantity	4.70	2.17	0
	Partner quantity	2	1.17	0
	Partner diversity	3	1.24	0
Outcome variables	Number of response actions	1	3	5
	Lag time of response actions	63	40	26

After calibration, to use fsQCA, one next needed to apply the truth-table algorithm that identifies combinations of elements that produce the outcome of interest. A truth table includes all logically possible combinations of the elements, and each row corresponds to one combination.

In the truth-table algorithm, fsQCA can simplify the configurations through "easy" and "difficult" counterfactual analysis, and obtain "parsimonious solution" and "intermediate solution", so as to judge whether the causal condition in the configuration is the core condition or the peripheral condition. Therefore, our work used "parsimonious solution" and "intermediate solution" obtained by fsQCA to explain whether the causal variables are the core or the peripheral causes.

4.2 Results

According to Ragin's recommendation, in the truth-table, the consistency threshold was set as 0.75. Moreover, the frequency threshold was set to 5 to ensure that the analysis included more than 90% of the samples. After truth-table analyzing, we found that five types of configurations bring great responses effects of

DSAs, including three configurations with a small number of response actions (HPN1, HPN2, HPN3) and two configurations with a long responses delay (HPT1, HPT2), as shown in table 5 below.

Table 5. The configurations for achieving high responses effects

	Response effect with a small number of response actions				Response effect with a long responses delay	
	HPN1	HPN2	HPN3		HPT1	HPT2
			HPN3a	HPN3b		
Digital technology						
breath	●	●	●	●	●	●
depth		●		⊗	●	⊗
Partnership resource						
Partner quantity	●		●	●	⊗	●
Relationship strength	⊗	⊗	●	●	●	●
Partner diversity	⊗	●	●		⊗	⊗
Consistency	0.80	0.77	0.77	0.77	0.77	0.76
Row coverage	0.20	0.21	0.30	0.27	0.18	0.18
Unique coverage	0.02	0.02	0.01	0.01	0.06	0.06
Overall solution consistency			0.75		0.76	
Overall solution coverage			0.36		0.24	
Frequency cut-off	●		5	⊗	5	

Notes: Black circles (“●”) indicate the presence of a condition, and open circles (“⊗”) indicate its absence. Blank spaces indicate “don’t care”; that is, the condition is not relevant to that particular configuration. Large circles suggest “core” or central conditions, while small circles indicate contributing conditions.

The solution table shows that the fuzzy set analysis results in five solutions exhibiting acceptable consistency (≥ 0.75) and furthermore indicates the presence of both core and peripheral conditions. Solution HPN1 indicates the core importance of digital technology breadth and partner quantity, and partner diversity and relationship strength are the causal conditions that must be absent. Solution HPN2 shows that breadth and depth of digital technology as well as the partner diversity are the core elements that must appear, while the strength of the partnership is a core element that cannot occur. In addition, the presence of the partner quantity has no bearing on this configuration. Solution HPN3 contains two neutral permutations, which means these two solutions share central conditions and only differ in their contributing conditions^[25]. Comparing solutions HPN3a and HPN3b thus indicates that high diversity of partner and the absence of digital technology depth can be treated as substitutes. Furthermore, both HPN3a and HPN3b show the breadth of digital technology, the partner quantity, and the partner diversity the core conditions to orchestrate these types of configurations.

In terms of response effect with a long response delay, there are two solutions. Configuration HPT1 shows that the breadth of digital technology, the depth of digital technology and the strength of partnership are the core conditions that need to appear, while the partner diversity is the core element that cannot appear. Moreover, the partner quantity is the peripheral element that cannot appear. Configuration HPT2 shows that in the absence of the technology depth and partner diversity, the number of partners and the strength of partnership should be high. In addition, the digital technology breadth exists in this configuration as a peripheral condition.

5. THEORETICAL CONFIGURATIONAL PROPOSITIONS

The results reflect the "equifinality" of the configuration, which helps to summarize a variety of digital resource combinations that can reduce or prevent the response of competitors (high responses effect). This study draws on previous research paradigms, extracts propositions from the results, and makes a comparative analysis of the cases in the results. Specifically, combines the "awareness-motivation-capability" framework of competitive dynamics^[7] and the basic logic of it enabled competitive advantage sustainability^[17], this study proposes three propositions that can trigger the high responses effects of DSAs.

5.1 Types of digital technologies bundling a large number of partners

Configuration HPN1 is a DSAs' resource portfolio with fewer responses from competitors, as shown in Table 6. The characteristics of resource orchestration presented by this configuration can be summarized as follows: under the condition of less mature digital technology module and weak tie with the partners, the DSAs initiated by abundant digital technology module and a large number of single type partners can effectively reduce the number of competitors' responses.

Table 6. Summary of proposition 1

Configuration	Core causal conditions	Peripheral causal condition	Successful case
HPN1	Breadth Partner quantity ~Partner diversity	~Relationship strength	In October 2012, LYCOM used the technical system related to ticket business to aggregate the information of more than 8000 scenic spots in China, and launched real-time comfort services for tourists.
Characteristics	Under the condition of less mature digital technology module and weak tie with the partners, the DSAs initiated by abundant digital technology module and a large number of single type partners can effectively reduce the number of competitors' responses.		

Notes: "~" indicate absence of causal condition.

AMC framework is a classical theoretical framework for analyzing and predicting competitive behavior in the field of dynamic competition^[7]. As precursors to competitive behaviors, awareness indicates that competitors perceive the competitive actions initiated by the focal firms, and motivation and capability respectively indicate whether competitors have motivation and ability to respond to competitive actions. Among them, awareness and motivation are related to the degree of market overlap of competitors and focal firms. The higher the degree of market overlap, the more the competitors may perceive the competitive actions of the focal firms. The capability is related to the resource endowments of firms. On the basis of the competitors' awareness and motivation to respond to the competitive actions initiated by the focal firms, the resources they own become the key factor of whether they can respond. At the same time, the researches on the sustainability of IT enabled competitive advantage hold that the key to reduce competitors' responses to the IT enabled competitive actions is to use the competitive IT resources to combine with the complementary resources to improve imitation barriers^[17].

Thus, there are two main reasons why configuration HPN1 can effectively reduce the number of competitors responses. First of all, use rich digital technology components to combine with a large number of partners to provide consumers with real-time information services, competitors have less motivation to respond. Although in the digital environment, competitors can easily perceive the DSAs initiated by e-commerce platform firms, but because the main purpose of such actions to provide real-time information services is usually to improve the after-sales experience and increase user stickiness, the time and size of the effect are difficult to estimate, so the competitors may have little motivation to respond. Second, the integration with a large number

of partners' systems improves the ambiguity of the combination of digital technologies and partner resources, further limits the response ability of competitors. If the competitors want to respond to the DSA, they need to have the same digital technology resources and partner resources as the focal firms, and clarify the mechanisms of resource allocation, which are very difficult.

Based on the above discussion, this study proposes the following proposition:

P1: using the rich and newly developed digital technology components to combine with a large number of single types trading partners to obtain information data and product resources of partners and launch DSAs, can effectively reduce the number of competitors' responses, and gain higher responses effects.

5.2 Types of flexible allocation of partner resources led by digital technologies

Configuration HPN2 is the resource combination that can trigger DSAs with fewer response actions, and configuration HPT1 is the resource combination that can trigger DSAs with longer response delay time. As shown in table 7 below, whether in configuration hpn2 or in configuration hpt1, the breadth and depth of digital technology are the core causal conditions for the high responses' effects of DSAs. Interestingly, the two types of configurations show different characteristics in partner resources deployment.

Table 7. Summary of proposition 2

Configuration	Core causal conditions	Peripheral causal condition	Successful case
HPN2	Breadth Depth Partner diversity ~Relationship strength		In September 2014, Qunar used the technical systems related to the airlines and the hotels, gathered a variety of external cooperation resources such as hotels and airlines, and launched a promotional activity of cash back on products purchased.
HPT1	Breadth Depth Relationship strength ~Partner diversity	~Partner quantity	In January 2014, Ctrip united its strategic investment partner, Yidao, launched the "shuttle" service by using the technical system of car rental and airline.
Characteristics	DSAs initiated by a large number of mature digital technology modules combined with various types of partners can effectively reduce the number of responses from competitors, while DSAs initiated by a single type of well-connected partners can effectively delay the response time of competitors.		

Notes: "~" indicate absence of causal condition.

The main reason why HPN2 configuration can reduce the number of competitors' responses would be that the rich and mature technology components can combine with multiple types of partners, which improves the difficulty of competitors' responses. Specifically, after gathering a large number of heterogeneous partners, e-commerce platform firms usually deploy a variety of partner resources based on the existing technologies to launch regular marketing activities to attract consumers. In addition, due to the high heterogeneity of partners participating in the actions, different business departments are usually required to coordinate, which not only involves the cooperation of business departments within the e-commerce platform firm, but also involves the negotiation of various matters with heterogeneous partners, such as marketing strength, promotion process, etc., which puts forward higher requirements for the resource orchestrated ability of competitors. For example, Alibaba launched its first "double 11" promotion in 2009. Because this type of DSAs need to be based on a rich and mature technology systems and a variety of partner resources, which were not prepared by major e-commerce platform firms including jd.com and Dangdang at that time, until 2012, the responses to the

“double 11” initiative were weak.

When e-commerce platform firms pay more attention to deep cooperation with a single partner, they can connect closely related partners through a large number of mature digital technology components to obtain unique product resources (configuration HPN1). Strategic partnership and competitive product resources improve the barriers of competitors' response, thus delaying the response time of competitors. For example, in 2014, Ctrip integrated its subsidiary, HHtravel, with rich and skilled digital technologies, top-level tourism products have been launched and attracted a large number of high-end consumers. As competitors needed to build strategic partners to provide them with high-quality line products, response time was greatly delayed.

Based on the above discussion, this study proposes the following propositions:

P2a: using the rich and mature digital technology components to combine with diverse trading partners to launch DSAs can effectively reduce the number of competitors' responses, and gain higher responses effects.

P2b: using the rich and mature digital technology components to connect with a small number of partner technologies closely related to a single type of cooperation, so as to obtain high-quality product resources and relationship resources, launch DSAs, which can effectively delay the responses time of competitors, and gain higher responses effect.

5.3 Types of strong partnerships

Configuration HPN3 is the resource combination that can trigger DSAs with fewer response actions, and configuration HPT2 is the resource combination that can trigger DSAs with longer response delay time.

Table 8. Summary of proposition 3

Configuration	Core causal conditions	Peripheral causal condition	Successful case
HPN3	Breadth Partner quantity Relationship strength	Partner diversity ~Depth	In December 2013, Ctrip strategically invested in 8 different types of international car rental firms, using its own vehicle business technology system to connect with partner technology system, and launched overseas self-driving service.
HPT2	Partner quantity Relationship strength ~Depth ~Partner diversity	Breadth	In April 2014, Tuniu, in close cooperation with hundreds of tourism product suppliers, launched a special-sale channel, which can quickly reduce stock according to the supplier's own situation and market demand.
Characteristics	With a large number of closely related partner resources, DSAs initiated by rich and immature digital technology modules can effectively reduce the number of responses from competitors and delay the response time of competitors as well.		

Notes: “~” indicate absence of causal condition.

The main reason why configuration HPN3 can reduce the number of competitors' responses is that it uses rich and newly developed digital technology components to connect with a large number of good partners to gain various product resources of partners, and enter new markets to launch new products. Competitors will be difficult to respond due to lack of domain knowledge and related resource endowment. Specifically, on the one hand, due to the lack of understanding of the new market and unclear benefits of the emerging product market, competitors have little motivation to respond. On the other hand, because of lacking of domain knowledge necessary for the new market, competitors are also difficult to understand how to imitate the focal firms.

Similar to HPN3, in the absence of mature digital components, e-commerce platform firms have a large

number of strong relationship partners who can use a variety of technical functions to find niche markets and establish new business models (configuration HPT2). At this time, although competitors have high motivation to respond, they need to invest a lot of time in advance to find a large number of close partners resources. The resource combination of DSAs represented by configuration HPT2 mostly occurs when the e-commerce platform firms have been deeply involved in some industries for a long time, and have built a very good relationship with the upstream and downstream partners of the industry, and have fully estimated the development trend and potential profit point of the industry. In this case, competitors will have strong response motivation for the emerging business model launched by focal firms. However, it is difficult for competitors to establish similar close relationships in the short term, thus delaying the response time.

Based on the above statements, this study proposes the following proposition:

P3: using rich and newly developed digital technology components to connect with a large number of closely related partner technologies, acquiring a large number of high-quality product resources of partners to launch digital strategic actions, can effectively reduce and delay the number and response time of competitors, and gain a higher competitive advantage.

6. DISCUSSION

Based on the resource orchestration view and competitive dynamics theory, this study uses the research configurational paradigm to explore digital resources combinations which create value of e-commerce platform firms, and proposes theoretical propositions. Specifically, this research has several contributes for business value of IT:

Firstly, in view of the characteristics of the complex interaction of digital technologies and partner resources in e-commerce platform firms, this study explores the relationship between the dynamic combinations of two types of advantage resources and different types of DSAs based on the configurational approach, and clarifies that in competitive dynamics, the value of e-commerce platform firms comes from the dynamic combinations of advantage resources. This finding breaks through the limitation of thinking that taking possession of resources as the source of value in the previous research, and provides new evidence for exploring the resource orchestration mechanism of DSA in competitive dynamics.

Secondly, this study introduces the research paradigm of competitive interaction in competitive dynamics into the business value of IT. On the one hand, the logical chain of value creation of e-commerce platform firms is built completely from resources to actions to responses' effects; on the other hand, the internal mechanism of gaining advantages through competitive interaction among e-commerce platform firms is examined in more fine-grained way, which lays a solid foundation for the research of business value of IT in digital environment.

Thirdly, e-commerce platform firms need to pay attention to embedding their digital technologies into external partner resources to form innovative products and services that are difficult to imitate, so as to gain competitive advantages. At the same time, in the competitive dynamics, digital technologies and partner resources interact with each other in a complex way, that is to say, different resource combination patterns can help firms gain competitive advantage in a specific competitive situation. With the change of the situation, the former resource combination patterns that play an effective role may lose their effectiveness. Therefore, e-commerce platform firms should not blindly cultivate the fixed resource combination, but should learn the integration mode of digital technologies and partner resources in an all-round way, and make use of them in time according to the environment.

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The Impact of Online Word-of-mouth and Negative Media Exposure on Consumer Habitual Skepticism: The Mediating Effect of Attribution

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Abstract: How did habitual skepticism come into being? In this research, the causes of consumer habitual skepticism are explored from the perspective of attribution. We put forward two important antecedent variables, negative online word-of-mouth and negative media exposure. The study results show that the higher the negative word-of-mouth perception is, the higher the stability and controllability of consumer attribution will be, and the higher the degree of consumer habitual skepticism will be. The higher the intensity of negative media exposure is, the higher the stability and controllability of consumer attribution will be, and the higher the degree of consumer habitual skepticism will be. We test this framework through two experiments. Study 1 investigates the influence of negative word-of-mouth spread and media exposure on consumer habitual skepticism. Study 2 investigates the effect of two independent variables on consumer habitual skepticism from an overall point of view and explore the mediation effect of attribution.

Keywords: online word-of-mouth, media exposure, consumer habitual skepticism, attribution theory

1. INTRODUCTION

For the past few years, with the unceasing exposure of products' harm crisis incidents and company scandals, consumers' confidence in products and industries has decreased^[1]. Consumers have showed great skepticism about company advertising^[2], and environmental statements^[3], corporate crisis public relations^[4], enterprise social responsibility^[5], media reports^[6] and other aspects, even to the point of questioning without thinking. This kind of doubt which is formed by continuous stimulation and reinforcement of external information for a certain period of time is called consumer habitual skepticism. There are studies showing that skepticism can further influence consumers' emotions and attitudes. To be more specific, skepticism about advertising propositions will make consumers reject the attractiveness of advertising, which will further let them generate a lower brand attitude and willingness to buy related products^[7]; Consumers' skepticism of the company will lead to a decline in enterprise reputation^[8] and a decreased willingness to buy its products^[9]. Once the consumer skepticism becomes a habit, it will be very hard for companies to gain consumers' trust. Obviously, as an important consumer emotion, understanding consumer habitual skepticism is vital for companies, but the research about it is evidently not enough. How did habitual skepticism come into being? And what kind of factors affected it? So, in order to fill these gaps, this study is aimed at understanding the generation mechanism of consumer habitual skepticism through developing relevant conceptual frameworks and conducting empirical tests. We put forward that media exposure and word-of-mouth spread are important antecedents of consumer skepticism. This is because consumer habitual skepticism is formed by the constant influence of external environmental information, and online word-of-mouth and media exposure are important sources for consumers to get external information. Furthermore, because consumers use the knowledge of persuasion to help them understand and handle some incidents through attributional reasoning^[8]. The research literature which consumers doubt also shows that causal attribution can cause consumers to doubt the company, so we take attribution as the intermediary mechanism in this study.

We achieved the goals above through two studies. Study 1 investigates the influence of negative word-of-mouth spread and media exposure on consumer habitual skepticism. Study 2 investigates the effect of

two independent variables on consumer habitual skepticism from an overall point of view and explore the mediation effect of attribution. The remaining parts of this paper will begin with a review of related research which forms the theoretical basis and assumption generation, then talk about research methods and the results of three studies. In the end, this paper will discuss the survey results and their management influence, limitations and future research approaches.

2. THEORETICAL FRAMEWORK

2.1 Negative online word-of-mouth

Word-of-mouth (WOM) generally refers to non-commercial interpersonal communication, which includes discussions about products and sharing contents related to product; It can be direct recommendations or just mentions^[10]. It includes not only face-to-face discussion and sharing, but also online mentions and comments. From the aspect of marketing effectiveness, the study by Bughin, Doogan, and Vetvik^[11] found that word-of-mouth is the key factor in 20% to 50% of all purchasing decisions. Because of the intangibility and service experience, customers are more likely to rely on interpersonal communication in the form of word-of-mouth in service contexts^[12]. Word-of-mouth communication have an influence on the short-term and long-term judgments of consumers on product evaluations. This influence is even greater when consumers are in face of an uncertain experience and when word-of-mouth communication content is presented by experts^[13]. Word-of-mouth can positively influence decision-making, and meanwhile can also negatively affect decision-making^[14]. Many studies suggest that negative word-of-mouth is more powerful than positive one.

Compared with traditional word-of-mouth, online word-of-mouth information is wider in range, faster in speed and more in quantity. Hennig thurau et al.^[15] defined online word-of-mouth as all positive or negative comments about a product or company made by a potential, actual or former customer passing on to a mass group or organization through an online medium. Online word-of-mouth can be spread through a series of communication tools based on network media, such as online product discussion area, online forum, newsgroup, blog, instant messaging, etc.^[16]. Due to the communication cost is low, consumers can share their points of views and attitudes anytime and anywhere. What's more, the internet word-of-mouth is anonymous, which makes the sender of the message more unscrupulous when teasing and complaining. Negative information is more diagnosable, and information consistency theory also proves that information different from the original information will be handled more seriously^[17], as a result, individuals will rely more on negative information when making a decision. Therefore, negative online word-of-mouth often has more influence than positive word-of-mouth. The consumer habitual skepticism we study in this paper is mainly derived from negative word-of-mouth.

2.2 Negative media exposure

Media, the medium of information spreading, is an important way for the public to get information. "Exposure" is always considered as a specific mechanism of media, and some studies directly equate it with negative reporting. Generally speaking, the media prefer to publish reports with negative information, because it is easier to get the attention of the audience by negative reports than by positive information^[18].

Negative exposure refers to that media distributes information about potential threats to products, services and individuals for free^[19]. According to a survey conducted by DDB Needham worldwide, negative reports and how enterprises deal with them have also become the most important factors affecting consumers' purchase decisions. More importantly, social psychology research indicates that people rely more on negative information when they form an overall evaluation of a goal^[18]. This effect not only works when forming an overall impression of a person, but also works when evaluating products. Because negative information is more diagnostic and useful, consumers prefer to form their own value judgment by negative exposure^[20]. Besides, the

study found that negative media exposure is more biased. This bias comes from the journalists and editors' personal preferences^{[21][22]}; on the other hand, it comes from the choices made by journalists to maximize their own interests due to the audience preferences^[23]. Because of consumers concern about food safety, some media deliberately exaggerates the facts to attract the attention of consumers in order to meet consumer preferences.

With the booming of the Internet, online media have become an important information source for consumers. Many scholars have begun to pay attention to the credibility of network media^[24]. Li Xiaojing and Zhang Guoliang^[25] compared the credibility of traditional media, web1.0 websites and social media through an online random sampling survey, and found that among the three types of media, traditional media is still considered the most reliable. Social media is used more and more commonly and frequently, the credibility of which, however, is the lowest among the three.

2.3 Consumer habitual skepticism

Skepticism is a common psychological state of humans, in which the perceiver has malicious guessing about the motives of others and believes that others may have hidden motives. As a result, Fein^[26] defined consumer skepticism as a dynamic state, and it is a state of psychological doubt caused in specific situations. It is a potential response of consumers to advertisement, promotion and public relations^[27].

Habits are always understood as "learned behavior sequences which will become automatic reactions to specific situations and can play a role in achieving certain goals or final states"^[28]. Verplanken and Aarts^[29] defined habit as learning oriented automatic response, that is to say, habit is not innate, but an individual's learned response to a certain stimulus that can be cultivated later^[28].

Further, we put forward the definition of consumer habitual skepticism: it is a kind of psychological state, which looks at people and things around in negative and pessimistic psychological state. When in face of the hidden and unknown motivation, people will come in to this state, expecting that the other party lacks ability, which is dishonest, malicious, irresponsible, and will violate consumer's interests, even hurts consumers. Habitual skepticism is a kind of thinking activity of thinking, exploring and researching from the opposite side due to individual's uncertain perception of organization or other's behavior motivation, product features and other specific things. This kind of thinking has the characteristics of negativity, exploratory and automaticity. To be more specific, firstly, habitual skepticism is a kind of negative guessing automatically generated by the individual's uncertainty of other people's behavior motivation. Secondly, habitual skepticism is an automatic response when people are uncertain about the motives of others' behaviors, which tends to negatively deduce the intention of other people's behavior. Finally, habitual skepticism is an individual's cognitive inertia for reducing risk, which makes the perceiver unconsciously doubt about the motivation of other people's behavior, thus conducting a series of negative speculation which they think reasonable.

2.4 Attribution theory

Attribution is the process of inferring and judging the cause of their or others' behavior based on related information and clues^[30]. People will infer the explanations of their own or other people's behaviors based on the reasons behind them, and these explanations determine the following behaviors^[31]. Attribution can have an effect on consumers' purchasing or choosing behaviors. Many studies have manipulated consumers' beliefs to lead consumers to attribute choices to liking the product or to being constrained by the situation, or to purchasing the product to please others^[32]. The study on attribution in the field of consumer behavior mostly occurs in the framework of product quality defects or service failures to explore the judgments and behavior intentions of consumers on the attribution of negative incidents. Generally speaking, the attribution of accidents can affect consumers' satisfaction and emotion, and it has an impact on the behavior of consumers, the success or failure of products, and the spokespersons, communicators of product in the context of consumption and service^[33].

Studies about the social psychology normally think that the antecedent variables of attribution are related to motivation, information, and belief^[31]. On the one hand, consumers may have motivations to make some causal inferences from hedonic or self-esteem needs; on the other hand, relevant information about an action, such as the frequency of occurrence, and what other actions occur simultaneously, forms the basis of consumer attribution. Finally, the previous beliefs may lead consumers to make some causal inferences. In addition, most studies combine the antecedent variables of attribution with the outcome variables for testing^[31], and found that attribution outcome variables include multiple behaviors, intentions, and emotion^[34]. It can be roughly classified as a result related to the locus^[35], a result related to controllability, and a result related to stability^[34].

Consequences linked to locus. Consumers' attribution to locus of the occurrence will influence their degree of satisfaction. Oliver and Desarbo^[36] manipulated source attribution through experiments and found that when investors attribute the success of their stock investments to external causes (such as institutional reports and reminders), they will have higher degree of satisfaction than those who attribute it to internal causes (investors' own research and decisions). A similar effect is seen in the negative event situation, where consumers will be more dissatisfied if they attributed the problem to the seller^[37].

Consequences linked to controllability. Controllability refers to the extent to which the consumer believes the event can be controlled. For example, passengers may consider the slow speed of check-in baggage to be a controllable factor for airlines, while flight delays are considered to be a problem with less controllability by airlines^[38]. Controllability also has an effect on consumers' anger about product failure^[35], and they may express more anger at product failure caused by controllable factors of companies.

Consequences linked to stability. Stability perception influences consumers' expectations of whether similar events will happen again^[34]. If consumers think a kind of product or service failure is stable, then they will adjust their expectations for that product or service. Stability often works together with the source of the occurrence to form the attribution of consumers to relevant events or problems, which will further affect the consumers' subsequent behavior.

2.5 Negative online word-of-mouth, negative media exposure, and consumer habitual skepticism

Compared with positive word-of-mouth, negative word-of-mouth is easier to obtain and diagnose, as a result, its impact on consumer attitudes and behavior^[39] is even greater. However, it is worth noting that due to the popularity of the Internet, the influence of negative online word-of-mouth, the negative or passive word-of-mouth information spread through the Internet, is becoming more and more significant, whose perniciousness far more exceeds the word-of-mouth in the past interpersonal communication. And its spread and diffusion through the key nodes of all kinds of social network platforms will affect a wider range of consumers to form a skeptical attitude towards organizations or products involved in negative events, forming habitual skepticism from month to month.

Negative word-of-mouth communication involves interpersonal processes and informal processes. It's easier to explain the receiver's understanding of the sender's motivation for delivering such kind of information using attribution theory^[40]. Because the cause-and-effect analysis is the individual's internal need to understand social events, the information receiver will infer why other people share negative information about the brand^[41]. As a result, attribution becomes the cognition generated by that the information receiver infers the reason why the transmitter propagandizes the negative information. The research^[40] verified that attribution involves the evaluation of interpersonal information on the focus object of the receiver. Lacznia, Decarlo and Ramaswami^[42] also verified that attribution is the intermediary of the influence of negative word-of-mouth on brand evaluation. So, from this study's point of view, the receiver's attribution is also the intermediary of the influence of negative online word-of-mouth on consumers' habitual skepticism.

According to the classical attribution theory study, causal attributions that people make about information

include stimulation (it refers to negative events in this case), people (it refers to communicators in this case), environment, or a combination of the three. However, the specific types of attribution generated by individuals depend on that by which way the information is delivered. In the context of negative word-of-mouth communication, receiver may make the attribution based on the extent to which others agree with the spreader's negative view, that is, common understanding. The more negative online word-of-mouth information about an event, the more controllable the problem is expected to be, so this kind of common understanding will have an effect on the controllability of attribution. What's more, the stability of attribution will be influenced by the stable negative experience of communicators in different times and situations. As communicators relate negative information with specific brands (rather than other brands), consumers will increase their criticism of enterprises, which means they will attribute the causes of negative events to enterprises rather than other environmental causes.

As a result, we infer:

H₁: Negative online word-of-mouth perception influences consumer habitual skepticism through consumer attribution.

H_{1a}: The higher the negative online word-of-mouth perception is, the higher the stability of consumer attribution will be, and the higher the degree of consumer habitual skepticism will be.

H_{1b}: The higher the negative online word-of-mouth perception is, the higher the controllability of the consumer attribution will be, and the higher the degree of consumer habitual skepticism will be.

If media exposure is focused too much on bad news, it will affect people's cognitive framework and form "habitual skepticism"^[43]. This is mainly because the media, as a communication tool with high reliability, has always been an important method for individuals to get public information. When the media frequently exposes negative information, the public will feel a higher degree of insecurity and uncertainty. They may even think that in the social environment and life, there are risks everywhere and they always need to be vigilant. Furthermore, the public's processing of negative information is different from that of positive information. Studies have proved that negative information is more diagnosable. Therefore, the public may be more sensitive to negative information. They are more willing to process it at the cognitive level, with deep memory. As a result, the frequent media exposure of the negative information will inevitably arouse consumers' habitual skepticism.

Taking product's harm crisis as an example, media exposure will inevitably expand the negative effects of the crisis. Due to media exposure, the range and degree of negative events perceived by the public will exceed the actual situation. And the use of multimedia (including voice, picture, photo and even 3D animation, image, etc.) will also improve consumers' perception of the negative information's facticity, that is, improve the stability of that negative events are caused by companies^[44]. From the previous literature review, it can be found that when the media exposes negative events, sometimes it will cause some deviation in the report in order to gain the attention of the public. This deviation objectively leads to the controllable attribution of consumers to the relevant company or brand.

As a result, we infer:

H₂: The intensity of negative media exposure influences consumer habitual skepticism through consumer attribution.

H_{2a}: The higher the intensity of negative media exposure is, the higher the stability of consumer attribution will be, and the higher the degree of consumer habitual skepticism will be.

H_{2b}: The higher the intensity of negative media exposure is, the higher the controllability of consumer attribution will be, and the higher the degree of consumer habitual skepticism will be.

3. METHODS AND CONCLUSIONS

All assumptions will be studied through two experiments. We hope that our findings will provide new points of views to the literature on online word-of-mouth, media exposure, and consumer habitual skepticism.

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Digital Innovation in Organizational Research: A Systematic Review

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Abstract: As digital technologies penetrate and integrate into the industry, organizations are facing increasing pressures to apply digital innovation to update and transform their business models. To meet the growing need to guide the practice of digital innovation, progress have been made in the theoretical work of digital innovation management. However, due to digital innovation literature is increasing rapidly in recent years and research in different fields and disciplines is so fragmented, scholars are hard to have a general picture of digital innovation research. For the purpose of addressing this gap, this study tried to provide roadmap for the DI studies by answering the those questions: how digital innovation research evolved over time, how to understand the concept of digital innovation, and what research streams and opportunities exist in current digital innovation research. We conducted a systematic review with a hybrid methodology composed of bibliometric analysis and content analysis, covering the period 2010–2019. Results show that the current digital innovation research covers four perspectives: (1) connotation, process and outcome, (2) strategy, (3) resources, (4) organization and culture. Furthermore, we concluded research questions and opportunities for future research in different research fields.

Keywords: digital innovation, digital technology, innovation management, systematic review

1. INTRODUCTION

In the digital era, digital technologies are utilized by organizations to innovate products and services, business processes, or business models. Digital Innovation (DI) is challenging both theories and practices in organizational research, and scholars call for more research on it. Hence, a multitude of DI research springing up in the last ten years has made some achievements, in information systems, strategy management, innovation management and other organizational research fields, including product architecture for organizing DI ^[1], service-dominant logic of service innovation ^[2], value space framework explaining the value creation and capture in DI and so on ^[3]. With their great works, it is essential for the subsequent researchers to have a general picture of existing research, especially influential works, to further DI research.

DI management research substantially can be classified into innovation management research, which revolves around organizations. Therefore, the core issue of DI management is still the interaction between DI and organization. However, the studies of DI in different fields and disciplines are so fragmented that DI literature in organizational research are difficult to be understood clearly and comprehensively. Kohli and Melville (2019) tried to deal with this gap in their literature review, and the theoretical framework they proposed is helpful to understand actions and outcomes of DI ^[4]. Nevertheless, account of the rapidly increase of DI literature and the fact that some emerging literature cannot be simply integrated into the theoretical framework of “innovation actions and outcomes”, it is still unclear what we know about DI in totality.

For the purpose of addressing this gap, this study made a systematic literature review on DI research. Differing from previous reviewing works, we focused on the theme of “digital innovation and organization” from perspective of innovation management, and tried to answer following research questions: how DI research evolved over time, how to understand the concept of DI, and what research streams and opportunities exist in current DI research?

The rest of the paper is organized as follows. The second section refers to research methods and explains the methodological procedures of the systematic literature review in detail. In the third section, through

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bibliometric analysis, we present how DI research theme evolved. In the following section, main findings and discussions on definitions, research streams and opportunities of DI are concluded with the help of content analysis. The paper ends with a brief summary of contributions, limitations and future research.

2. RESEARCH METHODS

Systematic reviews start by defining a review protocol. A pre-defined protocol is necessary to reduce the possibility of researcher bias ^[5]. In general, review protocol includes: research background, research questions, search strategy, study selection criteria and processes, data extracting and synthesis. Figure 1 depicts the main stages in our research.

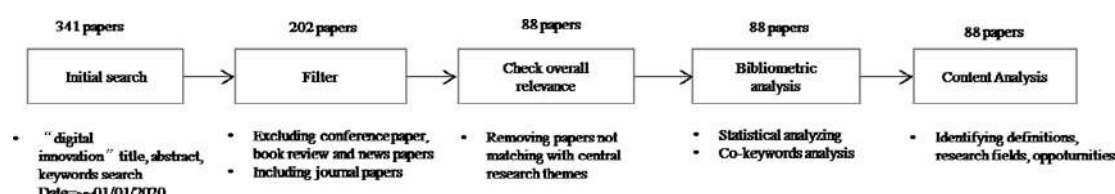


Figure 1. Phases of systematic literature review

2.1 Search strategy and selection criteria

The main academic bibliographic database for the search was ‘Web of Science (WoS)’. To ensure the direct relation of results with DI domain, the review is performed in studies only where the phrase ‘digital innovation’ is found in their title, abstract or keywords. Moreover, the search duration is between years of 2010-2019. Based on this search criterion, 341 articles were returned from WoS database. Duplicate articles, conference papers, book reviews were removed which left a total of 202 articles. The abstracts of articles were then reviewed to ensure their relevance to the focus of our theme. Some articles despite containing the “DI” in the title or abstract or keywords, actually are not relevant to our research theme, are excluded, such as articles on education innovation, finance innovation. This led to a final sample of 88 articles that were reviewed in this study.

2.2 Bibliometric analysis procedures

Bibliometric analysis can generate quantitative information from a large number of historical document data using statistical and social network analysis ^[6]. Firstly, we obtained the number of published articles by journal and year which help us to analyze how the publications evolved over time. And then, presuming that the more it is cited, the greater the influence it has on a given field of research, we listed the most-cited articles from the sample. Finally, by using author-selected keywords’ analysis, we could obtain summary important information from studies without access to full-text studies.

In addition, to determine the research themes in DI, the author-selected keywords network of the 88 papers were analyzed. Network structure was based on the following scenario: keywords were chosen as the vertices and co-occurrence of two keywords in an academic paper was defined as an edge of network. Analysis of keywords network was performed by Gephi 0.9.2 tool. The keywords network considering two periods of analysis (2010–2015, 2010–2019) was used to identify emerging concepts associated with DI research.

2.3 Content analysis procedures

In this stage, we designed a data extraction form in order to record all the information accurately. The research steps are presented as following. In the first step, we extracted the definitions of DI given by the 6 articles from the list of 17 articles more than 10 times-cited. To better understand these definitions, comparisons are made by dividing them into two categories according to the common characteristics presented in the definitions. This process was performed by reading each study carefully.

In the second step, we identified research filed of current DI literature. There are different frameworks for

research classifications in the innovation management area. Inspired by the outstanding work of Chen and Zheng (2016) in innovation management [7], we extracted five key elements: research perspectives, research fields, research questions, representative contributions and opportunities for future DI research.

3. BIBLIOMETRIC ANALYSIS

3.1 Descriptive statistics

The left picture in Figure 2 shows that the number of DI literature is increasing year by year. From 2010 to 2018, the increase was gradual, while in 2019 it became almost exponential. This reminds scholars that DI research is in a period of great concern. 10 most frequently cited journals published approximately 44% of the articles in sample. Results are presented in the right picture in Figure 2.

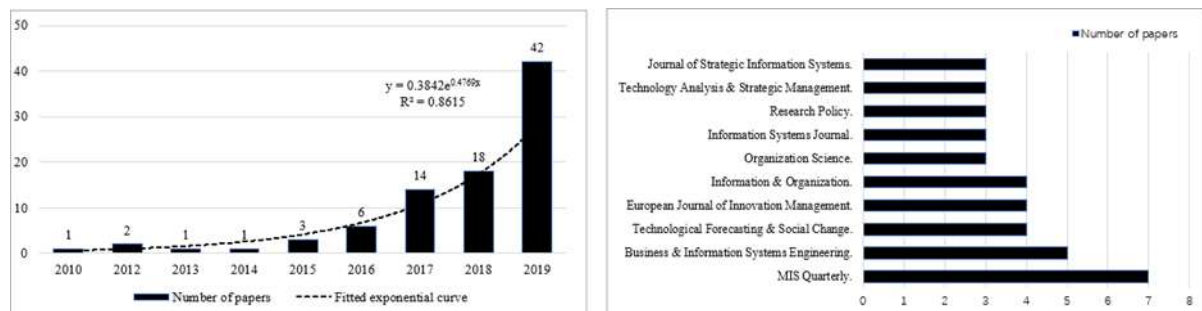


Figure 2. Distribution of papers by publication and year.

The right picture in Figure 2 shows that five of the 10 journals are belonging to the field of information systems, which means more attention has been paid to DI research from this field. But the top journals focusing on organization and innovation management, such as European Journal of Innovation Management, Organization Science, and Research Policy, are also following up the DI research.

Table 1. List of the 10 most-cited articles in the sample

Author	Journal	Times cited	JCR(2018)	AIF
Lusch & Nambisan (2015)	Mis Quarterly	291	4.373	1563.5
Yoo et al. (2012)	Organization Science	268	3.257	1140.9
Yoo et al. (2010)	Information Systems Research	325	2.457	1123.5
Nambisan et al. (2017)	Mis Quarterly	93	4.373	499.7
Nylen & Holmstrom (2015)	Business Horizons	61	2.282	200.2
Svahn et al. (2017)	Mis Quarterly	35	4.373	188.1
Yoo (2013)	Journal Of the Association for Information Systems	42	3.103	172.3
Huang et al. (2017)	Mis Quarterly	29	4.373	155.8
Lee & Berente (2012)	Organization Science	34	3.257	144.7
Saldanha et al. (2017)	Mis Quarterly	17	4.373	91.3

Presuming that the citation of a paper represents its influence, Table 1 lists the 10 most-cited articles and the calculation of their impact index (A_{IF}). A_{IF} was proposed by Carvalho et al. (2013) and was calculated according to the equation: $A_{IF} = \text{Citation} * (\text{JCR} + 1)$ [8]. Although the work of Yoo et al. (2010) ranks third position in the list, they are pioneers in the study of DI. A lot of interesting and insightful concepts have been proposed by them, such as the Layered Modular Architecture of Product. Lusch & Nambisan (2015) offered a broadened view of service innovation based on service-dominant logic, which incorporate some concepts, such as DI, digital infrastructure and software-based platform, into a more general framework.

3.2 Keywords network analysis

In the following part of this study, we got the general situation of DI research with the analysis of keywords. The main content of our analysis includes evolution of keywords network, identification of communities, influential keywords under different research theme.

3.2.1 Evolution of keywords network and communities

From 2010 to 2015, there are 40 keywords extracted from 8 articles. Figure 3 shows that “Digital innovation” and “Service innovation” are in the central of the keywords network. During this period, connections among nodes in the same subgraph are relatively close, while connections among subgraphs are relatively loose. The situation changed in the period of 2010-2019: the size of keyword network has increased rapidly to 288 nodes due to the mushroom of publishing papers. The overall connectivity of the network was significantly higher than period from 2010 to 2015. The maximum connected subgraph covered 93.4% (269 nodes) of the total number of nodes. This shows that different research topics are more closely related. Due to the large number of nodes in Figure 4, nodes of network which degree is less than five were filtered. The size of nodes was distinguished according to the value of betweenness centrality. The betweenness centrality is used to measure the control of resources by nodes. Generally, greater betweenness centrality means stronger role it plays as a bridge.

3.2.2 Communities and influential keywords

We detect distinct communities in the network using the modular algorithm in Gephi. There are 5 components, and 21 communities in the Figure 4 (the modularity index is 0.6558), which represented the diversity in DI research. Five larger communities and the ratio of community size to the maximum connected subgraph size showed as following: digital innovation (20.82%), open innovation (14.87%), innovation (11.15%), case study (10.04%) and service innovation (8.55%). Nodes with higher degree centrality in each community are also listed in Table 2. The degree centrality is used to measure the importance of a node in the network. Greater degree centrality of a node means greater prestige or influence of it.

Table 2. Representative keywords with high centrality in Top 5 communities

Community	Keywords (degree centrality in keywords network)
Digital innovation	digitization (46), digital transformation (13), IoT (12), new product development (10), digital business model (10), industry 4.0 (9), smart product (8), digital-physical (8), digital product and services (6)
Open innovation	open innovation (25), value creation (17), innovation process (15), social media (10), crowdsourcing (10), IT (10), innovation management (10), collaborative innovation (10), digital innovation ecosystem (9)
Innovation	innovation (23), digital (18), affordances (16), innovation practices (11), artefact (9), mobile payment (7)
Case study	case study (23), digital technology (20), building information model (9), organizational performance (9), capability (9), sustainability transformation (5), green IS (5), architectural practice (5), digital capability (4)
Service innovation	service innovation (24), business model (19), value co-creation (15), service-dominant logic (14), agency (10), resource integration (8), platforms (8), ecosystems (8)

4. CONTENT ANALYSIS

In this part, definitions of DI given by influential articles are discussed, and different research perspectives and research fields are identified. Content analysis helps us to figure out the answers of two important problems: (1) what are the similarities and differences in definitions of DI; (2) what are the research streams existing in DI studies, and what are the interesting research questions and opportunities in those streams.

4.1 Definitions of digital innovation

Two main viewpoints of how DI has been defined in the most influential studies are elaborated. The first classification of DI definition views it as the use of digital technology/IT in a wide range of innovations. The similarity of the definitions of DI given by the scholars is that they all recognized the importance of technology in the process of innovation. They consider that the use of technology can explain how and why the “same” technology can be repurposed by different actors or has different innovation outcomes in different context^[9]. However, (1) although they all emphasized the technology in innovation, they did not reach an agreement on the

connotation of it, such as Nambisan et al. (2017) used the term “digital technology”, Saldanha et al., (2017) noted that the technology means IT, and Shibeika & Harty (2015) did not specify the type of technology^{[9]-[11]}.

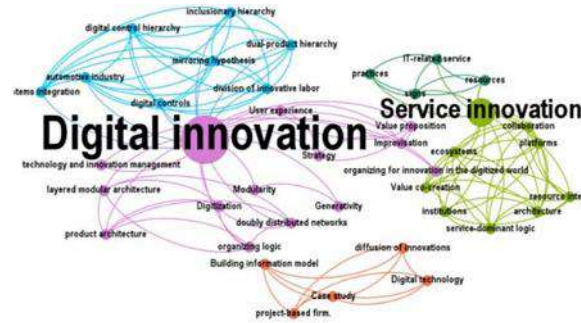


Figure 3. Keywords network from 2010 to 2015

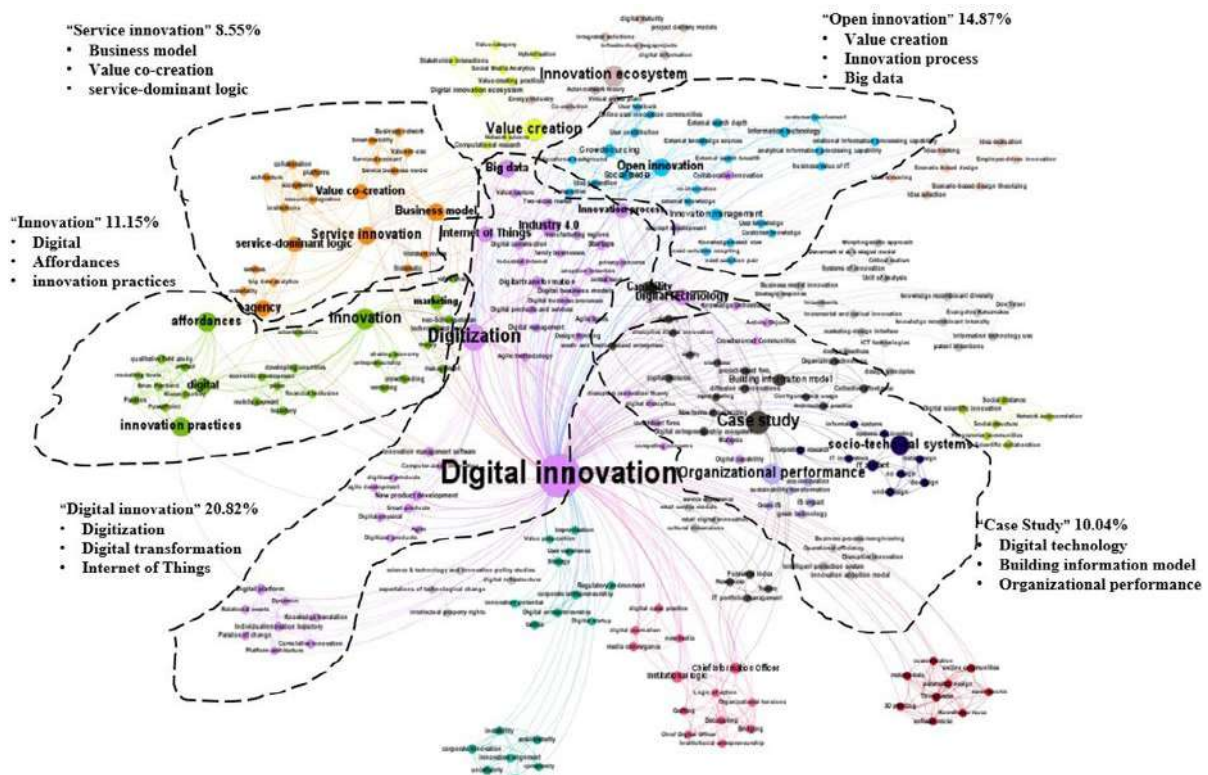


Figure 4. Keywords network from 2010 to 2019

The second classification of DI definition views it as a kind of recombination. The pioneering work of Yoo et al., (2010) emphasized the nature of innovation, “new combinations of digital and physical components to produce novel products”^{[1][13]}. Their definition stressed the role of digitization which makes physical products programmable, addressable, sensible, communicable, memorable, traceable, and associable as the necessary but insufficient condition for DI^{[1][14]}. And they also pointed out that DI is different from process innovation and implied a focus on product innovation^[1]. However, the differences of other scholars who following this perspective lie in two aspects: (1) Huang et al., (2017) proposed that DI is both a process and an outcome, and he also proposed that DI needs to generate new value-in-use from the users’ perspective^[12]; (2) Henfridsson et al., (2018) pointed out that in order to better understand value creation and value capture in DI, not only design recombination but also use recombination should be considered^[3]. The work of these scholars mentioned above developed and supplemented the view that “DI is a kind of recombination” defined by Yoo et al., (2010), especially the influential view of Henfridsson et al., (2018), which has been clearly supported by other scholars.

Table 3. Definitions of DI and two classifications of them

Classifications	Definitions of digital innovation
Use digital technology/IT for innovations	<ul style="list-style-type: none"> Nambisan et al. (2017): “the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology”^[9]. Saldanha et al.(2017) and Fichman et al. (2014): “broadly defined as a product, process, or business model that is perceived as new, requires some significant changes on the part of adopters, and is embodied in or enabled by IT”^[10]. Shibeika & Harty (2015): “the technologies and associated digital working practices used for the management and delivery of projects in construction”^[11].
Recombination of digital and physical components	<ul style="list-style-type: none"> Yoo et al. (2010): “the carrying out of new combinations of digital and physical components to produce novel products”^[1]. Huang et al. (2017): “the recombination of digital components in a layered, modular architecture to create new value-in-use to users or potential users of a service”^[12]. Henfridsson et al. (2018) : “the outcome of the activities by which a set of digital resources are recombined in both design and use through connections across value spaces”^[3].

4.2 Research perspectives and fields in digital innovation

In following content, 88 DI articles are coded into diverse research perspectives and fields, with keywords of each article are classified into the corresponding perspectives. Four research perspectives, twelve fields and representative keywords with higher frequency identified in each perspective are listed in Table 4.

Insights can be revealed from Table 4: (1) The research perspective of connotation, process and outcome of DI have the largest number of papers in our sample, and then following order is organization and culture, innovative resources and strategy; (2) Research field of connotation, type and outcome of DI gained the most attention among twelve fields, which means the ontology of DI are concerned by scholars mostly. Table 5 shows more details about examples of research questions and corresponding contributions in each research field.

Table 4. The distribution of research perspectives and fields

No#	Research perspective/ research filed (number of articles)	Keywords with high word frequency
I	Connotation, processes and outcomes (29) <ul style="list-style-type: none"> Connotation, processes and outcomes (23) Innovation diffusion process (6) 	innovation, digital ventures, case study, disruptive innovation theory, digital technology innovation management software, new product development, adoption intention
II	Strategic perspective of innovation (13) <ul style="list-style-type: none"> Open innovation (5) Innovation strategy (5) Innovation capabilities (2) Innovation Management (1) 	open innovation, collaborative innovation, strategic response, incremental and radical innovation, ambidexterity, innovation alignment
III	Organizational & Cultural Perspectives of Innovation (26) <ul style="list-style-type: none"> Process management (17) Innovation system (5) The organizing forms (3) Institution and culture (1) 	digitization, service innovation, innovation process, business model, value creation, innovation ecosystem
IV	Innovative resources perspective (20) <ul style="list-style-type: none"> Information and knowledge Management (14) Human resources management (6) 	knowledge recombinant diversity, design thinking, knowledge-based view, customer knowledge, venturing

4.3 Research opportunities

I. Connotation, processes and outcomes of digital innovation

- Connotation, processes and outcomes. Articles in Connotation, processes and outcomes of DI are more deductive which discussed how to comprehend the nature of DI, how to explain the value creation and value capture in the process of DI, and how DI has an impact on organizations. Some influential articles pointed out

the directions of future research. For example, Yoo et al. (2010) pointed a series of research questions related to the new strategic framework and IT infrastructure management of the organization, and Henfridsson et al. (2018) proposed that future research can focus on recombination of use and design in DI^{[1][3]}.

- Innovation diffusion process. DI is not only about the creation, but the diffusion. This research area focuses on process and influencing factors of innovation diffusion, which is not a new theme in innovation management. But in the context of DI, new theories and lens need to renew probably. For example, Shibeika & Harty (2015) suggested that there is a need to understand the diffusion of DI at the interface between the firm and the industry by understanding the dynamics and challenges of DI diffusion in relation to technology standards and best practice^[15]. In addition, more other factors (from the perspective of inventor or adopter) influencing DI can be investigated and more theories (such as institutional theory) can be integrated into this field.

II. Strategic perspective of digital innovation

- Innovation strategy. In this filed, firms' strategic responses related to DI are the focus. Scholars discussed strategic contradictions caused by DI and how to adjust these strategies. We identified some opportunities for further research: (1) empirical patterns and intellectual tools need to be developed for understanding and managing the competing concerns faced by incumbents as they embrace DI^[16]; (2) how incumbents may strategically respond to the challenges posed by the emergence and diffusion of digital technologies^[17].

- Innovation capabilities. In this filed, the role of organizational capabilities in the process of DI was explored. Researchers concerned how firms build and improved capabilities taking advantage of digital technology or the carrier of digital technology (such as social media) to profit from DI. Two essays in this field are identified and authors suggested (1) scholars to empirically test, enrich and refine their conceptual framework^[18] (2) and delve into other technology-related drivers of DI, such as technological culture^[19].

- Open innovation. This field focuses on how companies use open innovation and benefit from it. The concepts of ecosystem, collaborative innovation and value network are often mentioned. We have identified opportunities for further research: (1) future work are encouraged to focus on operationalizing service-dominant business models through service compositions to support business processes^[20]; (2) future research need to further the understanding of the dynamic and co-creation processes enable by digital technologies, such as the supply-demand interactions taking place in the value creation and capture processes in the digital economy^[21].

III. Organizational & cultural perspective of digital innovation

- Process management. This area focuses on the coordination of elements and the optimization of their combination in DI processes and how digital technologies can be integrated into the innovation process. Future research should do more on: (1) the topic of the division of innovative labor, especially from a supplier perspective^[22]; (2) how digital processes and product innovation are related and how they can be integrated in firms^[23]; (3) the potential of digital technologies (such as Big Data Analysis Technology) in developing service automation and human-material service practices^[24].

- Organizing forms. This area focused on how companies and the ecosystems they engaged in are organized to respond to DI. The emergence of new organizing forms, such as digital platforms, is affected by DI deeply. Hinings et al. (2018) proposed that "digital organizing forms" is one of the types of DI, which indicates some clues in this stream. However, more exploration is required in how the DI interacted with organizing forms^[25].

- Innovation system. The evolution of DI ecosystem and the value creation in it are concerned in this field. Opportunities identified in this field: (1) how interactions between consumers and stakeholders create value and whether it would be different in various context; (2) how to study the evolution of DI ecosystem using big data and advancing digital technology.

Table 5. Research fields, questions and corresponding contributions

Research fields	Examples of research questions in this field	Corresponding contributions
I: Connotation, process and outcome	<ul style="list-style-type: none"> • How to understand DI and its impact on organizational logic? • How to create and capture value in DI? 	<ul style="list-style-type: none"> • A framework to describe the emerging organizing logic of DI. • A framework to explain value creation and capture in DI
I: Innovation diffusion	<ul style="list-style-type: none"> • What factors influence in the adoption of innovations? • How start-ups improve the diffusion rate of DI through business model design? • How DI diffuse across complex firms? 	<ul style="list-style-type: none"> • The impact of cultural dimension on global in-store retail innovations is empirically studied. • The design strategy of business model. • A range of activities and dynamics of a non-linear diffusion process are showed;
II: Innovation strategy	<ul style="list-style-type: none"> • How do firms manage competing concerns in DI? • How do firms adjust business models to deal with the impact of DI? 	<ul style="list-style-type: none"> • The strategies to deal with four competing concerns faced by firms. • The elements of business model that enterprises should adjust to deal with technological innovation.
II: Innovation capabilities	<ul style="list-style-type: none"> • How to use social media to benefit from innovation? • How to use digital technologies to benefit from products and services innovation? 	<ul style="list-style-type: none"> • A conceptual framework of the capabilities allowing companies to benefit from social media. • The driving factors of DI and its mediating role between the driving factors and firm performance are studied;
II: Open innovation	<ul style="list-style-type: none"> • How can organizations benefit from co-innovation ecosystem? 	<ul style="list-style-type: none"> • The process of external knowledge acquisition under different collaborative innovation models are revealed.
III: Process management	<ul style="list-style-type: none"> • How to reconcile the opposite hypothesis in the division of innovative labor? • How do companies manage the process of DI? 	<ul style="list-style-type: none"> • Reconciled two competing views by distinguishing two different product hierarchies. • A managerial framework supporting ongoing improvements in DI management;
III: Organizing forms	<ul style="list-style-type: none"> • How small medium enterprises achieve agility to respond to disruptive DI? • How the Digital Entrepreneurship Ecosystem (DEE) is organized? 	<ul style="list-style-type: none"> • A framework on agility. • Eight processes around the themes of division of labor and integration of efforts in DEE;
III: Innovation system	<ul style="list-style-type: none"> • How the interactions create value in the DI ecosystem? • How the DI ecosystem evolves? 	<ul style="list-style-type: none"> • Value creation and its types in DI ecosystems are revealed. • Two mechanisms of the evolution of DI Ecosystems.
IV: Human resources management	<ul style="list-style-type: none"> • What are the types of Chief Digital Officers (CDO) and the reasons why organizations adopt the role? • How to find and management the digital project team for innovation? 	<ul style="list-style-type: none"> • Domains where successful CDOs build digital capabilities and three types of CDO are identified. • The role, empowerment, learning and leadership development in digital teams are identified.
IV: The information and knowledge management	<ul style="list-style-type: none"> • How do IT-enabled capabilities influence firms' ability to leverage customer involvement and shape the amount of firm innovation? • What role of big data in the innovation process? 	<ul style="list-style-type: none"> • Important complementarities between specific types of customer involvement and specific IT-enabled capabilities are found. • Big data is the trigger and the enabler of the DI process.

IV. Resources perspective of digital innovation

• Human resources management. The role of leaders (Chief Information Officers, Chief Digital Officers and IT experts), entrepreneurship and digital team is mentioned in this stream. Especially the study of digital teams is an emerging theme in innovation management. Future research can explore other human resource

management issues in organizations.

- Information and knowledge management. This field is about information and knowledge management in DI. There are 14 articles in this field which means relatively high outputs are generated. The knowledge-based view, organizational learning, signal theory and other theories closely related to knowledge and information management are mentioned. Opportunities identified in this field: (1) how the digital technology affects the knowledge management; (2) how companies take advantage of information and knowledge from another stakeholder's involvement (such as customers and suppliers) in innovation process.

5. CONCLUSIONS

As digital technology continues to transform the landscape of the industry, research interests and activities on DI in organizations have been on the rise. This paper has provided a systematic overview of the DI research based on categories extracted from the extant literature, serving as a roadmap for the DI studies. Contributions of this study can be concluded into following aspects. First, evolution of DI research is revealed in this study. The amount of DI literature has increased rapidly in recent years, and the interaction among research fields and disciplines is getting deeper. This fact is also approved by the evolution of keywords network. Second, we compared and summarized the definitions of DI given in some influential papers with the conclusion of that the use of digital technologies and the recombination are two main viewpoints. Third, by referring to relatively mature innovation management framework, we classified the research streams of DI into four perspectives and twelve research fields. This provides reference for other researchers to further DI literature. Forth, we identified future research opportunities under each research fields.

The limitations of this article are articulated as following. First, some articles covering several research fields or perspectives are divided into one specific classification according to the focus of them, which may neglected the fusion among different research streams. Second, some new emerging research areas, such as institutional and cultural design of organizations, are also included in the innovation management framework. However, as only few literatures are classified into these areas, we do not specify them in this paper. Third, this study does not make further analysis on connections among research fields and future research are suggested to make more progress in this respect. Finally, the theories adopted in DI research need more analysis in future work.

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The Relationship between Product Innovation and Online Sales:

A Red Queen Competition Perspective

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Abstract: Competitions among online sellers on an e-commerce platforms has entered the era of “Red sea”. The highly transparent feature reduces the costs of learning and imitation, which breeds vicious competition on markets and increases product similarity. Hence, online sellers have to promote product iteration and innovation to meet the changes of market demands. However, how to measure the product innovative of online sellers, as well as the relationship between the posture of product innovation and online sales in changing competitive environment have barely been empirically revealed. This study intends to theoretical analyze the relationship between the posture of two different types of product innovation and online sales grounded on the red queen competition theory. The expected results are: First, compared with the average level of the industry, the better the posture of updated product innovation is, the higher the online sales are. Second, compared with the average level of the industry, the relationship between the posture of new product innovation and online sales is inversely U-shaped. This study not only expands the research scope on organizational competition mechanism based on the red queen competition theory, but also provides essential ideas for online sellers to develop product innovation strategies in competitive environments.

Keywords: Product Innovation, Competitive Pressure, the Red Queen Competition Theory, E-commerce platform.

1. INTRODUCTION

In recent years, with the maturity of the e-commerce platform business model, the competition pressure of online sellers becomes increasingly intense, which contributes to the arrival of the era of e-commerce “red sea”. The important way for online sellers to survive from the red sea is to update and iterate their products quickly^[1], and this is one of the effective strategies for them to gain competitive advantages. However, the online sellers’ product innovation behavior will intensify market competition, so that it will restrict their competitive behavior and performance. On the one hand, the highly transparent competitive environment enables online sellers to quickly acquaint with the new development of competitors, which could help them to reduce learning costs and promote product innovation. On the other hand, when the performance improvement is gained by an online seller through effective competitive behavior, the performance of its competitors will be reduced. Consequently, it will lead to the imitation and follow-up of competitors, and then it will inhibit the performance of the core online sellers. And this inhibiting effect is significantly stronger than the positive effect brought by competitive behavior, which forces the core online seller and its competitors into a cycle of action and performance^[2]. Therefore, online sellers must constantly take effective actions to cope with the rapid changes in the market.

Since the mutual influence between online sellers’ competitive behavior and industry development, the impact of online sellers product innovation on competitive advantage not only depends on the active level of their own behavior but also on the relative level that compared to the industry development. As is shown in the competitive relationship in the red queen competition theory, online sellers participating in the competition must constantly “run” to keep relatively static with competitors.

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Competitive actions have been regarded as the cornerstone of enterprise development and growth, and its positive impact on organizational performance has long been known in previous studies. However, in the context of e-commerce red sea competition, it has not been empirically revealed that how to measure the posture of innovation behavior of online sellers and the relationship between their behaviors surpassing competitors and online sales. Based on previous studies on competition mechanism revealed in the red queen competition theory, this study proposes that: when exploring how to break through the competitive pressure by product innovation, the development of online sellers must be placed in the context of industry evolution. Only by correctly considering the relationship between the posture of online sellers' product innovation and market pressure can we correctly understand the actual utility of online sellers' product innovation. Therefore, our research question is: under the competitive pressure on the platform, how can online sellers improve online sales through product innovation strategies?

2. LITERATURE REVIEW

The red queen competition theory is based on a quote from the Queen of Hearts in the movie *Alice in Wonderland*. She once said: "Running at your fastest speed just allows you to maintain your current position. To move forward, you must double your current speed^[3]." Through integrating organizational learning theory and ecological theory, this theory describes the symbiotic evolution of competitive subjects and systems and the mechanism of competition constraints in organizations^[4]. It also reveals how environmental changes affect the movement of subjects' important reference value: When an organization takes action to obtain a competitive advantage, it may trigger a reaction among competitors. Continuous competitive interactions between organizations and social comparison behavior develop and improve the industry's average level constantly, thereby forming a natural choice of "survival of the fittest" for the subjects that survive in the environment. In this scenario, the emergence of a company's competitive advantage relies on the behavior of matching and surpassing its competitors^{[4][5]}. This means that, whether a company can obtain a competitive advantage depends not only on its absolute speed in a competitive environment but also on its relative speed in comparison with other competitors in the environment.

In previous studies, the research on the red queen competition theory focused mostly on the following aspects:

(1) Organizational competition is related to the time exposed to the competitive environment. Through empirical research, Barnett and others^{[6][7]} found that recent competition experience can not only reduce the core organization's mortality rate but also significantly increase its performance growth rate. At the same time, it has a significant inhibitory effect on competitors' growth rate and birth rate. However, the long-term competitive experience will show the opposite effect.

(2) Organizational competitive behavior is linked to the experience that being exposed to the competitive environment. Levitt^[8], Barnett^[5], and others have pointed out that organizations often adopt solutions that are well-known in the past to deal with new problems, which may have a negative impact on the organization's adaptability. This is the "capacity trap" of the red queen competition theory.

(3) Individual competition will have an impact on the whole industry. Foscari's^[9] research further characterizes the micro-processes of mutual learning between organizations and the causal competitive relationship. It found that the survival outcome of an organization is not only related to its own survival behavior, but also to the survival environment and its adaptability of the entire population system.

By analyzing previous studies, the red queen competition theory found that the behavior of another organization's search solution is caused by the improvement of one organization's performance. This is consistent with what has been discussed in our paper: under the pressure of competition, online sellers have to

make product innovation to gain more advantages. Therefore, the theory provides a theoretical basis for this paper. Admittedly, in previous research, competitive behavior has been regarded as the cornerstone of corporate development and growth, and its positive impact on organizational performance has long been known. For example, in the field of IT investment, Mithas^[10] and others have discussed the impact of business investment deviations on business strategy and business performance based on the industry average level. Nevertheless, in the context of the e-commerce red sea competition, how to measure the posture of product innovation of online sellers, and the relationship between their posture of product innovation beyond competitors and online sales have scarcely been empirically revealed. In view of these research gaps, starting from the internal competition mechanism revealed by the red queen competition theory, this paper takes the changes in the market environment caused by inter-organizational competition into consideration and uses the industry average level as a benchmark, so as to explore the impact of the online seller's posture of product innovation near or far from industry benchmark on online sales.

3. RESEARCH MODEL AND HYPOTHESIS

3.1. Research model

Grounded on the red queen competition theory, online sellers on the e-commerce platform are subjects with organizational learning ability. In a competitive environment, when an online seller's performance is lower than its ideal level, its internal search learning mechanism will be triggered. Viewed from online sellers practice, the decision-making behavior of online sellers in product dimension can be divided into two types: the first one is updated product innovation, which is generally implemented by improving the existing product description and label; the second one is new product innovation, that is, showing the new product in the platform display box.

Therefore, from the perspective of the red queen competition theory, this paper discusses the relationship between the online seller's posture of product innovation and online sales compared with the average level of the industry. The research model is shown in the figure below:

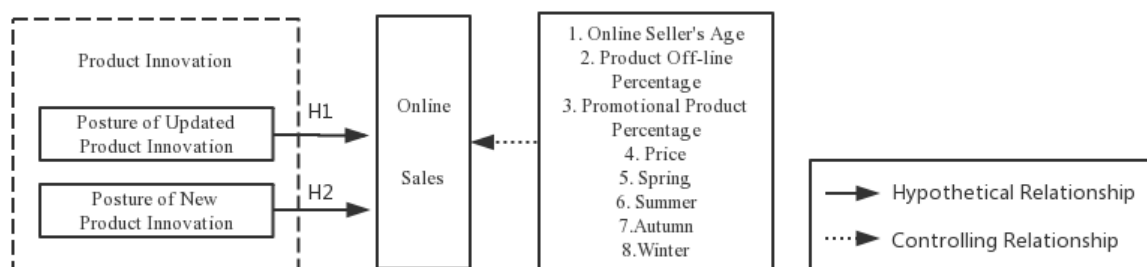


Figure 1. Research model

3.2. Research hypothesis

3.2.1. The relationship between the posture of updated product innovation and online sales

In this paper, the posture of updated product innovation of online sellers refers to the posture of the operation behavior of the online sellers to upgrade, innovate, cut down or make the product line more characteristic timely according to the change of market demand. It is the purposeful organization and management of product managers to increase user's stickiness or contribution. Updated product innovation is a kind of utilization innovation^[11], which is usually confined to a specific and relatively narrow scope of knowledge, so both the learning cost and the market risk are low. This study proposes that compared with the average level of the industry, the online sales are in proportion to the posture of updated product innovation of the online seller itself. Three reasons are listed below:

- (1) An updated product innovation is an easier way for the e-commerce platform to obtain the revenue

quickly and accurately^[12]. Considering the updated product innovation on the platform as a change to the features, labels, services or copywriting of the existing products, online sellers can take advantage of the traffic dividend of the recommendation system of the platform to match user needs more accurately.

(2) The features of updated product innovation make online sellers more flexible to adapt to market needs. The updated product innovation on the e-commerce platform involves the description of product content instead of the change of product structure. The worst result of organizational learning maladjustment is the decline of product search traffic, and even such maladjustment behavior can be quickly reflected and adjusted in time. Therefore, the characteristics of high flexibility and low risk of updated product innovation give online sellers opportunity to adjust themselves, which facilitates it to adapt to the environment quickly and flexibly.

(3) The long-term exposure to the competitive environment is conducive to improving the competitive advantage of product. Empirical research shows that organizational learning and competition experience can enhance the ability of organizations to perceive and respond to the opportunities and threats, enable organizations to control the risks and costs of innovation activities more effectively, and improve their competitiveness. Especially on the e-commerce platform, the long-term sales and word-of-mouth accumulation will be conducive to consolidating the product's competitive advantage.

Therefore, hypothesis 1 is proposed as follows:

H1: Compared with the average level of the industry, the online seller's posture of updated product innovation has a positive impact on online sales.

3.2.2. The relationship between the posture of new product innovation and online sales

In this paper, the new product innovation of online sellers is that the online sellers will put the brand new product introduction on the platform to sell. Different from updated product innovation, the new product innovation takes place at the beginning of the product life cycle^[13]. It involves the uncertainty of the acceptability of new products in the market. From the perspective of the classification of innovation situation, the new product innovation of an organization belongs to "exploratory innovation". This study suggests that: the influences of new product innovation on online sales are related to the relative degree of new product innovation of online sellers to the average level of the industry.

New product innovation is an online seller's search and learning behavior to gain more competitive advantages. Its effect on online sales is manifested in the following two aspects: First, the high transparency of the e-commerce platform reduces the cost of sellers to obtain market demand, so the new product innovation can enable online sellers to better adapt to market demand and achieve the ideal online sales of themselves. Second, new product innovation is the search results based on organizational learning. The more product features change, the more likely it is to attract new users and increase online sales. Therefore, in comparison with the industry average level, the stronger the seller's new product innovation capacity is, the higher the online sales will be.

However, an increasing number of new product innovation does not always lead to increasing online sales, because exploratory innovation has the innate characteristics of high cost, high risk, and long cycle. From the perspective of the market, as the number of new products increases, the market demand overloads, which leads to the decline of online sales directly. Meanwhile, from the perspective of online sellers, the red queen competition theory holds that when the new organizational capacity exceeds the average level of the industry, the seller's output ratio of cost input will decline, and it is easy to fall into the "capacity trap", as well as lead to the decline of the seller's learning ability and the loss of competitive advantage.

Therefore, hypothesis 2 is proposed as follows:

H2: Compared to the industry average, the relationship between the online seller's posture of new product innovation and online sales is inversely U-shaped.

4. RESEARCH DESIGN

4.1. Research setting

This paper selects the tourism e-commerce platform as a research sample because of its fierce competition, rapid evolution, and high information transparency. Specifically, a typical tourism e-commerce platform, Ctrip is chosen for the following two reasons: (1) It provides the online sellers' information on the product details page, which makes it possible to obtain the research data. (2) According to industry statistics, Ctrip has consistently ranked the top three in the online travel and vacation market over the past three years.

As China's largest tourism e-commerce platform, Ctrip's package tour product can be divided into domestic tours and outbound tours according to the geographic scope of the destination. The outbound tourism market is growing fast and competitive. Moreover, outbound package tour products are only allowed to be operated by online sellers with the qualification of international travel agencies, so the information about relevant travel agencies is reliable and comprehensive. Therefore, this paper selects the outbound package tour product in the Ctrip platform as the research object.

Furthermore, according to the "Major Data Report on Tourism Economy in the First Half of 2018" issued by the Ministry of Culture and Tourism Data Center, we select the most popular domestic outbound tourism city—"Shanghai" as the departure city, and select 15 popular destination cities for outbound tourism as our research's destination cities. And they make up 1*15 market segments.

4.2. Data collection

In this paper, the core task of data collection is to transform the data of Ctrip outbound package tour products into the data at the seller level. Accordingly, the data collection will be carried out through the following four stages: Firstly, constructing the outbound package tour product database; secondly, determining the list of the online sellers; thirdly, preprocessing data; fourthly, constructing the data set at the seller level. In the end, 114 sellers are included in the scope of the study. The observation period is from March 1, 2017 to December 1, 2018, and the invalid routes and repeated key fields have been cleared.

4.3. The measurement of variables

4.3.1. Dependent variable

In this paper, the total number of tourists (Count) of the online seller's current package tour product is taken as the dependent variable, which reflects the seller's current online sales. Monitoring the long-term data, we found that the statistics of the number of Ctrip outbound package tour products are calculated in a cumulative way. Therefore, the number of people traveling on a package tour product in the period t equals to the cumulative number of people traveling on the package tour product in the period t minus the cumulative number of people traveling on the package tour product in the period $t-1$.

4.3.2. Independent variables

(1) Posture of updated product innovation

The updated product innovation refers to the package tour product updated and changed by the seller in the period t compared with the period $t-1$. The total number of package tour products provided by online sellers is different. In order to reduce such data differences, this paper calculates the ratio of seller's product updated innovation in the total number of package tour products in the period t before calculating the posture of updated product innovation of online sellers.

In this paper, the method of text similarity is used to calculate the posture of updated product innovation. Text similarity, a method of text mining, refers to the similarity between two texts. The first step is to obtain the package tour product with the same ID of the period t and the period $t-1$ in the product database of this study and make statistics of the text data containing key fields to form word bags. In the following step, TF-IDF (Term Frequency—Inverse Document Frequency) is used to vectorize the word frequency of each circuit. Finally, the

text-similarity of the package tour product in the period t is calculated by the law of cosines. The value of text-similarity is between 0 and 1, and the higher the value is, the smaller the change of the same product ID in the product description of two phases is. Through observation, we found when the text-similarity in this study is above 0.8, the package tour product changes little in the description. Therefore, the package tour product with text similarity between 0 and 0.8 is selected as the package tour product that is updated.

In this paper, the average of updated product innovation ratio of all sellers in the study samples is regarded as the industry average level in the period t . And the difference between the updated product innovation ratio of each seller and the average level of the industry is the posture of updated product innovation.

(2) Posture of new product innovation

New product innovation refers to the package tour product that is newly put on sale by the online seller. The total number of package tour products provided by sellers is different. In order to reduce such data differences, before calculating the posture of new product innovation, the ratio of new product innovation in the total package tour product of the period t is calculated. In this paper, the average of new product innovation ratio of all sellers in the study sample is regarded as the industry average level in the period t . Then the difference between the new product innovation ratio of each seller and the average level of the industry is the posture of new product innovation.

4.3.3. Control variable

Referring to the study of Barnett about the red queen competition theory^[13], the online seller's age (Age) is included as the control variable in this paper. In addition, previous studies have shown that when the performance is lower than the organization's expectation, the organization will take actions such as promotion or removal of products to change the existing competitive position. Based on this, this paper controls other factors affecting performance at the level of organizational behavior, including product off-line percentage (Off-line), the promotional product percentage (Prom) and the product price (Price).

At the same time, due to the long period of data collection, we select the seasonal factors as dummy variables: spring (Spri) is (1,0,0,0), summer (Summ) is (0,1,0,0), autumn (Autu) is (0,0,1,0), and winter (Wint) is (0,0,0,1). Considering the "dummy variable trap", we only add spring, summer and autumn into the model.

4.4. Econometric model

According to the research hypothesis, this paper adopts the econometric model of the unbalanced panel to analyze the impact of the posture of new product innovation and the posture of updated product innovation on organizational performance respectively, and then constructs the following two econometric models:

Model 1: The impact of organization's posture of updated product innovation on online sales.

$$\text{InCount}_{it} = \alpha_0 + \beta_1 \text{Age}_{it} + \beta_2 \text{Off_Shelf}_{it} + \beta_3 \text{Prom}_{it} + \beta_4 \text{Price}_{it} + \beta_5 \text{Spri}_{it} + \beta_6 \text{Summ}_{it} + \beta_7 \text{Autu}_{it} + \beta_8 \text{Update}_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

Model 2: The impact of organization's posture of new product innovation on online sales.

$$\text{InCount}_{it} = \alpha_0 + \beta_1 \text{Age}_{it} + \beta_2 \text{Off_Shelf}_{it} + \beta_3 \text{Prom}_{it} + \beta_4 \text{Price}_{it} + \beta_5 \text{Spri}_{it} + \beta_6 \text{Summ}_{it} + \beta_7 \text{Autu}_{it} + \beta_8 (\text{New})^2_{it} + \beta_9 \text{New}_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

Where, α_0 is the intercept term; β_i ($i = 1 \cdots 9$) represents the regression coefficient of the model; ε_i is the disturbing term that changes with individuals and time, and captures other factors that may cause changes in dependent variables that are not considered. And μ_i captures individual heterogeneity cannot be seen that does not change with time.

5. EXPECTED RESULTS

Our research sample in this paper contains 114 individuals ($n=114$) and accumulates 21 periods of data ($T=21$), which can be considered as short panel data. In choosing the model estimation method, the fixed effect

is preferred in this paper. Since the independent variable studied in this paper, the posture of updated product innovation and the posture of new product innovation are variables that change with time, this paper finally determines to use the method of fixed effect and clustering robust standard error to make a model estimation.

5.1. The impact of the posture of updated product innovation on online sales

We expected that at the 0.05 significance level, β_1 , β_3 will have a positive influence, while β_2 , β_4 will have a negative influence. This means: (1) The longer the online seller stays on the e-commerce platform, the more market experience it will get and the more competitive the organization becomes; (2) The more promotional products in the period t is, the higher the online sales are; (3) The more off-line products in the period t is, the lower the online sales are; (4) The lower the product price in the period t is, the higher the online sales is. And seasonal factors also have significant impacts on online sales. These are consistent with previous relevant studies and objective facts, which can prove that the control variables selected in this paper are reasonable.

After the seller's posture of updated product innovation is included, we expect that at the 0.05 significance level, β_8 will have a positive influence. The results can indicate that: compared to the industry average level, the higher the posture of updated product innovation in the period t is, the better the online sales will be, which can support hypothesis 1.

5.2. The impact of the posture of new product innovation on online sales

After adding the posture of new product innovation, we expect that at the 0.05 significance level, β_8 and β_9 are all significant negative, which indicates that there is an inverted U-shaped relationship between the posture of new product innovation and online sales: the total number of tourists in the seller's package tour product increases at first and then decreases with the strengthening of the posture of new product innovation. A more detailed analysis is: on the left side of the axis of symmetry, the relationship between the posture of new product innovation and online sales is positive, and the slope gradually slows down. In other words, the better the posture of new product innovation (the closer to the industry average level) is, the better the online sales will be, but the contribution of the posture of new product innovation to online sales will decrease as it approaches the industry average level. On the right side of the axis of symmetry, the relationship between the posture of new product innovation and online sales is negative, and the slope gradually steepens. That is to say, the better the posture of new product innovation (the further away from the industry average level) is, the worse the online sales will be, and the negative impact of the posture of new product innovation on online sales will be intensified with the deviation from the industry average level. This can support hypothesis 2.

6. EXPECTED CONTRIBUTION

The expected contributions of this study can be summarized as follows:

(1) Grounded on the red queen competition theory, this paper will expand the research on the competition mechanism of organizations, which reveals the relationship between individual competition behavior and industry average level. Through this study, we hold that the emergence of online sellers competitive advantage is not only relevant to the self-learning and improvement of the organization, but also depending on the relativity with the industry average level and the adaptability with the industry environment. To some extent, this extends the practicability of the red queen competition theory in competition mechanism and provides a new idea and foothold for the follow-up research.

(2) The research will examine the behavioral paths of online sellers on the platform to achieve online sales by launching different types of product innovation. In this paper, package tour product is taken as the research object, and the following conclusions are found: As a kind of low-risk utilization innovation, the posture of

updated product innovation has a positive linear relationship with online sales; As a kind of exploratory innovation with high cost and risk, the posture of new product innovation improves online sales to the greatest extent when catching up and maintaining at the average level of the industry.

(3) Our research can provide important practical guidance for online sellers to deal with the pressure of competition through product innovation. This study offers an important idea for online sellers to develop product innovation strategies and improve market competitive environments.

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Multi-category Comparative Analysis of Factors Affecting E-commerce Sales

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Abstract: With the continuous development of e-commerce, more and more types of goods are sold online, so merchants should develop different sales strategies for different types of goods. This paper firstly selects 15 variables to build a stepwise regression model. In the analysis of influencing factors on sales of products in different categories, we find that there are significant differences in the impact of the number of appended reviews and pictures reviews on the sales of utilitarian and hedonic products. In the analysis of influencing factors on sales of products in the same category, we find that the factors influencing the sales of different clothing products are also different to some extent. At last, we put forward some suggestions on adjusting price and title length, and writing product details. This paper is more detailed in variable selection and product classification than some previous studies. It is meaningful for merchants to optimize sales plans and improve product sales.

Keywords: e-commerce sales, influencing factors, product classification, text similarity calculation

1. INTRODUCTION

In recent years, with the continuous development of information technology, e-commerce transactions are rapidly increasing. By the end of 2018, global e-commerce sales have reached 2.8 trillion US dollars, accounting for 11.9% of the global retail sales, and clothing has had the highest online sales among all kinds of products. In the face of opportunities and challenges, e-commerce merchants need to strengthen the understanding of the factors that affect the sales volume, which can better serve consumers and improve the revenue.

Scholars have conducted various studies on the factors affecting sales volume. In addition to price^{[1], [2]}, online review^{[3], [4]}, service^{[5], [6]} and other common variables, this paper specially adds the related variables of product details and product title. In product details, scholars have focused more on the impact of the pictures^[7],^[8] and the interaction with text^[9]. This paper focuses on description text in the product details, and extracts the number of adjectives, the number of nouns, similarity between details and reviews.

In this paper, we select 15 variables and study the similarities and differences of the factors affecting the sales of products in different categories and in the same category. The results of the study have significance to optimize product display and improve product sales. This paper introduces some references and theoretical hypothesis in the second and third parts, data processing and model construction in the fourth and fifth parts, and significance and conclusion in the sixth and seventh parts.

2. LITERATURE REVIEW

2.1 Product type

After Hirschman and Holbrook (1982) divided the product into two categories of hedonic and utilitarian^[10], more and more scholars began to study the different influences of hedonic products and utilitarian products on consumers. Many scholars believed that the judgment of hedonism and utilitarianism directly affected the preference for online retail products and further affected the shopping intention in the future^[11]. For utilitarian products, the objective connection between features and utility makes it easier to obtain product information,

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while for hedonic products, consumers more rely on subjective impression and reduce dependence on product features or information^[12]. Of course, hedonism and utilitarianism are not necessarily the two ends of the one-dimensional scale, and different products can be high or low in hedonic and utilitarian attributes^[13].

2.2 Factors affecting sales volume

After sorting out previous studies, we find that the factors influencing online purchase behavior mainly include the following:

Table 1. Literature review

Variable	Author	Viewpoint
Price	Jadhav and Khanna, 2016 Chevalier and Goolsbee, 2003	Low price and promotion are important factors that affect online shopping.
Online review	Mo and Li et al., 2015 Babić and Sotgiu et al., 2016	Positive reviews, pictures reviews and appended reviews have a positive impact on consumer purchase behavior. The negative effects are not significant.
Product score	Tamimi and Sebastianelli, 2015 Babić and Sotgiu et al., 2016	Digital and star ratings have a significant impact on product sales.
Reputation	Babić and Sotgiu et al., 2016 Muda and Mohd et al., 2016	Electronic word of mouth and perceived reputation have a strong impact on product sales.
Service score	Chen and Wu et al., 2016 Lim and Heng et al., 2016	Service quality is positively correlated with consumer satisfaction, which can affect consumer loyalty.
Logistics score	Hu and Huang et al., 2016 Kawa, 2017	Logistics services have an impact on consumer satisfaction and are increasingly important in e-commerce.
Product display	Pappas, 2016	Providing detailed and accurate information about products can increase purchase expectations.
Product title	Li and Wang et al., 2015	Extract product features from online reviews for product title optimization.

3. THEORY AND HYPOTHESIS

3.1 Horizontal analysis and vertical analysis

We refer to the differences of products in different categories as horizontal differences (e.g. mobile phones, necklaces), and the differences of products in same category as vertical differences (e.g. shirts and jeans belong to the clothing category).

In the analysis of horizontal difference, according to Hirschman and Holbrook (1982), we classify the products into two categories: hedonic products and utilitarian products^[10]. Hedonic products provide more pleasure and excitement, consumers would pay more attention to themselves. While utilitarian products are mainly instrumental and functional, consumers need to spend much more time to compare properties differences between products. What's more, many scholars have analyzed the factors influencing consumer purchasing behavior from the perspective of product types^{[17], [18]}. Therefore, we put forward the hypothesis 1:

H1: The influencing factors of sales are different in utilitarian products and hedonic products.

In the vertical difference analysis, considering that clothing account for a relatively high proportion of online physical products retail sales, we choose clothing as our vertical analysis objects. Considering that the vertical difference of clothing may be small, we propose hypothesis 2:

H2: The influencing factors of sales are basically the same in clothing category.

3.2 The influencing factors of sales

According to the previous research results and combined with the actual situation, the following 15 variables are selected as independent variables from 5 aspects to analyze their impact on sales.

Table 2. Selection of variables

Variable type	Selected variable
Price related	Price
Product reviews related	The number of cumulative reviews, The number of appended reviews The number of pictures reviews, Similarity of details and reviews
Store evaluation related	Product rating, Description rating, Service rating, Logistics rating
Product display related	The number of product pictures, The number of words in product details The number of adjectives in product details, The number of nouns in product details
Product title related	The length of the product title Similarity of details and title

We hypothesized H3 for the independent variable:

H3a: Variables except price have a positive impact on sales volume.

H3b: Price has a negative impact on sales volume.

4. DATA ACQUISITION AND DATA PROCESSING

4.1 Data acquisition

Ordinary taobao stores lack data such as product rating, the number of appended reviews, the number of pictures reviews, so we choose products in the Tmall stores as our research objects. We obtain the data of the top 800 products in the web ranking of 15 types of products. The data collection time is from June 10, 2019 to June 15, 2019. There are 12,000 products, and the data volume is about 100G.

In the analysis of horizontal difference, we select 10 types of products according to the classification of utilitarianism and hedonism. Utilitarian products are: notebook, professional SLR camera, mobile phone, guitar and suitcase. Hedonistic products are: diamond necklace, clothing, facial cleanser, nuts and beer. In the vertical difference analysis, in order to control the influence of season and style type on clothing sales, we select six types of clothing: shirt, jeans, dress, wind coat, sweater and down jacket.

4.2 Data processing

4.2.1 Calculation of text similarity

We get all the pictures in the product details, count the number of pictures, and use Baidu AI platform to identify the text information in the pictures. Then, we use the 'jieba' package in python to segment the text information in the product description, and count the number of all words, adjectives and nouns. Finally, TF-IDF algorithm is used to calculate the similarity between description text and title and similarity between description text and reviews.

4.2.2 Calculation of other variables

First, price variable processing: because a small number of the same product may use different prices to distinguish its low version and high version (such as: notebook, mobile phone). Faced with such products, we can only choose to use the average price to represent the price of such products. Secondly, picture processing: we calculate the size of the picture according to the height of the picture. Every 1000 pixels of height count as

one picture, and the results remain 1 decimal place. The number of pictures calculated in this way is closer to the number of pictures perceived by the naked eye.

4.2.3 Data cleaning and data processing

In order to reduce the influence of outliers and dimensions on the results of the model, we remove outliers to clean the data, and then standardize the data.

5. MODEL CONSTRUCTION

We put all the known 15 influencing factors into the model. In order to eliminate multicollinearity, the correlation test of 15 independent variables is conducted, and correlation between the number of words and the number of adjectives and nouns is greater than 0.7, so we delete the number of words. A stepwise regression model is used to filter the remaining independent variables, at last, we obtain the final model.

5.1 Horizontal analysis of products of different categories

We want to analyze whether each variable has the same influence on the sales of utilitarian and hedonic products, so we summary the final results into the following table:

Table 3. Horizontal comparison of factors influencing sales volume

Classification	Utilitarian products					Hedonic products				
Category	Notebook (7391)	SLR camera (3007)	Mobile phone (2905)	Guitar (2686)	Suitcase (1464)	Diamond necklace (4150)	Clothing (1232)	Beer (276)	Nuts (163)	Facial cleanser (139)
Product Price	-0.206***	-0.009***	-0.136***	-0.136***	-0.104***	-0.150***	-0.251***	-0.089***	-0.076**	
The number of cumulative reviews	0.298***	0.844***	0.118***	0.609***	0.187***	0.576***	0.667***	0.387***	0.217***	0.116***
Product rating						-0.069***	0.024**			
The number of appended reviews		-0.167**	0.258***		0.294***	-0.348***	-0.574***	-0.571***		
The number of pictures reviews	0.167*		0.270***		0.175*	0.386***	0.484***	0.926***	0.381***	0.726***
Description rating	0.055*		-0.074**		0.105***	0.137***	0.072***			
Service rating		-0.065*	0.140***			-0.111***				
Logistics rating		0.073*			-0.207***		-0.059***		0.072**	-0.101***
The number of product pictures			0.084**	0.006**			-0.038***		0.116***	0.098***
The number of adjectives	0.059*		0.143**			-0.089**		0.172***		-0.085***
The number of nouns		-0.056**	-0.151***			0.096**	-0.067***	-0.170***		
Similarity of details and reviews		-0.049*	-0.088***		0.105***	0.055**	0.096***			-0.058**
Similarity of details and title					-0.108***		-0.033**		-0.085***	
The length of title		0.124***	-0.130***	-0.057*	0.049*	0.045*	-0.059***			
R ²	0.3	0.56	0.48	0.47	0.55	0.53	0.56	0.55	0.35	0.67

P-value: 0.01*** 0.05** 0.1* Their average price is shown in parentheses

On the whole, the model passes the F test, and coefficients pass the T test. Except for notebook and nut, the R² of other models is greater than 0.45, which has certain explanatory significance. The robustness test of the model showed that among the 14 variables, product price, the number of cumulative reviews, the number of appended reviews, the number of pictures reviews, the number of product pictures, the similarity of details and reviews have the strongest robustness. Among these, product price has a significant negative impact on product

sales, which is consistent with our hypothesis H3b. The number of cumulative reviews and pictures reviews has a significant positive impact on sales. The influence of product pictures number is mainly positive, while the influence of nouns number is mainly negative. However, product rating, service rating and similarity of details and title only have an impact on the sales of a few products, and the impact is not significant on the whole.

The differences between utilitarian products and hedonic products are mainly reflected in the number of appended reviews and pictures reviews. Influence of the number of appended reviews on hedonic products is mainly negative, while that on utilitarian product is mainly positive. The positive impact of the number of pictures reviews on sales of hedonic products is greater than that of utilitarian products. These differences fit our hypothesis H1.

In addition, we find that except for professional SLR and clothing, the negative influence of the price on sales showed a trend of the higher price and greater influence.

5.2 Vertical analysis of products of the same category

5.2.1 Analysis of influence factors

In order to analyze the vertical differences of factors influencing sales volume, we select 6 subcategories of clothing for analysis. We summary the model results and obtain the following table:

Table 4. Vertical comparison of factors influencing sales volume

Category	Jeans (476)	Shirt (777)	Sweater (1031)	Dress (1264)	Wind coat (1378)	Down jacket (2374)
Product Price	-0.067***	-0.167***	-0.218***	-0.202***	-0.141***	-0.121***
The number of cumulative reviews	0.434***	0.752***	0.761***	0.497***	0.664***	0.294**
Product rating			0.070***			0.091***
The number of appended reviews	-0.376***	-0.571***	-0.968***	-0.165***	-0.698***	-0.278**
The number of pictures reviews	0.645***	0.498***	0.689***	0.404***	0.667***	0.219**
Description rating			0.172***	0.055**	0.107***	
Service rating				-0.095***		-0.086**
Logistics rating	-0.149***	-0.045*				
The number of product pictures	-0.054***		0.155***		0.049**	0.062*
The number of adjectives				0.045**		-0.080**
The number of nouns			-0.092***			
Similarity of details and reviews			0.129***	0.050**		0.223***
Similarity of details and title	0.063***		-0.097***			
The length of title	-0.041**	-0.081***	-0.069**		-0.061**	0.118***
R ²	0.69	0.64	0.53	0.73	0.59	0.17

P-value: 0.01*** 0.05** 0.1* Their average price is shown in parentheses

With the exception of the down jacket, the R² of models is all greater than 0.5, the model fitting effect is good. Product price, the number of cumulative reviews, the number of appended reviews, the number of pictures reviews and the length of title have the strongest robustness. The number of cumulative reviews, the number of pictures reviews, similarity of details and reviews have a positive impact on sales. Product price, the number of appended reviews and the length of title have a negative impact on sales. Interestingly, only description rating has a positive impact on sales, while service rating and logistics rating have a weak negative impact.

From the perspective of the vertical difference, the influencing factors of different clothing types are still

significantly different, so we reject our hypothesis H2. We find that sweaters, dresses, wind coat and down jackets are more significantly influenced by description rating, the number of product pictures, and similarity of details and reviews than shirts and jeans. This may be due to the fact that sweaters, dresses, wind coat and down jackets require more product information, while shirts and jeans have a more uniform style type.

5.2.2 Analysis of price influence

In the previous horizontal analysis, we believe that the higher the price of the product, the greater the negative impact of the price on the sales volume. To verify this conclusion, we reprocess the data. Considering the particularity of down jackets sold in summer, we exclude down jackets, integrate the data of other clothing, and divide them into three equal parts according to the price level.

From the results of high price, middle price and low price clothing, we find that the negative impact of price on product sales is not that the higher the price, the greater the impact. In order to further study and observe this phenomenon, we further subdivide products into 6 categories, ranging from lowest price to highest price, from clothing 1 to clothing 6. The results show that the negative influence of price on product sales presents the u-shaped curve change. For products with low overall price, the elasticity of sales volume to price is greater while the price is lower. For products with high overall price, the elasticity of sales volume to price is greater while the price is higher. Sales of products in the middle range are barely affected by price.

Table 5. The influence of price on clothing sales at different prices

Category	Low price clothing	Middle price clothing	High price clothing	Clothing 1	Clothing 2	Clothing 3	Clothing 4	Clothing 5	Clothing 6
Product Price	-0.189***	-0.053**	-0.136***	-0.185***	-0.094***			-0.100**	-0.133***
P-value: 0.01*** 0.05** 0.1* Here we just show the result of the price variable									

6. ANALYSIS AND DISCUSSION

6.1 Discussion of results

As for the price variable, the result in this paper is basically consistent with the results of previous studies. It is believed that the price elasticity of online sales is very high. Furthermore, this paper shows that the degree of the negative impact of price on sales is affected by product type and product price level. As for the number of cumulative reviews, this paper is consistent with Tamimi and Sebastianelli's idea that the number of reviews can promote product sales^[18]. But they thought that product rating had a positive impact on consumers' purchase intentions, whereas this paper argues that the influence of product rating is insignificant. The different opinions may be related to the purchase channel of consumers, product rating is only displayed on the computer, but not on the mobile phone. Some scholars believed that store service and store logistics had a significant positive impact on sales^{[5], [6]}, but this paper finds that service rating and logistics rating have no significant impact on some products, and even have a negative impact. We guess the stores with lower sales volume may hope to improve the store sales volume by improving the service quality and logistics speed. Product pictures have a positive effect on the sales of some products and a negative effect on the sales of others. Li et al. believed that this may be caused by excessive information load of some products' pictures^[9].

6.2 Theoretical and practical significance

Firstly, this paper analyzes in detail the similarities and differences of the factors influencing sales volume of products of different categories and products of the same category. In addition, this paper classifies different

categories of products into utilitarian and hedonic, which is more detailed than previous studies. The results show that the influence of appended reviews on utilitarian products is positive, while that on hedonic products is negative, and pictures reviews have a greater positive impact on hedonic products than utilitarian ones. Therefore, when selling utilitarian products, consumers should be encouraged to add reviews, and while when selling hedonic products, consumers should be encouraged to display photos.

Secondly, in line with previous viewpoints, this paper also proves that price has a significant negative impact on sales volume. Furthermore, this paper further proves that the influence degree is affected by the price of the product itself. The results show that in the field of clothing, the influence degree changes in a u-shaped curve, that is, products with middle price have the lowest price elasticity. Therefore, we think that when selling products with middle price, the merchants can raise the product price appropriately and lose part of the sales volume in order to gain more profit.

Thirdly, the results show that the similarity of details and reviews has a positive impact on sales volume, while the number of nouns has a negative impact, indicating that merchants should pay more attention to consumer demand when describing product details and reduce the use of nouns. Moreover, the impact of title length on clothing sales is negative. Therefore, the title length should be reduced and controlled when naming clothing products.

7. CONCLUSION AND PROSPECT

7.1 Conclusion

In the horizontal analysis, the number of cumulative reviews and pictures reviews have a positive impact on sales. The price has a negative impact on product sales. What's more, product rating and services rating only have an influence on sales of a few categories of products, which is not significant on the whole.

As for the differences between utilitarian products and hedonic products, first of all, the impact of the number of appended reviews on hedonic products is mainly negative, while the impact on utilitarian products is mainly positive. Secondly, the positive impact of the number of pictures reviews on sales of hedonic products is greater than that of utilitarian products.

The influence of each variable on clothing sales is similar to that on other categories of products, and the number of cumulative reviews, pictures reviews and similarity of details and reviews have a positive impact on sales. Product price, the number of appended reviews and length of title have negative impact on sales volume. From the perspective of price alone, the negative impact of price on clothing product sales presents a u-shaped curve. For products with low overall price, the elasticity of sales volume to price is greater while the price is lower. For products with high overall price, the elasticity of sales volume to price is greater while the price is higher. But sales of mid-priced products are barely affected by price.

There are also vertical differences in the factors affecting the sales of clothing products. Sweaters, dresses, wind coats, and down jackets are more significantly influenced by description rating, the number of product pictures, and the similarity of details and reviews than shirts and jeans.

7.2 Limitation

Due to the limitation of funds, time and manpower, this paper still has many limitations. First, the sample size is limited. Only 10 categories of products are selected in the horizontal analysis of this paper, which could not completely represent all utilitarian and hedonic products. The sample size should be further expanded to increase universality and authenticity in future studies. Second, the values of some variables are not precise enough. Since the experimental data in this paper are from web crawling, the sales displayed on the web page are often rounded, such as: 5000+, 10000 +. In future studies, we should try to cooperate with businesses to

obtain first-hand real data, or use online public data sets to increase the accuracy of the results.

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The Impact of Positive Online Review Tags on Snacks Sales:

A Case of Bestore in Tmall

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Abstract: Customers' reviews in e-commerce sites play a significant role in influencing potential customers' purchasing decisions which ultimately affects products sales. Chinese e-commerce sites like Tmall, Taobao and JD.com contain a collection of aspect tags that group reviews with similar comments tags to help customers browse reviews and evaluate products more conveniently. To validate whether these tags are useful and actually playing a role in promoting future sales, we collected data including product information and review tags on a regular basis for consecutive 8 weeks from Bestore, a snack seller on Tmall. We classified the collected review tags into 9 types based on their semantic meanings. Finally, we analyzed and performed generalized estimating equations (GEE) modeling on the data set consisting of 234 products with a total of 734 tags. The results show that most of the aspect tags are related to immediate period sales volume and certain tags are more capable of nowcasting next immediate sales.

Keywords: E-commerce, online review, tag, sales

1. INTRODUCTION

It is increasingly common for people to share their views of various content over the Internet, and equally easy to find others' views (Bertola & Patti, 2016). When it comes to online shopping, this trend has exerted influence on how people actually decide whether to make a purchase. Most consumers tend to read reviews of a target product to help them make an informed decision (Zhang et al., 2016). A study by Mudambi and Schuff (2010) showed that consumers who search for information online about products and compare them with alternatives would normally have to weigh it against numerous reviews posted by other consumers. W. J. Duan, B. Gu, and A. B. Whinston (2008) summarized this trend as consumers helping each other in searching the space of possible solutions to their need.

Online reviews affect sales of products to a certain degree, which has been suggested in many studies (W. Duan, B. Gu, & A. B. Whinston, 2008; W. J. Duan et al., 2008; Forman, Ghose, & Wiesenfeld, 2008). Based on the mechanism found in which online reviews have an impact on sales, it is possible for companies to design and implement ways to influence sorting and effective visualization in e-commerce sites. Effective designs can motivate potential customers to a large degree as they can manipulate online reviews to match their requirements. For example, websites like Amazon, YouTube and Yelp sort their reviews according to various review factors to help enhance objects' exposure to users (Ren & Nickerson, 2014). Previous research has identified relevant factors such as sentiment, helpfulness, newness, the number of likes and source credibility to be useful design considerations.

Floyd, Freling, Alhoqail, Cho, and Freling (2014) demonstrated in their study the relationship between sales volume and different properties of reviews. They found that the effects of negative reviews on products are more salient than positive ones and usually cause unfavorable impacts on product attitudes. Therefore, it is necessary for retailers to detect and address service and product failure promptly, otherwise dissatisfied

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customers may post negative online reviews that may deter many potential customers.

Zhu and Zhang (2010) studied review data from the video game industry and found that online reviews were more influential for less popular games. In other words, for a commodity that has few customer reviews (i.e. not popular), the reviews play a more important role. Negative reviews may become extremely salient in this situation. Hence sellers should also take corresponding measures to solve this kind of problem.

According to Zha, Yu, Tang, Wang, and Chua (2014), there is a common problem with the display of most reviews. Current reviews are mostly not well organized, causing difficulties in information navigation and knowledge acquisition. Therefore, there is a need to design a mechanism that can help to present reviews and display them in a friendly way for customers to browse. The tag mechanism in Tmall is a representative design to allow more user friendly information acquisition in practice. As is shown in Figure 1, tag names are displayed in the form of buttons above the list of reviews. These tags organize a collection of phrases from all the reviews that contain identical or similar meaning by grouping them with a tag name and the number of appearances, which can help potential customers browse relevant reviews more conveniently and efficiently. The number that follows the name of the tag is the quantity of reviews that are aggregated by the tag, i.e. the number of reviews that share similar content. Tags with positive reviews of products distinguish themselves in red font, while those with negative reviews appear in green font. This mechanism provides more convenience for potential consumers to view both relevant positive reviews and negative reviews respectively.



Figure 1. Tmall's display of tags

When a tag is clicked, reviews that belong to this tag ("tag review") would be listed below, with the main content relevant to the name of the tag marked in red. As is shown in Figure 2, customers can easily choose which reviews to browse



Figure 2. Listing of reviews that belong to a certain tag

The tag mechanism described in this study is a common feature in most Chinese e-commerce platforms such as Taobao and JD.com, but is not a prominent feature in other international e-commerce websites such as Amazon and eBay (Amazon uses keyword tags). Coincidentally, knowledge about the usefulness of the review tag is currently lacking. Furthermore, there has been much research on products such as electronic products, hotels, and movies with little attention to food (Floyd et al., 2014). Snacks are a type of food commodity that has some unique product properties such as taste, smell, volume and variety. The impact of these tags on an industry with an estimated output value of 3 trillion yuan in 2020 is worthy of serious attention (Zhuoqiong, 2019). We chose Bestore (良品铺子), which is a prominent corporation mainly engaged in producing and selling snacks, as our research case as all relevant data sources can be collected from its official web page on Tmall.

In this study, we wanted to know whether review tags would have an effect on sales, and if so, to what degree, and since Tmall also offers the valence of each tag (positive or not), we decided to explore the effects of those positive tags. In addition, we wanted to explore the aspect tags' effects. Tags that are classified into different aspect types according to their names' semantic meanings would reveal the properties of products that customers most care about. Further, if tags are to be related with product sales, it is natural that tags could be considered as potential predictors for future sales, which would contribute to more precise prediction results of existing sales nowcasting models. Taken together, we posit the following research questions:

- (1) To what extent are positive review tags inter-related?
- (2) How are the positive review tags associated with product sales, price and discount rate?
- (3) To what extent are different positive tags associated with product sales in the current period?
- (4) To what extent are positive review tags capable of nowcasting product sales in the immediate period?

This study contributes to knowledge on several aspects of the tag mechanism in e-commerce. First, the original research adds to the limited knowledge on the tag mechanism and its impact on product sales. Second, the research enhances our knowledge on food products, and specifically snacks, which are a popular product in China but under-researched. Third, the research unveils the importance of e-commerce and product properties that customers care about most when purchasing snacks. Lastly, the research provides a model for nowcasting of product sales.

The remainder of the paper is structured as follows. Section 2 presents relevant work on the following three aspects: (1) the relationship between reviews volume and sales, (2) the research on exploring what product properties people care about when making purchasing decisions, and (3) the introduction of a generalized estimating equation model that we use on our data set. Section 3 describes our data set and some preprocessing work in detail. Section 4 explains specific variables for the experiments and shows our experiment results. Section 5 discusses the experiment results. Section 6 concludes our work and discusses limitations of the study, along with directions for further research on this topic.

2. LITERATURE REVIEW

2.1 Research on online reviews

In recent years, online reviews have played an increasing role in influencing consumer decision making. Online reviews help customers understand the pros and cons of different products to find the most suitable one for their needs and consumer advocacy has been shown to significantly affect product sales (Moe & Trusov, 2011; Salehan & Dan, 2016). In the industry research report by Deloitte (2012) a big proportion of consumers claims that their purchasing decisions are largely influenced by online reviews.

According to Bickart and Schindler (2001) customers are more willing to accept product information from online reviews rather than the information provided by vendors. As messages coming from similar others are more persuasive (Berger, 2014), the information from others who have experience with products is always thought to be more useful and closer to what they want to know. Similarly, information coming from consumers who share their reviews with their families, friends or colleagues are more influential as the reviews not only make sense of the shopping experiences but also enhance the social relationships (Peters & Kashima, 2007).

Studies have identified various ways that reviews influence consumer decision making. For instance, users are more likely to attach importance to negative messages than positive ones, and pay more attention to negative messages. Negative online reviews play a more significant role than positive online reviews (Park & Lee, 2009). Chen, Wang, and Xie (2011) also mentioned that both positive and negative online review information play a crucial role in increasing sales, and specifically, negative online reviews have a greater impact than positive online review information.

Online reviews have been measured in multiple ways to capture their effects from various aspects. Studies typically focus on the following metrics of online reviews: volume, valence, composite valence–volume, and variance (Rosario, Sotgiu, Valck, & Bijmolt, 2016). Volume refers to “the total amount of electronic word-of-mouth interaction”, that to say, the total number of online reviews for a product (Y. Liu, 2006). Yang, Kim, Amblee, and Jeong (2011) research confirmed there is a direct relationship between the volume of a product’s online reviews and the product sales. Online review volume indicates information about the number of people who have purchased the product. In addition, it can increase customers’ awareness of and reduce their uncertainty about the product, thus leading to the increasing of sales (Chen et al., 2011). Amblee and Bui (2011) investigated the impact of online reviews by analyzing the sales of digital micro-products. They showed that online reviews can be a form of social signal representing various types of reputation that affect sales which eventually contributes to the success of e-commerce businesses.

Valence indicates the nature of the review which can be negative, positive, mixed or neutral. It is also referred to as “sentiment” or “favorability” of online reviews which contains two layers of meaning: the objective information and the affect expressed therein (Babić Rosario, Sotgiu, De Valck, & Bijmolt, 2016). Sometimes the sentiment in online reviews is not straightforward and thus requires intelligent language processing techniques to unveil its meaning. For instance, to help customers gain more information from online reviews and make a decision Ullah, Amblee, Kim, and Lee (2016) applied Natural Language Processing technology to study and analyze the emotional content contained in online reviews of a large number of products.

Variance is a less popular metric in the investigation of online reviews. A low variance of online reviews means customers agree that the product is either good or bad, which explains why the influence of online reviews on sales can be either positive or negative (Babić Rosario et al., 2016). A high variance of online reviews indicates a high mismatch cost and affects sales, even though information on customers’ preferences towards the product is still available (Sun, 2012).

In sum, online reviews have been studied in various aspects. Regardless of the attributes that are of interest such as volume, valence or variance, understanding the mechanisms that govern product sales and online reviews is very important. Table 1 presents a summary of recent research related to online reviews.

Table 1. Summary of research on online reviews

Article	Data source	Data collection method	Data size	Data analysis method	Key findings
X. Liu, Lee, and Srinivasan (2019)	Major online retailer in the United Kingdom	Site data provider	500,000 reviews of 600 product Home and Garden	Supervised deep learning	Review content has a higher impact on sales when the average rating is higher, ratings variance is lower, the market is more competitive or immature, or brand information is not accessible.
Chen et al. (2011)	Amazon.com	Online search	120 digital cameras	First-difference econometric models	Customers' shopping statistics can help consumers to buy products that are really useful to themselves, and reveal the influence of word of mouth on product sales.
Moe and Trusov (2011)	A national retailer of bath, fragrance and beauty products	Record weekly	500 products	Developed models	The existing rating on the product has an impact on the customer's rating behavior.
Amblee and Bui (2011)	Amazon.com	Online search	133 Amazon Shorts e-books	Regression analysis	The reputation of a product can be presented through electronic word-of-mouth.
Park and Lee (2009)	Undergraduate students	Online survey	440 responses	Regression analysis	The relationship among e-WOM effect, the e-WOM website reputation and information direction can be different beyond different product type.
Yang, Kim, Amblee, & Jeong, (2011)	Korean film council (KOFIC) (2006)	A search engine provided by KOFIC web site	117 movies	OLS and panel data analysis	Consumers prefer products with larger sales or large e-WOM volume.
Sun (2012)	Amazon.com and BN.com	Online search	892 books	DID estimation approach	Previous ratings of product have a significant impact on customers to make purchase-decision.
Salehan & Dan (2016)	Amazon.com website	Crawler software	20 products	Regression analysis	Words containing positive emotions are more likely to be read.
Rosario et al. (2016)	Platforms of products	Wayback machine	1,532 effect sizes	Meta-analysis	There is a significant positive relationship between product sales and e-WOM, but products, platforms or metric factors may lead to another result.
Ullah et al. (2016)	Amazon.com website	A custom software tool	15,849 online reviews	NLP techniques	The emotional content of reviews are different in experience and search goods, but a large number of reviews help customers understand product well.
Y. Liu (2006)	Yahoo Movies Web site	Online search	40 movies 12,136 WOM message	Regression analysis"	WOM information during both a movie's prerelease and opening week, especially the volume, can have a significant impact on box office revenue.
Ha, Bae, and Son (2015)	Online booksellers in Korea	Online search	4,892 online reviews	Regression analysis	Online reviews from personal bloggers have the most significant effect on product sales than other ones by researching the source of online reviews including personal-blogger reviews, seller-blogger and seller-site.
Chong, Li, Ngai, Ch'ng, and Lee (2016)	Amazon.com	Web crawling and scraping	40,000 products	Sentimental and neural network analysis	The interplay effects of online volume, online valence, sentiments and discounts play a more important role on the prediction of sales volume than single variables.
Liang, Li, Yang, and Wang (2015)	IOS app store	Online research	149 apps	Multifacet sentiment analysis	Although consumers' opinions on product quality occupy a larger portion of consumer reviews, their comments on service quality have a stronger unit effect on sales rankings.

2.2 Tags in online reviews

With the increasing volume of reviews, the issue of information overload is inevitable. For example, best-selling products in Amazon commonly contain thousands of reviews (Amazon, 2019). A huge volume of reviews makes it difficult for consumers to obtain relevant and useful decision making information. Therefore, it is rational to extract and organize only core information. The implementation of review tags thus performs a vital function in reducing, summarizing and guiding potential buyers to retrieve and process useful information.

Because the number of reviews generated on the e-commerce sites far exceed the capacity of personal information processing, consumers have to resort to some heuristic rules to simplify the task of reading reviews. For example, potential buyers can judge the reviewer's reputation directly through the volume of online reviews posted and the average rating, without further reading the review text. Buyers can focus on low ratings, high ratings, or recently published reviews, because these reviews are relatively small and have high diagnostic accuracy (Q. Liu, Karahanna, & Watson, 2011).

Generally, information labels have three content requirements: user generated (opinion credibility), majority views (avoid overly biased views), and sufficient semantics to be retained (easy to understand) (Ames & Naaman, 2007). Tag based review summarization is a new feature on e-commerce websites to alleviate the problem of information overload faced by consumers. This features divides the reviews into categories based on product attributes (such as screen, battery, call quality), or user experience (such as novel style, good quality, beautiful appearance), and gives each class a label. In addition to tag names, labels usually mark instances (review bars) and tag polarity (corresponding merits or demerits), and display relevant reviews when the user clicks on the tag (Liu Jingfang, 2016).

There are previous studies that name these classified tags as 'aspect tags', namely tags that illustrate what the reviews are commenting on (Kayaalp, 2014; Levi, Mokryn, Diot, & Taft, 2012). Moreover, many researchers have been trying to explore effective methods that can identify aspects that certain reviews focus on. B. Liu (2012) summarizes four approaches to extract aspect tags, namely: (1) extraction based on frequent nouns and noun phrases, (2) extraction by exploiting opinion and target relations, (3) extraction using supervised learning, and (4) extraction using topic modeling.

Yu, Zha, Wang, and Chua (2011) tried to identify important product aspects from online consumer reviews. Important aspects feature two phenomena: (a) a large number of reviews would contain relevant information about the aspects, and (b) other consumers' reviews on important aspects would greatly affect potential customers' purchasing desire. These phenomena support the current study to classify review tags and to find the most influential review tags that can affect customer purchasing behavior, because product aspects that many customers care about most would also be reviewed most. Hence, by finding significant relevance between sales and reviews focusing on different aspects, i.e. assembled by different types of tags, we can also identify which aspects of products are important.

Tags on Tmall's product webpage are the more general form of aspect tags because they are not restricted to specific properties of products. For example, a tag like "the peanut tastes good" focuses on the property of food taste in essence, and the corresponding aspect tag should be "taste". Meanwhile a tag like "Seller is patient" shows the quality of service offered by the seller, so the corresponding aspect tag would be "service". Therefore, we chose to aggregate tags from Tmall into aspect tags according to the product properties that tags are focusing on. Our work is simplified by Tmall's existing tag mechanism, since we do not need to extract aspect tags directly from review text.

2.3 Analyzing review effects

Research has adopted various methods and models to explore the relationship between review volumes and

sales. W. Duan et al. (2008) used a simultaneous equation system to explore the relationship between movies' box office revenue and online reviews. The findings showed that while higher average ratings do not lead to higher movie sales, the greater number and generating speed of review posts do. Moreover Clemons, Gao, and Hitt (2006) used multivariate linear regression and reached a similar conclusion when focusing on online reviews' effects on beer sales.

Dewan and Ramprasad (2009) performed both Granger causality estimates and two-stage least squares on album sales and reviews data to solve the potential problem of endogeneity. The regression results also indicate the important role of review volume's contribution to higher sales. All researchers above have adopted difference of review quantity to show significant influence on sales. Therefore, we also adopt difference of review quantity for our explanatory variables, while the distinction is that we assemble these reviews using classified tags.

When data consists of weekly repetitive observations, i.e. longitudinal data which are collected on a regular basis from the same group of research objects, where observations are correlated with each other for the same object but independent between different objects, the generalized estimating equation (GEE) would be a good method. The GEE approach is an extension of generalized linear models designed to handle categorical repeated measurements arising from within-subject designs. GEE also relaxes the restriction on distribution of dependent variables and offers robust parameter estimates compared with other similar models (Ziegler, 2003). Furthermore, the interpretation of GEE results is identical to that for commonly used models for uncorrelated data (e.g., logit and probit) (Zorn, 2001).

The adoption of the GEE method to analyze online review data has been limited. This is probably due to the fact that most studies used only cross-sectional data. Nevertheless, a few successful examples provide guidelines for using GEE in e-commerce. For example, Senecal and Nantel (2004) adopted the GEE method to investigate consumers' usage of online recommendation sources and their influence on online product choices. Their results successfully indicate that subjects who consulted product recommendations selected recommended products twice as often as subjects who did not consult recommendations. Sodero, Rabinovich, Aydinliyim, and Pangburn (2017) used the GEE method which addresses the inherent endogeneity among the variables to establish links between inventory, prices, and sales empirically, using a large data set comprising a wide array of products sold on Amazon.com.

3. METHODOLOGY

3.1 Data collection

Tmall is a well-known B2C e-commerce platform in China established by Alibaba Corporation in 2012. It has become one of the most popular online shopping websites in China. On 11 November 2019, Tmall made a sales record of 268.4 billion RMB in a single day (Tmall, 2019). In Tmall, commodities with enough reviews would have tags displayed on the corresponding web page which would appear automatically as a key feature offered by Tmall.

A Java crawler program was developed to collect all the needed information on snacks available for sale on Bestore's official website on Tmall. Our data includes all available properties of snacks and tags. In addition, Tmall displays only monthly moving sales data of products, i.e. cumulative sales from 30 days ago to now, and we collected sales data weekly in order to compute sales differences between weeks. Our collection started on 18 June 2018, and we collected the same data on Sundays. In total we collected 8 weeks' (T_1 - T_8) data containing 234 different products' sales data and 734 unique tags. The 234 food products collected for the analysis were classified into 9 snack types according to Bestore's official classification of their products. Table 2 depicts the product classification statistics.

Table 2. Product classifications

Ordinal	Type	Explanation	Examples	Quantity
1	坚果炒货	Roasted seeds and nuts	熟花生米, 夏威夷果, 巴旦木	44
2	肉类熟食	Meat and cooked food	牛肉丝, 小香肠, 鸭脖子	48
3	果脯蜜饯	Preserved fruit	山楂球, 红枣片, 黄桃干	53
4	甜心糕点	Cake and pastry	沙琪玛, 麻花, 肉松饼	16
5	饼干膨化	Cookies and puffed food	薯条, 薯片, 锅巴	13
6	糖果布丁	Candy and pudding	棒棒糖, 巧克力, 果冻	12
7	山珍素食	Vegetarian diet	金针菇, 水果茶, 乌龙茶	3
8	海味河鲜	Seafood and fish, shrimps etc. from rivers.	海带丝, 鱿鱼丝, 小黄鱼干	35
9	良品礼盒	Gift box (several types of products packaged together)	果冻礼包, 干果坚果炒货组合, 饼干组合	10

3.2 Data Preprocessing

3.2.1 Tag formulation

In Tmall, tags with different names are classified according to their semantic meanings and different products contain certain variations of tags. In total, 734 tags were collected and were re-classified into 9 categories as listed in Table 3. We defined the following parameters to facilitate tag analysis:

Tag_{p,i,t_n} is the total number of tag category i at time n of product p .

$\Delta Tag_{p,i,t_{n+1}} = Tag_{p,i,t_{n+1}} - Tag_{p,i,t_n}$ is the first difference of the total number of tag category i of product p at time $n+1$ minus the total number of tag category i of product p at time n .

$\Delta Log(Tag)_{p,i,t_{n+1}} = \log(1 + \Delta(Tag)_{p,i,t_{n+1}})$ if $\Delta(Tag)_{p,i,t_{n+1}} > 1$ or

$\Delta Log(Tag)_{p,i,t_{n+1}} = \log(1 - \Delta(Tag)_{p,i,t_{n+1}})$ if $\Delta(Tag)_{p,i,t_{n+1}} < 1$ is the natural logarithm of the first difference of the total number of tag category i at time $n + 1$ minus the total number of tag category i at time n .

The difference parameter $\Delta Log(Tag)_{p,i,t_{n+1}}$ allowed us to associate the incremental increase (decrease) of the total number of tags with the incremental increase (decrease) in sales from time n to time $n + 1$.

Table 3. Tag Classifications

Ordinal	Tag Names	Explanation	Examples	Quantity
1	Food Taste	Taste of food (flavor, texture of food)	蛋糕很好吃; 虾干好吃; 味道好	503
2	Food Quality	Freshness, sanitation, look (size, shape, color)	分量够; 干净; 质量不错	130
3	Packaging	Packaging of food	包装很好; 包装不错;	8
4	Delivery Service	The quality of delivery service (e.g. Slow or fast)	发货快; 邮费便宜; 快递不错	7
5	Food Smell	Smell of food (e.g. Fragrant or unpleasant)	气味不错	13
6	Food Price	Price of food (e.g. Cheap or expensive)	便宜; 划算; 实惠	11
7	Customer Service	Quality of service offered after purchasing	服务好; 态度不错	6
8	Purchase Influence	Influence on buyer's surrounding people (e.g. buyer's friends praise the product)	人群	1
9	Emotion	Personal likes and dislikes for products (e.g. a buyer writes 'I love it very much'.)	超爱鸭舌; 喜欢草莓干; 鱼嘴大赞	55

3.2.2 Sales formulation

To analyze tags' effect on sales, we defined product sales parameters to be used in the GEE model.

$G_{p,t_{n+1}} = \frac{Sales_{p,t_{n+1}} - Sales_{p,t_n}}{Sales_{p,t_n}} \times 100\%$ is the normalized sale growth rate of product p at time n + 1.

$D_{p,t_{n+1}} = \frac{Current\ Product\ Price_{p,t_{n+1}}}{Original\ Product\ Price_{p,t_n}} \times 100\%$ is the normalized Chinese discount rate (打折) of product p at time n + 1.

$P_{p,t_n} = Price_{p,t_n}$ is the price of product p at time n.

3.2.3 Model formulation

We formulated two estimation models with GEE to answer the research questions. In the first model the dependent variable is $G_{p,t_{n+1}}$ because we wanted to validate the relationship between the incremental difference (increase) in the number of tags and the incremental difference (increase) in sales for the current time (see equation 1). For the second model the dependent variable is $G_{p,t_{n+2}}$ since we wanted to verify the incremental difference (increase) in the number the number of tags which could provide nowcasting to predict the next immediate future period of increment difference (increase) of product sales (see equation 2). The two models' equations are described below.

$$G_{p,i,t_{n+1}} = \sum_{tag=i}^j \beta_i * \Delta Log(Tag)_{p,i,t_{n+1}} + \alpha * P_{p,t_{n+1}} + \delta * D_{p,t_{n+1}} + \varepsilon \quad (1)$$

and,

$$G_{p,i,t_{n+2}} = \sum_{tag=i}^j \beta_i * \Delta Log(Tag)_{p,i,t_{n+1}} + \alpha * P_{p,t_{n+1}} + \delta * D_{p,t_{n+1}} + \varepsilon \quad (2)$$

We then performed GEE with SPSS by transforming the data set into a panel data format.

4. RESULTS

4.1 Correlation Analysis

To answer RQ1 and RQ2, we performed a correlation analysis to ascertain the discriminate strength of the review tags and their association with product sales, price and discount rate using differences model parameters. Table 4 depicts the descriptive statistics of the means, standard deviations, correlation coefficients and significance levels among the variables. For the investigation period, most of the products' sales are declining on a moving average basis and are offering huge discounts to attract sales. Overall the mixtures of products contain high variation in price, discount rate and overall sales.

4.2 Current tag to estimate immediate sale

To answer RQ3, we validated the relationship between differential tag changes from time n to time n + 1 and differential sales changes for the corresponding time from n to n + 1. We performed GEE with $G_{p,i,t_{n+1}}$ as the dependent variable and $\Delta Log(Tag)_{p,i,t_{n+1}}$ with positive review tags as the independent variables. We obtained the results shown in Table 5.

The results show that among all the positive review tags, Food Taste, Food Quality, Packaging, Delivery Service, Food Price and Emotion are all significant with $p < .05$ and all β estimates are positive. Purchase influence is significant at $p < .1$ only. Interestingly Price, Food Smell and Customer Service are not significant

Table 4. Descriptive statistics and Correlation matrix for the variables

Parameters	Min	Max	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
Price	1.00	135.00	26.80	15.16												
Discount	0.00	0.88	0.44	0.15	-.245**											
Sales(N+1)-Sales(N)	-107788	42032	-443.36	4584.28	0.014	-0.007										
(Sales(N+1)-Sales(N)) /Sales(N)*100	-64.04	158.24	-3.18	17.10	0.010	-.117**	.386**									
Food Taste	-8.48	8.55	-0.48	2.78	-0.041	-.093**	.119**	.217**								
Food Quality	-7.90	7.71	-0.62	2.26	-.103**	-0.041	.240**	.222**	.206**							
Packaging	-5.95	6.39	-0.28	1.23	0.029	-.079**	.077**	.139**	.221**	.198**						
Delivery Service	-6.65	5.95	-0.49	2.01	-.090**	-.085**	.272**	.287**	.548**	.559**	.285**					
Food Smell	-5.25	3.99	-0.17	0.90	-0.006	-0.022	.075**	.075**	.148**	.208**	0.016	.278**				
Food Price	-6.76	6.81	-0.16	1.89	-.105**	-0.006	.241**	.230**	.440**	.469**	-0.012	.588**	.308**			
Customer Service	-7.06	7.06	-0.13	1.38	0.031	-.054*	0.011	.059*	.166**	.162**	-.112**	.222**	0.044	0.042		
Purchase Influence	-5.68	4.86	-0.35	1.45	-0.041	-.081**	.276**	.255**	.467**	.483**	.246**	.647**	.244**	.510**	.179**	
Emotion	-8.55	8.55	0.01	1.17	0.007	0.030	.095**	0.021	-.353**	-0.004	-0.019	-0.009	-0.021	0.026	-0.027	-0.005

** . Correlation is significant at the 0.01 level (2-tailed). * . Correlation is significant at the 0.05 level (2-tailed).

in estimating current growth of sales. However, food smell and customer service are positively correlated with growth of sales with a small effect size of $r = .075$ and $r = .059$ respectively of $p < .01$. Notice that price has no effect in predicting growth of sales while offering a huge discount improves sales growth which is typical for snack products. Price promotion indicates that products with high price are being offered at huge discounts (1-Chinese discount rate).

4.3 Current tag to nowcasting next period sales

To answer RQ4, we validated the relationship between differential tag changes from time n to time $n + 1$ and differential sales changes for the corresponding time from n to $n + 1$. We performed GEE with $G_{p,i,t_{n+2}}$ as the dependent variable and $\Delta \text{Log}(\text{Tag})_{p,i,t_{n+1}}$ of positive review tags as the independent variables. We obtained the results shown in Table 6.

From the results, *Food Taste* and *Delivery Service* are the only two review tags that are significant with $p < .01$ to predict the growth of sales for the next immediate period. *Purchase Influence* and *Emotion* were significant at $p < .1$. This shows that these tags are valuable predictors for nowcasting to the next immediate period. Other tags are not so useful to predict sales in more distant periods, suggesting that the snack product properties are dynamic in Tmall.

5. DISCUSSION

Our investigation demonstrates that the tag mechanism in Tmall is actually playing a role in affecting food product sales on the e-commerce platform. Specifically, positive tags contribute to product sales, and tags of different types (aspect tags) individually have different weights in promoting sales respectively. In addition, some tags are more capable of serving as predictors for future product sales.

Our research fills in the gap of exploring the effect of the tag mechanism on product sales. The only existing research on Tmall tags was done by Liu Jingfang (2016), investigating the impact of tag-based review summarization on experience products and searched products in terms of perceived usefulness and system satisfaction but not for predicting sales. Our research suggests tags' positive effect on promoting product sales, while Liu's work focused on the improvement of customer's feelings in the purchasing process.

Our research pays more attention to the relevant relationship between tags and sales, and further to different effects of each aspect tag. Reading reviews to learn more about a product before purchase is essential for most buyers. However having thousands of reviews to browse will incur physical search cost and cognitive search cost (Q. Liu et al., 2011). Tags are essentially a mechanism that provides key phrase summarization of customer reviews that offer personal sentiment and judgment on products' properties. In this way, the tag mechanism serves as a way to overcome the customer's search cost of finding those reviews relevant to their favored product property and helps them to make faster decisions. Yatani, Novati, Trusty, and Truong (2011) study concluded that a system offering brief overviews of many reviews can accelerate the customer's decision process. Hence the tag mechanism in e-commerce sites is highly recommended.

Our findings also provide indirect evidence that there is a significant positive correlation between review volume and product sales, since essentially the difference changes in the aspect tag reviews parameter reflects volume change of certain types of reviews. This phenomenon can be explained by two theories. One is the uncertainty elimination effect. According to Chen et al. (2011) a greater volume of reviews reduce the customer's uncertainty about product properties and contribute to their purchase decision. In our case, the aspect tags provide easy access to better eliminate customer uncertainty about their most important product property, therefore leading to an increase in sales. The other theory is the awareness effect. A greater volume of reviews diffuses the existence of a product more easily, and thereby makes more people see the product and choose to purchase it (W. Duan et al., 2008).

The aspect tags that are significant in the current study are viewed as salient features in promoting product sales from the buyer's perspective. A possible explanation may be attributed to the nature of food features and the desired expectations from customers. Respectively, it is intuitive that *Food Taste* and *Food Quality* are both important criteria for customers, since a food product's core features are its taste and quality. These features include not only flavor and texture, but hygiene and freshness which would greatly influence people's desire to eat food, and especially for snacks which people consume more for their appealing taste rather than staple foods for satisfying hunger. On the other hand *Packaging*, *Delivery Service* and *Food Price* are essential decision factors not limited to food products that have a direct impact on sales. Packaging refers to the physical appearance of a product when a consumer sees it. Packaging designs can increase consumer intention to purchase (Schnurr, 2019). Delivery service refers to time spent on delivery and the condition of a product during the process of delivery. For food products, high quality and efficient delivery services are a key factor in consumer satisfaction (Suhartanto, Dean, Leo, & Triyuni, 2019). *Food Price* generally consists of customer opinions on whether the product provides value for money, which is certainly affecting their purchasing decision while assessing products (Buch-Andersen, Andreassen, Jørgensen, Ehlers, & Toft, 2019).

6. CONCLUSION AND FUTURE RESEARCH

In this paper, we explored the relationship between review tags, a mechanism to collect reviews with similar key content phrases and display them to customers, and the sales of products. Using real data from Chinese e-commerce platform Tmall and snack seller Bestore, we obtained specific insight into snack product sales mechanisms. To validate whether review tags of different semantic expressions would affect sales differently, we classified all review tags according to their meaning into 9 types. We performed GEE on our repeated observations of a longitudinal data set of review tags and sales volume, because GEE provides good robust parameter estimates. The results show that review tags concerning food taste, food quality, packaging, delivery service, food price and emotion would have a significant impact on sales. The result implies that customers pay considerable attention to these product properties when deciding whether to purchase in the immediate time frame. The second result indicates that review tags concerning food taste and delivery service are good predictors for a sales nowcasting model, which may help improve sales performance. Hence, our findings also offer real evidence for e-commerce platforms (e.g. Amazon, eBay) that do not have similar review tag mechanisms to consider implementing such features as they are useful in generating sales and contribute to reliable forecasting.

The current study is not without limitations. First, our classification of review tags are novel so require further validation and to establish standards and criteria as there has been little previous relevant work that we can compare with. Although our classification produces meaningful results, it would be also more reliable for later research to produce standardization across different product types other than snacks. Second, while we focused our analysis on 264 Bestore snack products, there are some mainstream varieties of snacks that Bestore does not sell, for example chocolate. Hence, our conclusions can only be generalized to similar snack ranges unless further analysis can be performed on a wider variety of snack products.

Although we obtained meaningful results about which types of review tags would influence sales, future research could explore how to design corresponding algorithms and visualizations to persuade potential online buyers to purchase the products. Future research can also look into designing interaction log experiments with real people from actual purchases to test different tag algorithms and visualizations. In addition, it seems very promising to try incorporating review tags as factors into sales prediction models, since our work implies their potential power as predictors. Apart from this, since reviews collected by review tags are the core elements that are making a difference, this offers great motivation for later research to add more review features to prediction

models.

Table 5. Parameter estimates of current sales

Parameters	B	SE	95% Wald Confidence Interval		Hypothesis Test	
			Lower	Upper	Wald χ^2	Sig.
(Intercept)	2.09	2.03	-1.88	6.06	1.06	0.30
Price	0.02	0.03	-0.04	0.08	0.42	0.52
Discount	-9.72	3.38	-16.35	-3.08	8.25	.004***
FoodTaste	0.56	0.20	0.17	0.95	7.87	.005***
FoodQuality	0.58	0.22	0.16	1.01	7.24	.007***
Packaging	0.79	0.39	0.03	1.54	4.15	.042**
DeliveryService	0.83	0.31	0.22	1.44	7.03	.008***
FoodSmell	-0.38	0.48	-1.31	0.55	0.65	0.42
FoodPrice	0.66	0.29	0.08	1.23	4.95	.026**
CustomerService	0.00	0.31	-0.62	0.62	0.00	0.99
PurchaseInfluence	0.71	0.37	-0.02	1.45	3.61	.058*
Emotion	0.81	0.34	0.14	1.48	5.56	.018**
(Scale)	260.55					

***, **, and * Mean difference is significant at the $\leq .01$, $\leq .05$, and $\leq .1$ levels, respectively.

Table 6: Parameter estimates for nowcasting sales

Parameter	B	SE	95% Wald Confidence Interval		Hypothesis Test	
			Lower	Upper	Wald χ^2	Sig.
(Intercept)	-2.01	1.93	-5.80	1.78	1.08	0.30
Price	-0.02	0.03	-0.09	0.05	0.33	0.56
Discount	-1.62	3.34	-8.17	4.93	0.24	0.63
FoodTaste	0.57	0.20	0.18	0.96	8.11	.004***
FoodQuality	0.11	0.23	-0.35	0.56	0.21	0.64
Packaging	0.50	0.39	-0.26	1.26	1.66	0.20
DeliveryService	1.33	0.32	0.70	1.96	17.02	.000***
FoodSmell	-0.71	0.49	-1.67	0.26	2.04	0.15
FoodPrice	0.00	0.28	-0.55	0.55	0.00	0.99
CustomerService	0.33	0.33	-0.32	0.98	1.01	0.31
PurchaseInfluence	0.81	0.42	-0.01	1.63	3.77	.052*
Emotion	0.72	0.39	-0.04	1.48	3.47	.062*
(Scale)	255.58					

***, **, and * Mean difference is significant at the $\leq .01$, $\leq .05$, and $\leq .1$ levels, respectively.

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The Influence of Online Travel Consumers' Confusion on the Delay of Purchase Decision

——Based on the Regulation of Cognitive Needs

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Abstract: The Internet makes it easier and faster to search for information online. The explosive growth of information has also led to a significant increase in consumer choice confusion, and consumers are increasingly inclined to delay purchase decisions. The current research on the relationship between consumer confusion and purchase decision delays lacks analysis from the impact of cognitive needs. Based on the existing literature and results, this paper selects three dimensions of similar confusion, overload confusion and fuzzy confusion, and uses 305 data obtained from the questionnaire survey to empirically explore the relationship between consumer confusion and purchase decision delay, and the adjustment mechanism of cognitive needs. The research results show that overloading confusion and fuzzy confusion have a greater impact on purchase decision delay; cognitive needs negatively regulate the relationship between similar confusion, overload confusion and fuzzy confusion and purchasing decision delay; when cognitive demand is high, overload confusion The positive impact of vague confusion and delayed purchase decisions will diminish. This research not only enriches theoretically the relationship between cognitive needs, consumer confusion, and purchase decision delays, but also provides guidance for online travel marketing in practice.

Key words : similarity confusion overload confusion ambiguity confusion need for cognition purchase decision postponement

1. INTRODUCTION

According to the "Statistical Bulletin" issued by the Ministry of Culture and Tourism, the domestic tourism market continued to grow steadily in 2018. The number of domestic tourists in the year was 5.539 billion, and the total tourism revenue for the year was 5.97 trillion yuan. With the development of the Internet, the number of people who choose to travel online is also rising, and online travel e-commerce platforms have become an important channel for consumers to complete their purchase decisions^[1]. The emergence of online travel has provided convenience for travel consumers to check travel information, book travel products, and evaluate service quality. The enrichment brought by the increase in information can help consumers make purchasing decisions to a certain extent, but when the product information is similar, excessive, and vague, it will cause consumer confusion. Faced with confusion, consumers tend to adopt coping strategies that delay decision-making^[5].

Through literature review, it is found that consumer confusion has been a research hotspot at home and abroad, and more and more scholars begin to pay attention to its causes and consequences. At present, in the field of online tourism, most scholars mainly focus on the impact of consumer confusion on customer psychological perception. For example, Lin Baomin and Tu Hongwei^[21] discussed the impact of consumer confusion on trust from the perspective of emotional evaluation theory, and Tu Hongwei and Wu generation^[22] discussed the impact of consumer confusion on negative word-of-mouth from the perspective of emotional

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aggregation response. At present, the relationship between consumer confusion and purchase decision-making has been studied to some extent, but there are some differences in the research conclusions, and there is no unified conclusion about the impact of online tourism consumer confusion on purchase decision-making. Walsh et al.^[7] found that the three dimensions of consumer confusion (similar confusion, overload confusion and fuzzy confusion) will positively affect the possibility of consumer decision delay; Lu et al.^[2-3] found that overload confusion will urge tourists to continue to find new information to complete consumer decision. However, some scholars have put forward the opposite view based on the confusion of mobile app consumers. They think that when consumers are difficult to identify different brands, even if the final decision is not accurate, they still tend to make decisions faster^[8]. With regard to the different conclusions among scholars, the author believes that further discussion is needed to determine whether consumer confusion has an impact on the delay of final purchase decision.

As for the relationship between consumer confusion and purchase decision-making (purchase decision delay, give up purchase), few domestic scholars have been involved. The research of foreign scholars is still in the exploration stage. For the online tourism scenario, no consistent conclusion has been drawn, which can not guide the marketing practice of enterprises. Secondly, the cognitive needs of consumers have a certain impact on the final purchase behavior. Therefore, on the basis of the existing research results, this paper puts forward the research hypothesis, based on the regulatory effect of different cognitive needs, constructs the influence model of consumer confusion on purchase decision-making, and tries to explore the relationship between the two.

2. THEORETICAL BASIS AND RESEARCH HYPOTHESIS

2.1 Theoretical basis

2.1.1 Consumer confusion

The research on perplexity started in the field of brand strategy and trademark protection, and early scholars paid less attention to the definition of consumer perplexity^[9]. At present, the definition of the connotation of consumer confusion can be generally divided into two categories: from the cognitive perspective, Turnbull et al.^[10] believes that consumer confusion refers to the failure of consumers to correctly understand product or service information about multiple aspects in the process of information processing; from the psychological state, Mitchell et al.^[5] proposed that consumer confusion is caused by similar, overloaded and fuzzy products. The confusion and uneasiness caused by information have a negative effect on the information processing and decision-making process of consumers. Based on the influence of consumer confusion on purchase decision-making in the process of information processing in the context of online tourism, this paper uses Mitchell and others to define the concept of consumer confusion, and regards consumer confusion as a kind of negative psychological state caused by similar, overloaded and fuzzy product information, which will make consumers form uncertainty related to products or services, and then information Processing and decision-making processes have an impact.

At present, in the research of consumer confusion, the dimensions are divided into three categories: Based on the consumer's psychological perception, Huffman et al.^[11] divides it into practical confusion and perceptual confusion; based on the cognitive source of confusion, Walsh et al.^[7] divides it into similar confusion, overload confusion and fuzzy confusion; from the perspective of comprehensive psychology and cognition, garaus et al.^[12] starts from the retail environment, divide it into practical confusion and perceptual confusion. It can be divided into emotional confusion, cognitive confusion and motivation confusion. Walsh et al. Develop the consumer confusion scale of good reliability and validity, which has been widely recognized and applied by the academic community^[8], and this paper is mainly based on the confusion generated in the process of consumer information processing in the context of online tourism. Therefore, Walsh et al. be used to measure consumer

confusion from three dimensions of similar confusion, fuzzy confusion and overload confusion. The impact of purchase decisions.

In view of consumer confusion, this paper uses the Walsh multidimensional puzzle tendency scale to define the three dimensions. Similar confusion is defined as that consumers tend to think that different products in a product category are similar in vision and function; overload confusion is defined as the psychological difficulty for consumers to understand, compare and understand the substitutes when they are faced with more product information and substitutes than they can handle; fuzzy confusion refers to that consumers are not clear, misleading or fuzzy about the handling. Psychological tolerance of product, product related information or advertisement.

2.1.2 Cognitive needs

In exploring the multidimensional structure of consumer confusion, Walsh et al.^[7] clearly suggested that if researchers want to understand the impact on consumer confusion on consumer behavior keenly, they should set up moderating variables in the research. In this process, consumer confusion is completely centered on the selection, evaluation and integration process of market information, and cognitive demand as a variable of consumer characteristics is related to information processing, so cognitive demand is selected as a regulating variable^[13]. Cohen, Stotland & Wolfe^[14] defined the cognitive needs (NFC) as "the need to build relevant relationships in a meaningful and comprehensive way"; Cacioppo & Petty^[15] defined the cognitive needs as "the tendency of individuals to participate and enjoy thinking"; Hansen, Samuelsen & Sallis (2013) also showed that the cognitive needs do not refer to clear or have the knowledge ability to deal with complex information, but consumers are willing to do so.

In the current research, need for cognition is usually regarded as a stable variable of personality traits, and there are also high and low levels for the division of cognitive needs. Individuals with high cognitive needs like complex task situations, and actively search relevant meaningful clues to understand and understand this situation. In contrast, individuals with low cognitive needs tend to be satisfied with the status quo, tend to avoid thinking, and adopt more simpler ways of thinking to deal with problems. In the context of online tourism, consumers with high cognitive needs are more inclined to process information, they have more experience knowledge and ideas, and they are more likely to search and select information that is more conducive to their own consumption decision-making in an active way; while consumers with low cognitive needs often have a state of negative response, and only rely on intuition or experience to judge the current information^[16]. Therefore, based on the situation of online tourism, according to the level of consumer cognitive needs, this paper judges the impact on consumer confusion on purchase decision-making.

2.2 Research hypothesis

2.2.1 Consumer confusion and purchase decision

Walsh et al.^[7] defined similarity puzzle as "tending to think that different products in product category are similar in vision and function". It is found that this situation is because consumers need to rely on visual cues (image, color, design, etc.) when processing information sources. Therefore, the similarity of information sources is often confusing for consumers, and ultimately changing their purchase decisions^[9]. In terms of its influence on purchase decision, similarity confusion has a significant positive effect. In other words, a higher level of similarity confusion leads to a higher level of purchase decision. Because of the confusion of similarity, consumers will compare various kinds of information, which will eventually lead consumers to think that because two (or more) products or services are essentially similar, consumers can choose one of them^[7]. In this case, similar confusion can be used as a decision heuristic method, so that consumers can make purchase decisions quickly. Based on this, this paper puts forward the hypothesis:

H1: In the context of online tourism, with the increase of similar confusion of consumers, the delay of

purchase decision increases.

On the other hand, Walsh et al.^[7] defined overload puzzle as "the difficulty consumers encounter when facing more product information and alternative information that cannot be compared and understood". Consumers who are prone to overload and confusion may delay their purchase decision^[17]. Previous studies also confirmed that with the increase of the number of alternatives, consumers have overload confusion, which leads to consumers' choice of default options, delay of purchase decision and even refusal of purchase^[13]. Based on this, this paper puts forward the hypothesis:

H2: In the context of online tourism, with the increase of consumers' overload confusion, the delay of purchase decision increases.

Finally, Walsh et al.^[7] defined fuzzy confusion as "consumers' tolerance for ambiguous or misleading products and product information". According to Cox (1967)^[18], inconsistent or ambiguous information may cause uncomfortable perception to consumers. Fuzzy confusion may also result from other factors such as stimulus similarity or information overload^[10,19]. When consumers do not determine the absolute advantage of one product over another, they do not know which product to buy and delay the purchase decision^[13]. Based on this, this paper puts forward the hypothesis:

H3: In the context of online tourism, with the increase of consumer confusion, the delay of purchase decision increases.

2.2.2 The regulatory role of cognitive needs

In the current online tourism market, the phenomenon of "product homogeneity" is more serious, and the products or services between different platforms have certain similarity, which also leads to similar confusion of consumers. Therefore, we assume that consumers think the online travel information between platforms is similar, and can replace each other, allowing consumers to choose any one of them. According to the opinion of scholar Ghosh t et al.^[8], consumers with high NFC prefer to process similar product or service information, and they are also more inclined to identify the subtle differences between similar product information. Therefore, this paper believes that with the increase of demand cognition, NFC consumers will spend more time on information processing to find the similar information differences published by online tourism platforms, which will also cost consumers more time to search, leading to delayed purchase decisions. On the other hand, low NFC consumers do not feel motivated to search for small changes in similar product or service information, so when making consumption decisions, low NFC consumers are more rapid. Based on this, this paper puts forward the hypothesis:

H4a: High NFC has a negative effect on the increase of similar confusion and the decrease of purchase decision delay.

H4B: Low NFC has a positive effect on the decrease of delay in purchase decision due to the increase of similar confusion.

When consumers face overload information, compared with low NFC users, high NFC consumers show more motivation to browse and search a large amount of information about products or services, which further explains the regulatory role of NFC. Therefore, high NFC will spend more search time, because high NFC consumers have more information to process, which increases their decision delay probability. Lu et al.^[3] also showed this point, overload confusion will urge consumers to continue to find new information to complete consumption decisions; while low NFC consumers often have no choice when facing overload information. In the face of products or services to be purchased, decisions are often made more quickly than high NFC. Based on this, this paper puts forward the hypothesis:

H5a: High NFC has a negative effect on the increase of purchase decision delay caused by the increase of overload confusion.

H5B: Low NFC has a negative effect on the increase of purchase decision delay caused by the increase of overload confusion.

According to the research of Ghosh T and Rao V g scholars, high NFC consumers will generate strong stimulation for complex or ambiguous information, just like solving problems, they tend to eliminate the "mystery" of such ambiguous information. In addition, compared with low NFC consumers, high NFC consumers have stronger motivation to understand potential information ambiguity^[8]. Therefore, we believe that the resolution of fuzzy confusion may promote high NFC to generate positive emotions, thus increasing the efficiency of high NFC consumers to make purchase decisions and the possibility of purchase. Based on this, this paper puts forward the hypothesis:

H6a: High NFC has a negative effect on the increase of purchase decision delay caused by the increase of fuzzy confusion.

H6b: Low NFC has a positive effect on the increase of purchase decision delay caused by the increase of fuzzy confusion.

In a word, the proposed hypothesis establishes a conceptual model, which emphasizes the relationship between the degree of consumers' confusion about information and purchase decision-making under the regulation of cognitive demand. As shown in Figure 1:

3. RESEARCH DESIGNS

3.1 Measuring tool

The scales used in this paper are mature scales tested by empirical research or revised by Chinese authoritative scholars. For the English version of the scale, the author invites teachers from tourism, marketing and translation majors to revise and translate the English scale together to ensure that the content and semantics are relatively consistent. This paper uses liker 5-point scoring method, "1 = totally disagree, 5 = totally agree", to measure the variables:

(1) Consumer confusion. The scale of consumer confusion tendency developed by Walsh et al.^[7] has 9 items in total, such as "due to the similarity of tourism products provided by online channels, I can't make effective differentiation", "because there is too much information about tourism products on online tourism websites, it's difficult for me to decide which product to buy", "when I buy products, I think online tourism websites provides Information are not enough, which involves three aspects of "similar confusion, overload confusion, fuzzy confusion" faced by online tourists. The internal consistency coefficient of the scale is 0.93.

(2) Delayed purchase decision. Purchase decision delay refers to the scale of Walsh et al.^[7], including 3 items. The internal consistency coefficient of the scale is 0.78.

(3) Cognitive needs. Using 18 item scale developed by Cacioppo and petty^[23], such as "thinking makes me happy", "I'm willing to think about complex problems", "I like to deal with some problems that need a lot of thinking", "I like simple problems rather than complex problems (reverse items)" "I like to think about some trivial problems in daily life, rather than long-term problems (reverse items)" And so on.

(4) Control variables. Because of the demographic characteristic variables such as gender, age, education level, etc., it is believed that there is an impact on consumer confusion^[5,10,22]. Therefore, in order to avoid these irrelevant variables affecting the logical relationship of the variables in the online tourism consumption environment, this paper treats three variables as control variables: gender, age, education level, etc.

3.2 Sample

The target object of this study is online tourism consumers. Through online research, with the help of "questionnaire star", the author takes the way of snowball to obtain data. In order to ensure the quality of online questionnaire, the questionnaire with more than 70% of the number of answers selected in addition to the basic

information is regarded as invalid questionnaire (12 in total), and 305 valid questionnaires are actually obtained, covering Guiyang, Henan, Sichuan, Shanghai and most provinces and cities in China.

The descriptive statistical analysis of the sample shows that the proportion of women is 60.78%; the proportion of women aged 19-29 years is 82.33%; the proportion of women aged 30-39 years is 10.34%; the proportion of people over 40 years is 7.33%; the proportion of high school and below is 10.78%; the proportion of college or undergraduate is 49.57%; the proportion of women with master's degree and above is 39.66%.

4. MODEL TEST AND RESEARCH RESULTS

This paper uses spss22.0 and amos24.0 for empirical analysis.

4.1 Sample basic inspection

Cronbach's α is used to test the reliability of data, and its value is above 0.7, which is within the acceptable range. Kmo and Bartlett's spherical test are used to detect the correlation between variables. The KMO value is closer to 1, and Bartlett's chi square value is significant, the more suitable for factor analysis. It can be seen from table 1 that Cronbach's α is $0.899 > 0.7$, indicating that the overall reliability of the data is good; KMO valued is 0.888, Bartlett's chi square value is 5090.708, and the significance is $0 < 0.01$, indicating that the sample data is suitable for factor analysis.

Table 1. Sample basic inspection

Bartlett test of sphericity	Cronbach's α	0.899
	KMO	0.888
	Chi-square test	5090.708
	df	528
	sig	0

4.2 Reliability and validity of the scale

Table 2 lists Cronbach's α coefficient, factor load and ave value of each latent variable. Cronbach's α is between 0.771-0.906, all of which are above 0.7, reflecting the good reliability of each measurement item; the factor load of each question item is between 0.608-0.892, all of which are above 0.5, indicating that the scale has a good structural validity; ave is used to reflect the variation of measurement indicators that can be explained by potential variables, and the ave value of each potential variable is above 0.5, indicating the acceptance The convergence validity is good. Table 2 shows the correlation coefficients of the three factors of consumer confusion and the square roots of Ave. the square roots of the three factors are all larger than the correlation coefficients of other factors, reflecting that the differentiation validity of the three factors of consumer confusion is better.

Table 2. Reliability and validity of the scale

Latent variable	Observed variable	Cronbach's α	Factor loading	AVE
Similarity confusion	SC1	0.827	0.859	0.862
	SC2		0.858	
	SC3		0.868	
Overload confusion	OC1	0.833	0.872	0.866
	OC2		0.871	
	OC3		0.854	
Ambiguity confusion	AC1	0.771	0.83	0.829
	AC2		0.869	
	AC3		0.785	
purchase decision postponement	DP1	0.836	0.867	0.868
	DP2		0.892	
	DP3		0.845	
Need for cognition	NFC1-6	0.906	0.608	0.618
	NFC7-12		0.621	
	NFC13-18		0.624	

4.3 Confirmatory factor analysis

We use confirmatory factor analysis to determine the structural validity of five main research variables: similar confusion, overload confusion, fuzzy confusion, cognitive needs and purchase decision delay. Because there are many measurement items of cognitive need variables in this study, in order to improve the fitting degree of the model, we follow the previous research methods and corresponding suggestions^[16], adopt the topic packing strategy, and use the composite score of dimensions as the indicator of each variable. The author uses random packing method to pack 18 items needed by cognition according to "parity method"^[24]. It is found that the fit of three indicators are better than four or six, and also better than using the original topic directly (bandalos, 2002; Rogers & Schmitt, 2004). Therefore, the three items generated by the final packaging are taken as the new indicators of cognitive demand dimension.

The results show that the factor load and t value of each factor in the five factor model have reached a significant level of 0.05, and there is no improper solution, which shows that several constructs involved in this paper have good aggregation validity. At the same time, we use the method of model comparison to examine the structural validity of each variable. As shown in Table 1, compared with the other seven models, the five factor model is the best fit for the actual data ($X^2 = 151.330$; $DF = 80$; $X^2 / DF = 1.892$; $GFI = 0.939$; $TLI = 0.961$; $CFI = 0.971$; $RMSEA = 0.054$), indicating that the five scales involved in this paper have good discrimination validity. In this study, the control for effect of an unmeasured later methods factor is used to test whether there is a common method deviation^[16]. The results show that after adding common method factors into the five factors, the fitting index of the model is not improved to a high degree, and the CFI is increased by 0.01, and the TLI is increased by 0.02, which shows that the model with method factors is not improved to a high degree. The fitting data has not been significantly improved, which shows that although the common method deviation may exist, it has little impact on this study. At the same time, Harman tested shows that the common method deviation in this study is not serious.

Table 3. Confirmatory factor analysis

Model	χ^2	df	χ^2/df	GFI	TLI	CFI	RMSEA	Model comparison test		
								comparison	$\Delta\chi^2$	Δdf
Single factor model	1079.614	90.000	11.996	0.651	0.524	0.592	0.190	1 vs 7	928.284**	10
Two factor model	747.729	89.000	8.401	0.714	0.679	0.728	0.156	2 vs 7	596.399**	9
Three factor model	324.080	87.000	3.725	0.859	0.882	0.902	0.095	3 vs 7	172.750**	7
Four factor model one	688.945	84.000	8.202	0.736	0.688	0.750	0.154	4 vs 7	537.615**	4
Four factor model two	759.951	84.000	9.047	0.719	0.651	0.721	0.163	5 vs 7	608.621**	4
Four factor model three	558.020	84.000	6.643	0.773	0.756	0.804	0.136	6 vs 7	406.690**	4
Five factor model	151.330	80.000	1.892	0.939	0.961	0.971	0.054			
Six factor model	91.402	65.000	1.406	0.962	0.982	0.989	0.037			
注：N=305，**p<0.01(双尾检验)										
Single factor model:AC+SC+OC+NFC+DP；Two factor model:AC+SC+OC,NFC+DP；Three factor model:AC+SC+OC,NFC,DP										
Four factor model one:SC+NFC,AC,OC,DP；Four factor model two:OC+NFC,SC,AC,DP；Four factor model three:AC+NFC,SC,OC,DP										
Five factor model:AC,SC,OC,NFC,DP；Six factor model:AC,SC,OC,NFC,DP,CVF										

4.4 Correlation analysis among variables

The mean value, standard deviation and correlation coefficient of the main research variables and control variables involved in this study are shown in Table 4. Similar confusion, overload confusion and fuzzy confusion were positively correlated with purchase decision delay ($y = 0.387$, $P < 0.01$; $y = 0.550$, $P < 0.01$; $y = 0.587$, $P < 0.01$); overload confusion and fuzzy confusion were positively correlated with purchase decision delay ($y = 0.153$, $P < 0.01$; $y = 0.129$, $P < 0.05$); cognitive need was positively correlated with purchase decision delay ($y = 0.292$, $P < 0.01$). The existence of the correlation between the above variables provides a preliminary support for the relevant assumptions in this paper.

Table 4. Correlation analysis among variables

Variable	1	2	3	4	5	6	7	8
SEX	1							
AGR	-.173**	1						
EDU	0.01	-.231**	1					
SC	0.025	-0.059	.152**	1				
OC	0.072	-0.024	.113*	.721**	1			
AC	.172**	-0.027	.121*	.496**	.606**	1		
DP	.145*	0.09	-0.042	.387**	.550**	.587**	1	
NFC	-0.006	0.083	-.206**	0.028	.153**	.129*	.292**	1
MEAN				3.44	3.52	3.72	3.78	3.22
SD				1.029	0.962	0.908	0.878	0.998

注: N=305; *p<0.05, **p<0.01
 SC:Similarity confusion; OC:Overload confusion; AC:Ambiguity confusion;
 DP: purchase decision postponement; NFC: Need for cognition.

4.5 hypothesis tests

For the assumptions of this paper, this study mainly refers to grant and Berry's analysis steps^[25]. On the basis of controlling the three demographic variables of online tourism consumers: gender, age and education background, the test results between independent variables and dependent variables are shown in Table 5.

Main effect tests. First of all, on the basis of controlling the three statistical variables of age, gender and educational background, the main effect of online travel consumers' confusion on the delay of purchase decision-making is investigated. It can be seen from table 5 that similar puzzle, overload puzzle and fuzzy puzzle have significant positive effects on purchase decision delay (M1, $\beta = 0.387$, $P < 0.01$; M2, $\beta = 0.55$, $P < 0.01$; m3, $\beta = 0.587$, $P < 0.01$). The H1, H2, H3 of this paper are verified.

Table 5. Results of hierarchical regression analysis

dependent variable	purchase decision postponement									
independent variable	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
control variable										
sex	0.135	0.106	0.045	0.137	0.241	0.276	-0.203	0.229	-0.221	0.249
age	0.113	0.103	0.106	0.09	0.219	0.005	0.168	0.096	0.412	-0.218
edu	-0.104	-0.106	-0.115	-0.045	-0.084	-0.078	-0.189	-0.165	-0.387	-0.352
independent variable										
sc	0.387**									
oc		0.55**								
ac			0.587**							
Moderator variable										
nfc				0.292**						
Interaction item										
sc*high nfc					-0.155					
sc*low nfc						-0.115				
oc*high nfc							-0.219*			
oc*low nfc								-0.182		
ac*high nfc									-0.316**	
ac*low nfc										-0.208*
R2	0.15	0.302	0.344	0.085	0.024	0.013	0.048	0.029	0.075	0.043
F	53.367	131.366	159.237	28.307	2.545	1.388	5.176	3.091	8.359	4.643

注: N=305; *p<0.05, **p<0.01

Regulatory effects test. Before verifying the regulatory effect of cognitive demand, in order to avoid the collinearity problem, independent variables (similar confusion, overload confusion, fuzzy confusion) and regulatory variables (cognitive demand) are centralized, and then interaction terms is constructed to investigate their influence on the delay of purchase decision. The results showed that under the regulation of high cognitive

demand, the regression coefficient of similar confusion to purchase decision delay was negative but not significant (M5, $\beta = -0.219$, NS); overload confusion had significant negative regulation to purchase decision delay (M7, $\beta = -0.155$, $P < 0.05$); fuzzy confusion had significant negative regulation to purchase decision delay (M9, $\beta = -0.316$, $P < 0.01$). It can be seen that assuming h5a and h6a are verified, h4a is not tenable. Under the regulatory effect of low cognitive demand, the regression coefficient of similar confusion on purchase decision delays is negative but not significant (M6, $\beta = -0.115$, NS); overload confusion has no significant effect on purchase decision delay (M8, $\beta = -0.182$, NS); fuzzy confusion has significant negative regulatory effect on purchase decision delay (M10, $\beta = -0.208$, $P < 0.05$). It can be seen that the validation results do not support hypothesis h6b.

In addition, in order to more intuitively present the regulatory effect between cognitive needs and online travel consumers' confusion and purchase decision delay, this study takes the mean value of cognitive needs variable plus minus a standard deviation as the grouping criteria, respectively, to describe the relationship between consumer confusion and satisfaction under the level of high cognitive needs and low cognitive needs. It can be seen from Figure 2 that whether online tourists' cognitive needs are high or low, confusion has a positive impact on the delay of purchase decision, which also verifies M4 ($\beta = 0.292$, $P < 0.01$). When the consumer cognition demand is high, the negative effect of consumer confusion on the delay of purchase decision is strong; while when the demand cognition is low, the negative effect of consumer confusion on the delay of purchase decision is weak.

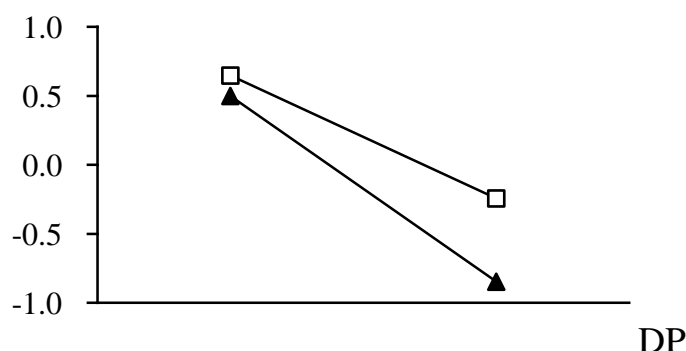


Fig 2. Regulatory effect diagram

5. CONCLUSION INSPIRATION

The results show that: ① similar confusion, overload confusion and fuzzy confusion have a significant positive impact on the delay of purchase decision when online tourism consumers search for information. Among them, overload confusion and fuzzy confusion have great influence on the delay of purchase decision. ② Cognitive demand negatively regulates the relationship between similar confusion, overload confusion, fuzzy confusion and purchase decision delay. That is to say, consumers' cognitive demand will weaken the positive relationship between similar confusion, overload confusion, fuzzy confusion and purchase decision delay. ③ When the cognitive demand is high, the positive relationship between overload confusion and fuzzy confusion and purchase decision delay will be weakened; when the cognitive demand is low, the positive relationship between fuzzy confusion and purchase decision delay can only be weakened.

Theoretical enlightenment: This study takes online tourism consumers as the research object, discusses the influence of consumer confusion on the delay of purchase decision, enriches the research of consumer behavior to a certain extent, especially the influence of consumer confusion on user behavior. Secondly, in the previous research on consumer confusion and behavior, most of the focus is the direct effect of confusion on the outcome variable^[26]. In fact, the relationship between consumer confusion and its behavioral response will also be affected by other variables, such as cognitive demand. Based on the cognitive demand, this paper divides it into

high and low situations to discuss, further enriching consumers Confused research.

Practical enlightenment: first of all, online tourism enterprises should try their best to control similar confusion in marketing promotion. No matter whether the cognitive ability of consumers is high or low, in the face of excessive information, it can not slow down the positive impact of consumer confusion on the delay of purchase decision, especially similar confusion. The results also show that the level of cognitive needs has no significant positive effect on the relationship between similar confusion and purchase decision delay. Secondly, when consumers are confused, online tourism enterprises should focus on consumers with low cognitive needs. This study shows that consumers with low cognitive needs are more likely to delay their purchase decisions when they are confused. Therefore, the staff of online tourism enterprises should patiently give answers and increase the time of interaction and communication with consumers with low cognitive needs, which can also make online tourism enterprises realize the shortcomings of online product marketing and publicity, and also provide new think direction for online tourism enterprises to provide effective promotion methods.

Research deficiencies and prospects: first of all, most of the sample data in this paper are concentrated between 19-29 years old, which may be different from the characteristics of online tourism consumers, inevitably affecting the externality of the research. Future research should collect a wide range of diverse samples to enhance the external effect of the research. In addition, this paper takes the mean value of the cognitive demand variable plus or minus a standard deviation as the grouping standard^[16]. In the empirical study, this paper use high and low cognitive demand to analyze the mechanism of the influence of consumer confusion on the delay of purchase decision. Although some meaningful conclusions are obtained, it is still necessary to explore whether it can accurately express the cognitive ability of consumers.

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The Factors of User Acceptance of News Feed Advertisement

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Abstract: With the rapid development of mobile e-commerce, the advent of news feed ads has been increasing. In view of users' stereotypes about advertisements, how to improve user acceptance of news feed ads is a matter of great concern to mobile commerce operators. In the existing theoretical research, more discussions are start from the perspective of technology and channels. Based on the theory of perceived value, this study deeply analyzes the characteristics of news feed ads, and takes functional value perception, convenience value perception, prompt response value perception, trust value perception and social value perception as independent variables. Due to the variables, a user acceptance model was constructed, questionnaires were distributed and the assumptions were verified by regression analysis. The results show that perceived value theory can effectively explain the users' willingness to accept ads on the mobile advertising side, of which, convenience value perception, functional value perception and social value perception have a greater impact on the willingness to accept, prompt response value perception followed, and the least impact is trust value perception.

Keywords: news feed ads; perception value theory; willingness to accept; empirical analysis

1. INTRODUCTION

As an important branch of mobile advertising, information flow advertising has the characteristics of high degree of personalization, fast response speed, and deep social influence. Based on the existing research results and the characteristics of information flow advertising, this paper establishes a research model to clarify the influencing factors of users' willingness to accept information flow advertising.

2. THEORETICAL BASIS

2.1 Information stream advertising

From the perspective of users, value perception is the basic thinking logic and judgment criteria for users to accept things. In the past, researches on the willingness to accept mobile advertising users have also been carried out from the perspective of value perception. Therefore, this research is based on the perception of value theory to analyze and verify the impact The factors of users' acceptance of information flow advertisements make up for the shortcomings of information flow advertisement research at the user level to a certain extent, and provide a theoretical reference for mobile social platforms to regulate the placement of information flow advertisements.

2.2 Theoretical basis of perceived value

Users' acceptance decision-making process of information flow advertisement is similar to that of online purchase decision-making process. However, because information flow advertisement is based on the recommendation of users' massive behavioral data, it has the characteristics of high personalization and quick response. When users judge whether to accept or not, the function value, convenience value, timely response value and trust value are the first response of users to the advertisement itself; and The social nature of mobile users makes users have a potential demand for whether advertising can be used as communication content. Therefore, social value perception is also one of the research factors in this study.

3. RESEARCH HYPOTHESIS

Hypothesis H1: functional value perception has a significant impact on users' acceptance of information flow advertisements.

Hypothesis H2: convenience value perception has a significant impact on users' acceptance of information flow advertisements.

Hypothesis H3: timely response has a significant impact on users' acceptance of information flow advertisements.

Hypothesis H4: trust value perception has a significant impact on users' acceptance of information flow advertisements.

Hypothesis H5: social value perception has a significant impact on users' acceptance of information flow advertisements.

4. RESEARCH DESIGN

In this study, questionnaire survey was used to obtain data. The questionnaire consists of two parts. The first part is the demographic variables of the respondents, mainly including age, gender, education level, commonly used mobile social platforms, etc. The second part is the measurement items of all variables in the model, which is designed with the method of Likert scale. The respondents are required to make five levels of evaluation for each statement: totally disagree, comparatively agree, general, comparatively agree and fully agree.

5. RESEARCH CONCLUSIONS AND IMPLICATIONS

The push environment of information flow advertisement is quite special. Although users are in the state of passive acceptance, they are in the active position of shielding, deleting and negative word-of-mouth propaganda. Therefore, this paper focuses on users' perception characteristics of advertisement to understand the relevant factors of their willingness to accept. The specific conclusions are as follows:

(1) Convenience value perception, function value perception and social value perception have great influence on users' willingness to accept, which further shows that users' willingness to accept information flow ads is greatly affected by the effectiveness of recommendation activities, and users' decision-making is very rational.

(2) The value perception of timely response has a significant impact on the willingness to accept, which indicates that most users have a strong subjectivity on the received information flow advertisements when they log in to the mobile terminal for social activities by using fragmented time.

(3) Trust value perception has a low impact on users' willingness to accept, indicating that the effect of Information Trust perceived by users in advertising on their willingness to accept is not good. This is because users often show a zero sum game judgment on advertisements.

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What are Online Retailers Looking For An Empirical Study of M & A by Online Retailers Short Research Papers

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Abstract: E-commerce has become an important tool for both small and large businesses worldwide and transformed business and industries over the past decades. In this paper, we start from resource-based view and define the two types of M&As of online retailers – online-to-online and online-to-offline M&As. According to RBV, we hypothesize that for internet retailers whose sales are dominantly from online, they are more likely to proceed an online-to-offline M&A than an online-to-online M&A; And for internet retailers whose sales are dominantly from offline, they are more likely to proceed an online-to-online M&A. We will use a sample of online platforms in U.S. to test our hypothesis. Implications for study and future research will be discussed.

Keywords: E-commerce, online-to-online M&A, online-to-offline M&A.

1. INTRODUCTION

E-commerce has become an important tool for both small and large businesses worldwide and transformed business and industries over the past decades (Eisingerich and Kretschmer, 2008). At the macro level, e-commerce represented 13% of total retail sales in 2017 and 49% of the growth in United States (Internet Retailer, 2017). Among emerging economies, China's e-commerce presence continues to expand every year. Its online shopping sales reached \$253 billion in the first half of 2015, accounting for 10% of total Chinese consumer retail sales in that period (Technasia News, 2016). At the firm level, a growing number of firms begin to start their e-business, as the online market is expected to grow by 56% in 2015–2020, while traditional markets are only expected 2% growth during the same time (Datamonitor Plc, 2012).

As more and more organizations realize the strategic value of e-commerce, more and more businesses jump into the parade of online retailers. For example, Walmart is well-known for its department stores. At the same time, Walmart also develops its e-business and it ranks at top 20 among millions of online retailers (Internet Retailers, 2017). A critical question facing online retailers is how to balance their online capabilities with offline capabilities. Some IRs allocate more resources on the online side, while other IRs focus more on offline side. Advanced online capabilities could provide online retailers with larger group on customer base, reduce information exchange cost and reach the economy of scale (Aufreiter et al., 2001; Amit and Zott, 2001). On the other hand, enhanced offline capabilities could help online retailers to have more branded products, improve their reputation and reach the economy of scope (Capron and Pistre, 2002; Malone et al., 1987; Sahaym et al., 2007).

According to resource-based view, both online and offline capabilities are firm's specific resources which generate from operation routines. These resources cannot be easily accessed from external exchange or developed in a short period. Prior research has argued that M&A is preferred over other types of alliances when firms need to acquire specific resources (Das and Teng, 2000), and complementary acquisitions will improve firm's weakness and create values (Helfat and Peteraf, 2003). However, limited research has studies how online retailers balance their online and offline capabilities through M&As.

In this study, we firstly exam the effect of both online-to-online and online-to-offline M&As on firms'

value. According to RBV, both M&As will positively affect firms' value. We then analyze how online retailers use complementary acquisitions to make their online and offline capabilities compatible and how market would react to that.

The rest of paper is structured as follows. We first discuss the theoretical background, research model and develop our hypotheses. We then present the empirical study and discussion. Finally, we discuss the future work.

2. THEORY AND HYPOTHESIS DEVELOPMENT

2.1 Theoretical Background

We draw from resource-based view (RBV) to develop our theoretical framework. According to RBV theory, the firm's strategic resources are main propellers of firm performance (Barney, 1991; Dierickx and Cool, 1989). While many RBV studies have examined the relationship between organizational resources and firm performance, RBV research also implies that competitive advantages could be created by resource alliance through M&A (Harrison et al., 1991; Hennart and Reddy, 1997). The primary focus of this stream of research has been on strategic resources that can be achieved by M&As.

2.2 Strategic Resources and M&A of E-Commerce: A Resource-Based View

Firms could acquire external resources through exchanges, strategic alliances, mergers, and/or acquisitions. Prior studies have suggested that M&A is preferred over other types of alliances when firms need: (1) to obtain others' resources; and (2) to retain and develop its own resources by combining them with others' resources (Das and Teng, 2000). Since firm-specific resources are usually based on its unique market power, tacit knowledge and unrepeatable characteristics, it is difficult to grasp these capabilities through market exchange contracts or alliances (Chatterjee 1986; Pisano, 1990).

The characteristics of online retailers usually determine the resources that are critical to create competitive advantage and firm value. Unlike traditional retailers who focus on exchanging goods and services at specific locations, the e-commerce leverages the power of Internet to generate electronic marketplace and virtual communities (Hagel, 1999). Online retailers need to manage the strategic resources from both online and offline. For online side, the Internet infrastructures reduce the cost of information exchange (Amit and Zott, 2001), and bring huge online markets and communities. For offline side, the power of huge electronic market cannot be realized through website alone. Online retailers should also have strategic resources such as branded products, efficient supply chain system, bargaining power, etc. These specific resources or capabilities are usually accumulated from firms operating routines and hard to get jumping improvement in a short period. Hence, M&As could be an efficient and effective way to acquire these resources.

In this paper, we use term 'online-to-online' and 'online-to-offline' to distinguish two types of M&As among IRs. "Online-to-online M&A" is the M&A is between IRs and internet related (online) firms, while "Online-to-offline M&A" is the M&A is between IRs and non-internet related (offline) firms. The resource-based view considers mergers and acquisitions as strategic actions to access other firms' resources, which could gather strategically complementary resources to earn competitive advantages (Das and Teng, 2000). Online-to-online M&As would provide internet retailers with larger customer group and enhanced online technology, while online-to-offline M&As could help online retailers to acquire more branded products, improve their reputation, and offline operating efficiency.

2.3. Online-to-Offline VS. Online-to-Online M&A

Online-to-offline M&As provide potential benefits for both sides. For offline side benefits, the Internet can leverage marketing opportunities (Kanter, 2001) and general operational efficiencies (Litan and Rivlin, 2001; Porter, 2001). Significant improvements of online side could enhance the data collection as well as communication between buyer and sellers. Furthermore, sellers could reach more potential customers and

acquire information more conveniently via Internet, which could leverage the traditional business transactions (Amit and Zott, 2001; Bakos, 2001; Park et al., 2004). Offline firms may need the technical skills and managerial personal from IRs to take advantage of Internet technology.

For online side, without the support of products and services, these advantages cannot be realized through a website alone. Even though significant benefits could flow into offline side when doing an online-to-offline acquisition, the resource flows from online side to offline side create additional values in mergers (Capron and Pistre, 2002). Firstly, investing into brick-and-mortar retail could build legitimacy and share reputation and trust of brand enjoyed by the offline firm. Prior research has demonstrated that customers are more willing to pay price premium for branded products than unbranded products (Smith, 2000).

Moreover, online-to-offline M&As generate economy of scope. Communication and coordination costs throughout firm value chain could be largely reduced, hence improving the efficiency of operations (Malone et al., 1987; Sahaym et al., 2007). Offline products could be sold at a lower cost and higher efficiency through online platform. Porter (2001) recommends that online firms develop hybrid value chains will gain higher efficiency and better positioning in the market. Also, value creation usually generates from new products and novel knowledge rather than new business designs (Rindova and Kotha, 2001). Online retailers could internalize these knowledge and products through M&As.

In most cases, the online retailers can also acquire competitive advantages from offline side through online-to-offline acquisition. To acquire unique data of grocery buying habits and patterns which are unavailable from online customers, Amazon acquired Whole Foods in 2017. Business Insider states that the data of Whole Foods are high margin upsell opportunities for Amazon. With this data, it is capable of building analytic models which can predict their grocery buying habits and providing just in time (JIT) services (Forbes, 2017).

Online-to-online M&As are helpful to online retailers to absorb new knowledge, adapt to challenges in a timely manner, as well as generate economy of scale. Rapid changes require online retailers to update their knowledge frequently. However, few online firms could utilize the potential of Internet to improve their market power (Aufreiter et al., 2001). Firstly, developing new technology requires intense investment with high risk. The purpose of online retailers is to use internet leveraging their products, rather than to be a pure technology firm. Secondly, the time compression diseconomies drive online technology converting into tradable commodities (Dierickx and Cool, 1989). M&As are often used to create economies of scale in R&D (Das and Teng, 2000). For instance, Apple.com acquire a lot of technology firms to develop its IOS system.

Furthermore, the value of online retailers will be greater because of economy of scale for information exchange (Amit and Zott, 2001). A larger consumer base will provide additional competitive advantages to online retailers (Amit and Zott, 2001). Larger online platforms, such as Amazon, have more transactions and are more trusted by consumers (Wiseman, 2000). Also, larger online website could easily generate virtual communities and have the power of online word-of-mouth (WOM), which will further help to build customer loyalty. Second, the marginal cost of acquiring data of online consumers gets lower as the customer base becomes larger. Online retailers with larger platform could access to data about consumers' behavior, which would provide huge benefits by understanding their behavior.

In summary, both online-to-online and online-to-offline M&A could create values for online retailers. Online-to-offline M&A could be beneficial to online retailers by constructing reputation, generating economy of scope, and accessing to unique data which could not be acquired from online. Online-to-online M&A could provide online retailers with efficient knowledge adoption and economy of scale. Prior research also suggests that acquisitions of both online firms by offline firms and online firms by other online firms will result in positive returns for acquirer (Uhlenbruck et al., 2006). Hence, here we hypothesize that:

Hypothesis 1: *Both online-to-online and online-to-offline M&A by internet retailers will positively*

affect firm's value.

2.4 Complementarity in M&As of internet retailers

While both online-to-online and online-to-offline M&A might increase firm's value, in this study, we further argue that internet retailers are more intended to proceed complementary M&As, and M&As with complementarity will generate better performances.

Previous research has proposed that complementarity is a critical construct in the resource-based view theory (Barney, 1991). Complementarity enhance the efficiency and effectiveness of firm's operation when a combination of resources or capabilities are different but mutually reinforced (Helfat and Peteraf, 2003). Kim and Finkelstein (2009) define acquisition complementarity as the acquisition that merging firms have different resources, capabilities, and strategies that could generate synergies and create values. This definition focus on the value creation with resource combination. Based on these literatures, we define complementary acquisitions of IRs as the acquisition that could improve the compatibility between online and offline capabilities with the complementary resources existing in merging firms.

According to resource-based view, the online capability and offline capability of online retailers should be compatible. If offline capability is not compatible with online capability, then online retailers might not fully meet consumers' demand, and hence the advantage of large online customer based would be compromised. On the other hand, if online capability is not compatible with offline capability, then the internet retailers have to face the bottleneck of limited market base and bounded online technology. Under such circumstance, M&A with complementarity will mutually reinforce the weakness and enables online retailers to create value that cannot be achieved without such combination (Helfat and Peteraf, 2003).

Complementary M&As bring online retailers with different but desired resources which could make their online and offline capabilities compatible. Complementarity could exist in product strategy and market choice (Kim and Finkelstein, 2009). When the offline capability is relatively weak, complementarity of product strategy might be preferred. The economy of scope suggests that mixed products and services could generate profit growth (Capron et al., 1998). When online retailer merges with an offline firm, they could combine the offline products with other products on the existing platform and generate new kinds of product portfolios (Karim and Mitchell, 2000). The new product mix is usually inimitable by other firms, and hence improves firm's offline capability. For example, the combination between Whole Foods products and Amazon Prime is hard to imitated by competitors so as to improve firm's competitive advantage. In addition, the broader product portfolios that generate from complementary acquisitions could also enhance the online retailers' reputation by sharing the brand with offline companies. For example, Amazon could share private brands of products by Whole Foods, and hence improve its offline side reputation and market status.

On the other hand, When the online capability is relatively weak, complementarity of market choice might be preferred by online retailers. The market complementarity could create firm's value by allowing merging firms to enhance their online capability and explore new markets. The economy of scale suggests that the online-to-online M&As could reduce the cost of information exchange and improve consumer base, which will provide additional competitive advantages to online retailers (Amit and Zott, 2001). The higher efficiency of information exchange and larger customer base improve firm's online capability. Furthermore, in order to explore online market, online retailers need to absorb new technology and knowledge. M&A is a good way to create economies of scale in technology development in a relative short time.

Hypothesis 2a: *For internet retailers whose sales are dominantly from online, they are more likely to proceed an online-to-offline M&A than an online-to-online M&A.*

Hypothesis 2b: *For internet retailers whose sales are dominantly from offline, they are more likely to proceed an online-to-online M&A than an online-to-offline M&A.*

Even though both online-to-online and online-to-offline M&As might positively affect firm's value, in this paper, we argue that M&As with complementarity tends to have higher abnormal returns. The online capability and offline capability of online retailers should be compatible so that the combination could generate the efficiency and effectiveness. It is true that acquisitions other than complementarity can also have abnormal returns and enhance firm's capability. However, this group of acquisitions are more likely to be add brilliance into firm's present splendor, while complementary acquisitions could provide timely enhancement and significantly improve the weakness part of internet retailers. Hence, we hypothesize that:

Hypothesis 3a: *For internet retailers whose sales dominantly are from online, abnormal returns will be greater if they proceed an online-to-offline M&A than an online-to-online M&A.*

Hypothesis 3b: *For internet retailers whose sales dominantly are from offline, abnormal returns will be greater if they proceed an online-to-online M&A than an online-to-offline M&A.*

3. METHODS

3.1 Sample and data collection

Our data for this research was combined from three primary resources, Internet Retailers, SDC Platinum, and COMPUSTAT. We test our hypotheses with a sample of M&As by online retailers from 2005 to 2008.

3.2 Dependent variables

The hypotheses included two dependent variables: The choice of M&A between online-to-online and online-to-offline and stock market performance. A variable called M&A type was coded as a 1 for online-to-online M&A, and as a 0 for online-to-offline M&As. If the target is an online retailer, the M&A is online-to-online; if the target is not an online retailer, the M&A belongs to online-to-offline. No firms were a hybrid of the two alternatives. Second, stock market performance was the stock market returns associated with the restructuring announcement. We measured stock market return using the standard event study methodology, whereby a cumulative abnormal return (CAR) was computed for the days surrounding the restructuring announcement. The standard event study approach estimates a market model for each firm and then calculates a cumulative abnormal return for the event. Specifically, the CARs were estimated using the following equation:

$$AR_{it} = R_{it} - (a_i + b_i R_{mt})$$

where a_i and b_i are the ordinary least squares (OLS) parameter estimates obtained for the regression of R_{it} on R_{mt} over an estimation period (T) preceding the event; AR_{it} is daily abnormal returns, R_{it} is the rate of return on the share price of firm i on day t ; and R_{mt} is the rate of return on the S&P 500 on day t . The parameter estimates were based on an estimation period of 150 days (-180 to -30) before the restructuring announcement. Abnormal returns were cumulated over the two-day window (day 0 is the announcement business day, +1 is the next business day) surrounding the announcement date. Stock market data were found in the WRDS database.

3.3 Independent variables

The independent variable in this paper is the percentage of online sales over total sales. According to our argument, complementary M&As bring online retailers with different but desired resources which could make their online and offline capabilities compatible. Hence, the percentage could reflect firm's strength or weakness between online and offline.

3.4 Control variables

Several factors other than the percentage of online sales over total sales could influence the regression results. including the financial performance and leverage, the size of the firm, prior M&A experience, year effects, and online retailer types (e.g., Khan and Mehta, 1996).

Financial performance was the acquirer's return on assets (ROA) and the leverage is measured by debt to

equity ratio. Acquirer's size was measured as the log number of the employees. Prior M&A experience may affect the M&A decision after. Hence, we control for the number of M&A in the prior year. Finally, we controlled for year effects and online retailer types.

4. FUTURE RESEARCH AND WORK

This study has following limitations. First, although we define the online-to-online M&As and online-to-offline M&As, there still might be other types of alliances that are missing. Future research could think of more types of alliance for online retailers.

Second, our analysis in this paper only focuses on the theory part of making complementary M&As. In the next step, we would like to examine the market reaction to these M&As, such as abnormal returns (e.g., AR and CAR). In addition, we would also like to test the market reaction for different types of online retailers.

Third, our samples are limited to large and public online platforms in U.S.; whether our results can be generalized to private firms or the firms in other countries deserves further examination.

Fourth, the number of observations of our research is limited. We are trying to collect data from more resources to enlarge our observations in the future work.

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Path Analysis of Perceived Value Influence on Shopping Satisfaction of Online Customers in the View of Mental Accounting

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Abstract: As a kind of psychological activity in the individuals, families or organizations, mental accounting focuses on economic activity, coding and evaluation. It is of practical significance to explore customer behavior patterns and psychological changes, and improve customer satisfaction through reasonable marketing.

Online enterprises need to pay attention to the perceived value of consumers and enhance overall consumer satisfaction so as to achieve long-term and stable development under the background of economic globalization. Enterprises and organizations obtain complete and accurate personalized demand information of consumers in order to achieve a win-win situation for both consumers and enterprises.

This study focuses on the influencing factors of online shopping satisfaction of consumers in the new environment of online and offline integration, and explores the path dependence and influence of online consumer perceived value and the website features of consumer satisfaction. Based on the theory of mental accounting and consumer behavior, this study combines the Howard-Sheth model with the consumer perception value theory to construct a theoretical framework.

This study extends prior work by using structural equation model to test the effect of perceived value on website features, trust and customer satisfaction from the perspective of mental accounting. It is hoped that this study can provide data reference and theoretical guidance for online enterprises in marketing and knowledge management, in a bid to develop accurate marketing strategies, customer segmentation and differentiated services, improve the operation mechanism of network market and promote online services.

Keywords: customer perceived value; mental accounting; customer shopping satisfaction; path analysis

1. INTRODUCTION

The rapid development of the Internet has changed global business practices and shopping patterns, especially in China. According to the 6th World Internet Conference, China's e-commerce transaction volume reached RMB3.16 billion, accounting for more than 35% of GDP in 2018. This also provides the basis for increasing personalized requirements and online shopping demand of consumers. This study intends to use the consumer's mental accounting to study consumers' online consumption behaviors.

Dissatisfaction usually leads to lose customers and income. Compared with American customers, Chinese customers have several characteristics: their sense of security is lower; they think they take more risks because of fake goods and false advertising, so they are more sensitive to price, and they are more cautious in making purchase decision^[1]. Therefore, it is of great significance to explore the factors that affect online customer satisfaction.

In this study, based on a survey, we empirically develop four key dimensions of a particular websites that affect consumers' shopping experience and satisfaction. Further, this study investigates the main features that consumers are looking for when calculating their mental accounting, identifies potential dimensions, and

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evaluates their relative importance. Thus, this study attempts to find the factors for improving service quality, and also provides new references for other scholars in this field.

2. THEORETICAL FRAMEWORK

The new retail model on the Internet not only brings convenience to consumers, but also has an impact on consumers' mental accounting and perceived usefulness. It is a hot research topic in academic circle to bring the theory of mental accounting into consumers' purchase decision-making.

Some researchers have started to investigate how the attributes of a website will influence customers' satisfaction. These studies have presented various characteristics as important factors for an effective B2C e-commerce website^[2]. There have been several other attempts to build an evaluation framework or identify dominant factors concerning customer satisfaction with online shopping from the perspective of website quality^[3], purchasing behavior^[4], consumer attitude^[5], customer value^[6], service quality^[7] and mental accounting^{[8][9][10]}.

This study analyzes the impact of shopping patterns on consumers' mental accounting under all-channel retailing, in order to provide recommendations for consumers and retailers in reality.

In the following section, we will attempt to reorganize mental accounting, perceived customer value, features of website and trust as main factors affecting customer satisfaction.

2.1 Mental accounting

Mental accounting was first put forward by Thaler^[11], who summarized and prospected the theory and research of mental accounting in 1999^[12] and 2008^[8]. The theory holds that consumers will treat different expenditures and benefits with different attitudes. By establishing a mixed model of cognitive psychology and microeconomics, this study explores the value function and concludes the coding rules of gains and losses.

The basic characteristics of mental accounts include hedonic coding, non-substitution, flexibility, and a combination of short-term and long-term orientation^[13]. For the classification of mental accounting, Thaler^[12] divided mental accounting into daily consumer spending and luxury spending. Chinese scholar Li Aimei et al.^[9] found that the mental accounting system of Chinese people has a relatively stable "3-4-2" classification structure, in which the "affective maintenance accounting" has Chinese characteristics and is widely used in subsequent studies.

Consumers often follow an implicit mechanism of value evaluation when measuring their mental accounting, and their perceived value is often inconsistent with their real value, with obvious individual differences.

Mental accounting will affect consumers' cognitive system and perceived value function. Conversely, consumers' personalized characteristics and the network environment will make mental accounting change. Therefore, this study intends to collect data and build a model from the perspective of mental accounting so as to explore the factors influencing consumer shopping satisfaction and path changes.

2.2 Customer value and perceived value

Value is considered to be an important constituent of relationship between marketing and the ability of a company to provide superior value to its customers, which is regarded as one of the most successful competitive strategies^[14]. Customer value is conceptualized as tradeoff between benefits and sacrifices with a focus on the concrete performance characteristics of the products/services^{[15][16]}.

Perceived value is a consumer's overall assessment of the utility of a product (or service) based on perceptions of what is received and what is given^[15]. By adding more value to their products or services, companies try to improve customer satisfaction so that the bonds are strengthened and customer loyalty is thereby achieved.

For e-commerce customers, perceived value is one of the main reasons to engage in online transactions. The purchase decision is determined by both monetary (price) and non-monetary (risk, convenience and happiness) factors. Zou and Chen pointed out in the online purchase model that consumers will measure the purchase intention in their mental accounting and then change to the actual purchase behavior^[17].

2.3 Website features

The key characteristics of a B2C website could be categorized along the lines of its content and design^[18]. Content refers to the information, features or services offered in the website, while design is the way by which the contents are presented to consumers.

Before purchasing a product, consumers look for information on website: brands, variety, price and quality. But, different consumers have different information needs. In this study, we use privacy security, ratings and comments, reputation, and customer experience as the main factors that influence the features of the website.

Privacy security remains a key issue in e-commerce industry since personal and financial information can be intercepted and used for fraudulent purposes^[19]. Perceived security is defined as “the subjective probability with which consumers believe that their personal information will not be viewed, stored, and manipulated during transferring and storage by inappropriate parties in a manner consistent with their confident expectations”^[20].

In order to alleviate risks, online consumers based their decisions on rating and comments provided by others' shopping experiences^[21]. Liu and Park distinguished between source reputation (i.e., perceived degree of honesty) and source expertise^[22]. They reported that online reviews posted by a source with a high reputation were more useful than reviews written by those who have a low reputation. An effective reputation system is useful for establishing a successful online comment community and Electronic word-of-mouth (eWOM) channel.

Kim et al. pointed out that the psychological feelings generated by customers in the process of browsing and shopping online, that's, the customer experience, were a comprehensive reflection of customer feelings, imagination and emotions^[23]. Further, Zhang Yanyan verified the positive impact of customer experience on trust and customer satisfaction^[24]. Zhao and Chen pointed out that customers shared the shopping experience, opinions and related knowledge on the website, and consequently, online comments would affect the shopping decisions of other consumers^[25].

Based on these views, this study uses these four main factors to construct a conceptual model.

2.4 Online trust and satisfaction

The concept of satisfaction originates from psychology and represents a positive emotion in which one's inner expectations are realized. Customer satisfaction refers to the emotional reflection of the gap between the customer's ultimate experience and the customer's own expectations^[10]. Customer experience mainly represents customer perception, which includes perceived quality and perceived value.

In a longitudinal study, trust is found to influence customer's purchase decision and satisfaction affects long-term loyalty^[26]. Online consumer satisfaction significantly affects their willingness of repeated purchase intention and continuous use. Cheung et al. showed that 80% of consumers with high satisfaction would purchase repeatedly, and 90% of them would recommend others to purchase^[27]. Online shopping has the disadvantages of security risks, privacy risks, etc., while avoiding the drawbacks of traditional shopping. Many scholars have analyzed the factors affecting consumers' shopping satisfaction from different angles and using different methods^{[28][10]}.

This study intends to measure the change of mental accounting by investigating and analyzing consumers' own perceived value, individual characteristics and shopping preferences, as well as the external characteristics of the website, and then analyze consumer behavior trends.

In short, this model takes consumers' online shopping environment and personal characteristics as input variables. Through the calculation, comparison and measurement of mental accounting, combined with their own online shopping experience and risk preferences, consumers will form trust and have different satisfaction and subsequent decision-making behavior.

3. RESEARCH MODEL

This study is based on the theory of mental accounting and the theory of online consumer behavior. Considering the research results of Howard-Sheth Model^[10], Zhang Jianhua^[29], and Liu Qinxian^[30], this study selects the most influential factors, and then constructs the customer online shopping satisfaction model in a specific B2C transaction.

The intrinsic variables in this model mainly refer to perceived value and perceived structure. Consumers' perception and experience determine their acceptance of stimuli and inputs. External factors are mainly related to the cultural background, financial level, values and other personalized comprehensive characteristics of consumers. Input variables, i.e. stimulus and input factors, include three levels: product stimulus, website sales strategy stimulus and online shopping environment stimulus. This model integrates external factors and input variables into "website features", which is also one of the innovations of this study. The result variables of this model mainly refer to the consumers' shopping satisfaction caused by trust, and the following possible word-of-mouth effect and repeated purchase intention.

The path diagram of the initial structural equation model is shown in Figure 1 below.

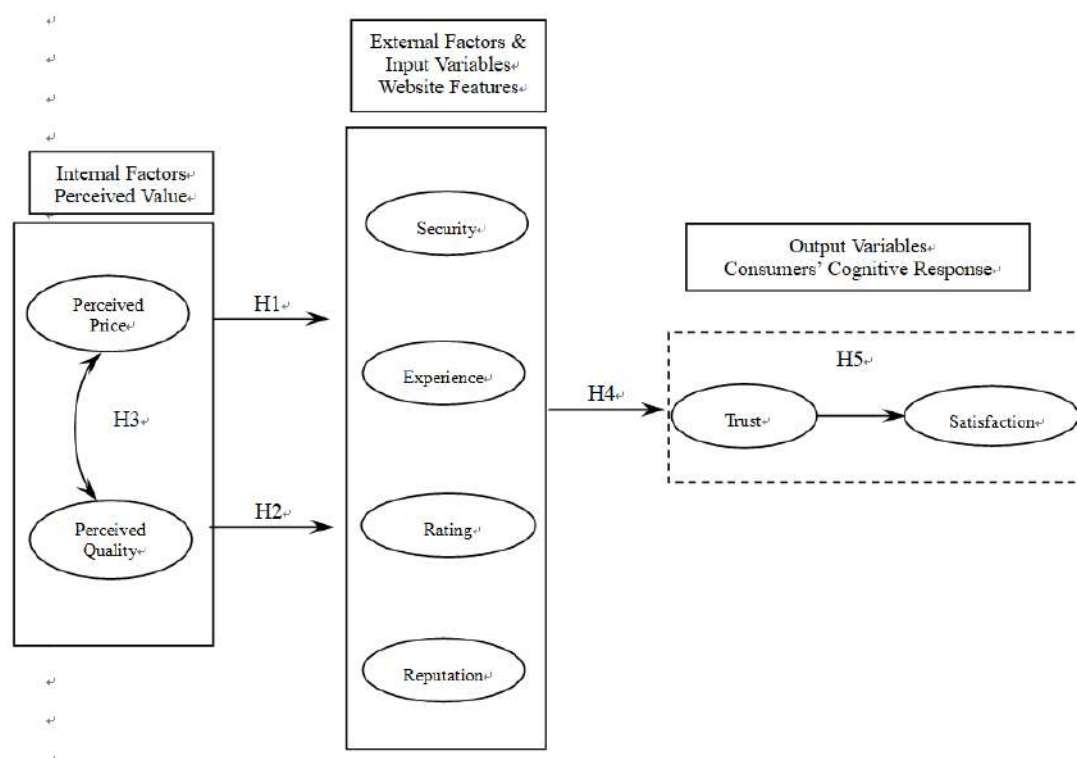


Figure 1. Hypothesis model

3.1 The impact of perceived value on website feature

According to Gale^[16] in his book *Managing Customer Value*, perceived quality is an assessment of a customer's comparison of a product or service on a shopping site with a competitor's product or service and perceived value is a comprehensive psychological perception that consumers adjudge based on the relative perceived price of an online product or service. Therefore, whether buying a product or service in a traditional

physical store or on a virtual website, consumers are most concerned with the value of the product, including the perceived quality and perceived price of the product. Therefore we put forward the following hypothesis:

H1. Perceived price has a positive influence on website features

H2. Perceived quality has a positive influence on website features

3.2 The relationship between perceived price and perceived quality

Perceived quality is different from objective or actual quality, a higher-level abstraction rather than a specific attribute of a product, a global assessment, which in some cases resembles attitude, and a judgment usually made within a consumer's evoked set^[15]. Many studies often discuss it from two parts: perceived service quality and perceived product quality.

From consumers' cognitive conception, perceived price is something that must be given up or sacrificed to obtain certain kinds of products or services^[15]. Perceived price is more meaningful than monetary price in e-commerce transactions.

Improving the perceived quality of online customers is beneficial to increasing the price level that customers are willing to pay. Perceived quality and perceived price are mutually influential. For this reason, we develop the following hypothesis:

H3. There is a significant correlation between perceived price and perceived quality

3.3 The impact of website features on E-trust

Studies of website features are identified into two categories: hedonic features (those that contribute to attractiveness, pleasure or fun) and utilitarian features (those that contribute to usefulness or ease of use)^[31]. Zha Jinxiang^[28] explored the relationship between e-commerce websites and customer satisfaction and loyalty with three dimensions from functionality features (such as usefulness, convenience, and fulfillment of website information), procedural features (such as website design, personalized services, privacy and financial protection, and entertainment) and social features (such as reputation, virtual community and word-of-mouth).

This study combines the previous research to figure out website features from four perspectives, namely website security (such as payment security, privacy statement and protection), customer experience (such as ease of use and convenience, FAQ, logistics, and after-sales service), online comments and rating (such as product information, online reviews and support rates) and website reputation (website integrity, unique style, staff service level and quality).

Many studies have shown that website features positively influence consumers' intention to engage in online activities, especially trust and satisfaction, for example, Zha Jinxiang^[28], Anil Bilgihana and Milos Bujisic^[32]. For this reason, we develop the following hypothesis:

H4. Website features have a positive impact on E-trust

3.4 The impact of E-trust on consumer satisfaction

Trust is defined as "confidence in a person or thing because of the qualities one perceives" in New Webster's Dictionary. In the latter literature, the definition has been further developed^{[33][34]}. In this study, E-trust refers to the willingness of a party believing another party in the uncertain (or risky) environment, including its ability, benevolence and integrity.

Higher trust results in lower transaction costs and lower transaction risk. Due to long-term trust relationships, consumers are likely to accept products of the website in a tolerant manner and then show satisfaction somehow. Online enterprises can also better promote their business philosophy, core values and products, so as to achieve a win-win situation^[29]. Therefore, we hypothesize that:

H5. Higher E-trust will lead to more customer satisfaction

Considering the four dimensions of website features, we divide the influences into different paths, forming the following hypothesis:

Table 1. Path hypothesis of the theoretical model

Hypothesis		Specific Content
H1: Perceived price has a positive influence on website features	H1a	Perceived price has a positive influence on website security
	H1b	Perceived price has a positive influence on customer experience
	H1c	Perceived price has a positive influence on online comments and rating
	H1d	Perceived price has a positive influence on website reputation
H2: Perceived quality has a positive influence on website features	H2a	Perceived quality has a positive influence on website security
	H2b	Perceived quality has a positive influence on customer experience
	H2c	Perceived quality has a positive influence on online comments and rating
	H2d	Perceived quality has a positive influence on website reputation
H3		There is a significant correlation between perceived price and perceived quality
H4: Website features have a positive impact on E-trust	H4a	Website security helps build E-trust
	H4b	The better customer experience can build more E-trust
	H4c	Positive online comments and rating helps build E-trust
	H4d	Website reputation has a positive influence on building E-trust
H5		Higher E-trust will lead to more customer satisfaction

4. DATA COLLECTION

4.1 Sample, questionnaire design and data collection

According to Nielsen's 2015 survey of global consumers, consumers aged 21-34 are the main force of online consumption, and they have the characteristics of technology and individuality and huge consumption potential^[35]. In China, the post-90s consumer groups, as “data aborigines”, account for 16% of China’s total population. From now until 2030, they will contribute more than 20% of China’s total consumption growth, higher than any other population category^[36].

Therefore, considering the popularity of some professional vocabulary (such as reputation and WOM), the sample group of this study mainly focuses on the 18-35-year-old consumer group with online shopping experience, relatively stable online shopping amount and frequency, and college education or above.

Each of the respondents is requested to complete a two-part questionnaire. The first one is the personal information. The second part consists of a five-point Likert scale, ranging from strongly disagree (1) to strongly agree (5), and most of the questions in the second part are from related literature, as in [28][29][37].

In particular, we select Jingdong (<https://www.joybuy.com/>) as a typical representative of B2C transactions in the questionnaire. It is very popular among young people because of its complete range of goods and logistics services.

A self-administered questionnaire (SAQ) survey was carried out from July to September 2017, including pre-research and formal research.

We design the initial questionnaire for pre-research, and collect 78 valid questionnaires. The data and each latent variable are tested for reliability and validity. The results show that the hypothesis is established and the theoretical model is verified basically. Combining the problems in the pre-survey and the suggestions of respondents, we modify the original questions and options to form the final questionnaire. In the formal survey, we send out 200 questionnaires. A total of 151 available questionnaires are collected, taking into account non-response biases and data availability.

4.2 Descriptive analysis

We summarize and calculate the valid data, and get the basic information of the respondents, as shown in Table 2. By descriptive analysis, we get lifestyle statistics and purchasing habits of samples, including frequency of online shopping, online buying propensity, and attitude toward risk and so on.

Table 2. Samples' descriptive statistics

Gender	Frequency	Percentage
Male	55	36.4%
Female	96	63.6%
Age	Frequency	Percentage
<18	1	0.66%
18-25	142	94.03%
26-35	8	5.31%
>35	0	0
Education	Frequency	Percentage
Junior college	8	5.30%
College	44	29.14%
Bachelor	85	56.29%
Graduate	14	9.27%
Income	Frequency	Percentage
<1500	87	57.62%
1500-3000	38	25.17%
3000-5000	19	12.58%
>5000	7	4.63%

As can be seen from Table 2, the younger group of 18-25 years old in the sample accounts for the majority, and the lower income accounts for more than 70%. In addition, more than 65% of the respondents have bachelor degree or above. On the whole, the sample is characterized by youthfulness, lower income, high level of education, and high frequency of online shopping, and so on.

When the respondents are asked “What do you value most when shopping online in Jingdong?”, the words with the highest frequency in the answer are “faster replacement speed”, “electronic products”, “global purchase” and “fast logistics”, “complete types”, etc. It can be seen that the online shopping characteristics of the samples are outstanding in individualized demand. They like to follow and purchase new products with high technology content, have higher requirements for logistics service quality and pursue higher quality of life.

When the respondents are asked “Do you easily trust others?”, nearly 60% of them choose less than 3 points (3=Neither agree nor disagree); when asked “Are you a risk-averse person?”, more than 70% of them choose more than 3 points, which indicates that most of the respondents are risk-neutral or risk-averse consumers. In summary, these basic attributes of the samples may affect the effects of subsequent model and data analysis results.

5. RESULTS AND DISCUSSION

This study uses data collected from surveys and analyzes with structural equation modeling. Each

respondent is given a questionnaire containing information experience shopping in Jingdong, and the questions are measured on a Likert scale to meet the needs for analyzing continuous variables in structural equation model.

All latent factors used in this study and their detailed descriptions are shown in Table 3. Also it presents the descriptive statistics for all data based on a 1 to 5 point Likert scale. The mean of all variables is greater than 3, the standard deviation is less than 1, and the overall data quality is good.

Table 3. Variable definitions and descriptive statistics for all data

Latent factor	Description (ID)	Mean	Std. deviation
Perceived Price (PP)	Products of this website have a price discount compared to other physical store. (PP1)	3.50	0.855
	Coupon and limited-time discount of this website would give me more benefits. (PP2)	3.35	0.881
	This website's logistics and distribution costs are cheaper than others. (PP3)	3.47	0.958
Perceived Quality (PQ)	The product category is complete on this website. (PQ1)	3.72	0.776
	The product information of this website is detailed and consistent with its actual situation.	3.44	0.813
	This website is designed to be convenient, humanized and friendly, and I do not need to ask	3.76	0.789
Website Security (WS)	The website's online payment system is safe relatively. (WS1)	3.70	0.739
	My personal information will not be illegally intercepted or leaked after the shopping on this	3.32	0.743
	The website will protect the privacy of customers in accordance with the privacy statement.	3.35	0.723
Customer Experience (CE)	This website provides customers with different feedback ways. (CE1)	3.46	0.885
	The online customer service is highly skilled and professional, and can help me solve	3.36	0.859
	The timely logistics and delivery services impress me. The products I purchased are always	3.99	0.796
	The after-sales communication channel is very effective and can timely solve the follow-up	3.31	0.850
Comment and Rating (CR)	I can often get products and related technical information from online customers' reviews and	3.65	0.850
	I really care about other online customers' comments and support rates. (CR2)	3.95	0.878
	This website's online comments do not have malicious marketing behavior of brush	3.43	0.837
Corporate Image and Reputation	The website is concerned about its reputation. (CI1)	3.68	0.805
	The website has its own unique design style. (CI2)	3.42	0.760
	The service personnel shows a good quality during the shopping and interactive process.	3.55	0.806
Customer Trust (CT)	I believe the quality of the products and services of this website, which makes me satisfied.	3.60	0.857
	The website will try its best to negotiate and resolve any problems in shopping. (CT2)	3.62	0.773
	I believe that the website will abide by its rules, commitments and privacy statements. (CT3)	3.68	0.725
	I believe in the integrity of the website. (CT4)	3.74	0.746
Customer Satisfaction (ST)	I feel satisfied after spending money on this website. (ST1)	3.45	0.936
	I did not encounter unpleasant things and I was not disappointed in shopping on this website.	3.70	0.764
	I will come back to this website if I want to buy similar products next time. (ST3)	3.67	0.764
	The website's online customer service always responds promptly, and the service attitude	3.38	0.915

Table 3 also presents the variables with higher mean are CE3 (The timely logistics and delivery services impress me. The products I purchased are always delivered within the time that I expected) and CR2 (I really care about other online customers' comments and support rates), and the variables with larger standard deviation are PP3 (This website's logistics and distribution costs are cheaper than others) and ST1 (I feel satisfied after

spending money on this website). Therefore, the respondents are very concerned about the service quality of the logistics and word-of-mouth. This result may be related to the group characteristics of the samples. In the subsequent research, the age and income of samples should be reconsidered for supplementary research.

Scales are subject to factor analysis for validation. As shown in Table 4, the selected variables load on distinct latent factors.

Table 4. Variable definitions and rotated factor matrix for all data

Latent	ID	1	2	3	4	5	6	7	8
Perceived Price	PP1	0.447	-0.035	-0.113	-0.137	0.349	0.545	0.060	0.015
	PP2	0.524	0.153	0.064	0.036	0.033	0.696	-0.012	0.007
	PP3	0.470	0.010	0.139	0.645	-0.064	-0.073	-0.114	-0.083
Perceived Quality	PQ1	0.439	0.007	0.155	0.016	0.733	0.129	-0.055	0.027
	PQ2	0.616	0.188	0.093	-0.123	0.073	0.013	-0.082	0.570
	PQ3	0.602	0.021	-0.114	0.214	0.358	0.132	0.175	-0.028
Website Security	WS1	0.538	0.536	-0.085	-0.005	0.213	0.005	0.131	-0.130
	WS2	0.315	0.781	0.102	-0.093	-0.079	0.026	0.000	0.075
	WS3	0.562	0.571	-0.136	0.204	0.032	0.151	-0.101	0.056
Customer Experience	CE1	0.597	-0.067	0.597	0.009	0.144	0.044	-0.019	0.053
	CE2	0.687	0.085	0.468	0.062	0.149	-0.030	-0.022	0.092
	CE3	0.510	-0.012	-0.419	0.471	0.189	-0.090	-0.055	0.164
	CE4	0.715	0.106	0.187	0.278	-0.189	0.110	-0.093	-0.206
Corporate Image and Reputation	CI1	0.605	0.003	0.142	-0.074	-0.059	-0.012	0.564	-0.014
	CI2	0.623	0.242	-0.033	-0.233	0.054	0.085	0.398	0.028
	CI3	0.598	0.307	0.412	0.012	-0.069	-0.141	0.289	-0.045
Comments and Rating	CR1	0.632	0.023	-0.118	0.307	0.067	0.066	0.280	0.355
	CR2	0.510	-0.243	0.009	0.461	0.120	0.256	0.362	-0.047
	CR3	0.734	-0.013	-0.028	0.125	0.089	-0.057	0.091	0.215
Customer Trust	CT1	0.767	-0.163	-0.038	-0.201	-0.107	0.075	-0.127	-0.070
	CT2	0.646	0.110	0.163	0.153	-0.263	0.314	-0.225	-0.298
	CT3	0.736	0.062	-0.071	-0.061	0.191	0.004	-0.156	-0.382
	CT4	0.865	0.019	-0.172	-0.009	-0.065	-0.045	0.065	-0.121
Customer Satisfaction	ST1	0.612	-0.009	0.092	-0.045	-0.280	0.075	-0.187	0.315
	ST2	0.821	-0.122	-0.136	-0.154	-0.158	0.033	-0.062	0.137
	ST3	0.763	0.028	-0.093	-0.101	0.163	-0.302	-0.117	-0.108
	ST4	0.645	0.015	0.510	0.181	0.062	-0.018	0.091	0.055

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

The bold data have relatively higher loadings and hence are selected for each latent factor.

It is worth noting that negative variables focus on “relative price advantage”, “online payment security”, and so on, which are potentially the most valuable information to online companies.

To further confirm the reliability of the scales, we also calculate and present the Cronbach alpha

coefficients in Table 5. It is recommended that the acceptable reliability for the Cronbach alpha coefficient be 0.70 or greater[38].

In our case, most coefficients are greater than 0.70 in additions to perceived price, perceived quality and website security factor, basically indicating the consistency and reliability of our variables and constructs. Let us move on these factors. Their Cronbach alpha coefficient is above 0.6 and below 0.7, indicating that there are some differences between the scale design elements and the views of respondents. This also reflects the gap between the experience and actual expectations of the respondents in Jingdong shopping, including price, quality and security. This result will not affect the stability of our subsequent analysis and results^[39].

Table 5. Cronbach alpha coefficient

Construct	Variables	Cronbach's α
Perceived Price	PP1 PP2	0.668
Perceived Quality	PQ2 PQ3	0.630
Website Security	WS2 WS3	0.654
Customer Experience	CE1 CE2 CE4	0.798
Corporate Image and Reputation	CI1 CI2 CI3	0.740
Comment and Rating	CR1 CR3	0.748
Customer Trust	CT1 CT2 CT3 CT4	0.841
Customer Satisfaction	ST1 ST2 ST3 ST4	0.780
Total		0.931

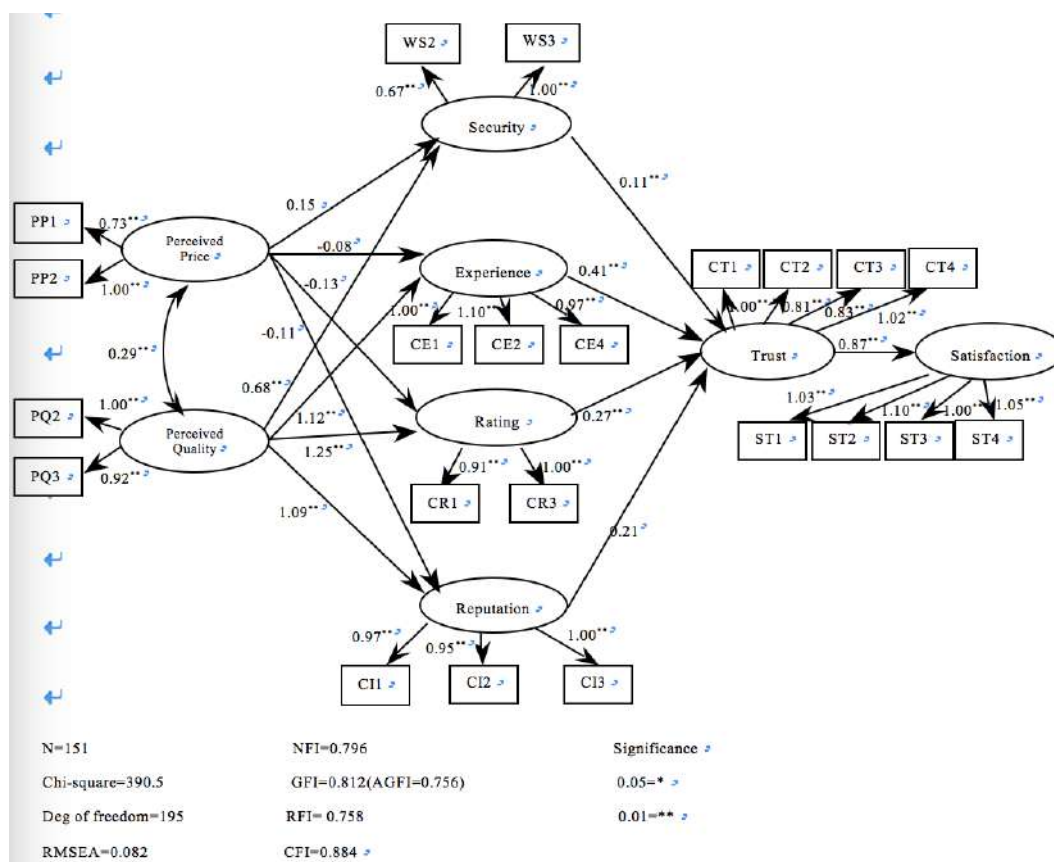


Figure 2. Preliminary calculation results for all data

Figure 2 shows the calculation results for all data of the structural equation. In the initial trial model, it should be noted that H1 (perceived price- website features) fails to pass the test, which means the direct impact from perceived price to website features does not exist. H4d (corporate reputation-trust) fails to pass the test either. In addition, fit index chi-square value (degrees of freedom) is 390.5 (195), which is slightly higher than the criterion. Therefore, the model needs to be modified according to the MI value. The modified results are shown in Figure 3. Figure 3 shows that $\chi^2/df < 2$, GFI > 0.8, CFI > 0.9, and the retained parameters all pass the significance test of $p = 0.05$, and then whole model is optimal. However, it is interesting that the relationship between perceived price and the three variables of the website features is not significant, which may be related to the small sample size and high data concentration of this survey.

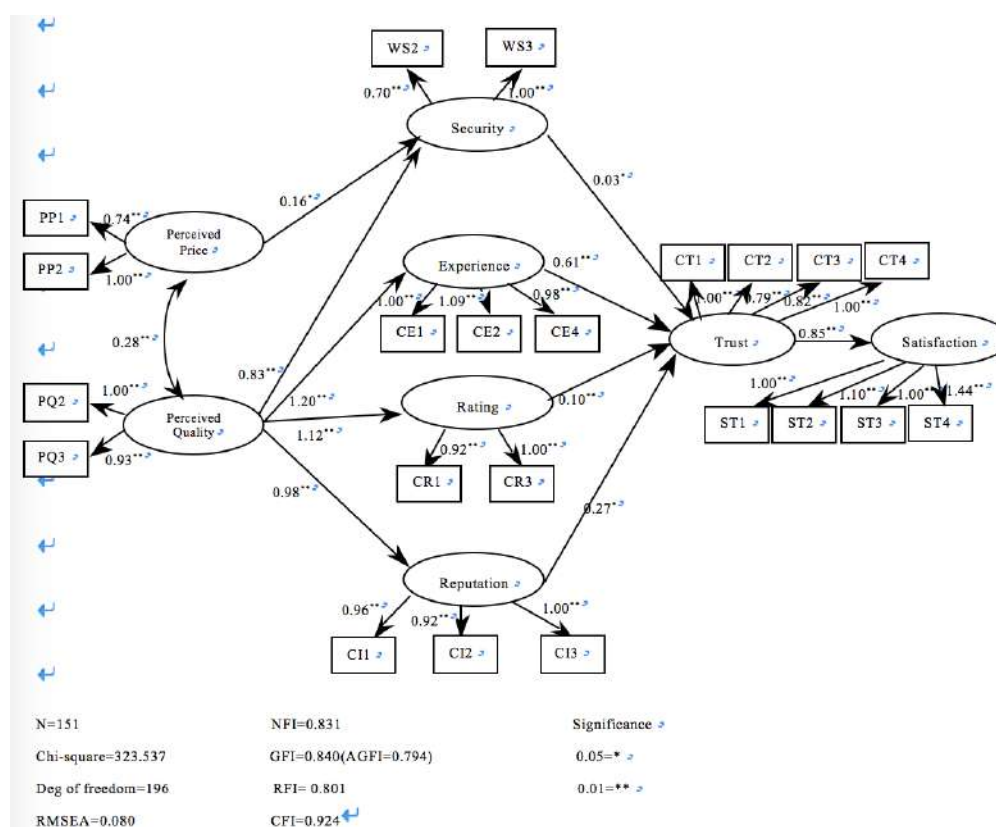


Figure 3. Modified results for all data

The analysis of all data in Table 6 shows that all hypotheses have almost been verified except H1 (about perceived price). In other words, the direct effect of perceived price is not significant and must pass perceived quality to have a positive impact on website features, even trust and satisfaction. This result shows that the era of “low price priority” has ended in China's B2C e-commerce market basically, and the psychological calculation and measurement process in the consumer's mental accounting has also become more complicated and objective.

Table 6. Summary of hypothesis results

Hypothesis	Effect	Support
H1: Perceived Price on Website Features	—	—
H1a: Perceived Price on Website Security	0.16	Yes
H1b: Perceived Price on Customer Experience	—	—
H1c: Perceived Price on Comment and Rating	—	—

Hypothesis	Effect	Support
H1d: Perceived Price on Corporate Image and Reputation	—	—
H2: Perceived Quality on Website Features	4.13	Yes
H2a: Perceived Quality on Website Security	0.83	Yes
H2b: Perceived Quality on Customer Experience	1.20	Yes
H2c: Perceived Quality on Comment and Rating	1.12	Yes
H2d: Perceived Quality on Corporate Image and Reputation	0.98	Yes
H3: Correlation between Perceived Price and Perceived Quality	0.28	Yes
H4: Website Features on Trust	1.01	Yes
H4a: Website Security on Trust	0.03	Yes
H4b: Customer Experience on Trust	0.61	Yes
H4c: Comment and Rating on Trust	0.10	Yes
H4d: Corporate Image and Reputation on Trust	0.27	Yes
H5: Trust benefit on Satisfaction	0.85	Yes
Total effect for H1= sum of component effects; “—” represents that results are not significant.		

Using structural equation modeling, perceived value is found to increase trust and satisfaction through website features, but such direct effect is not significant for perceived price. The small sample size and narrow sampling range are important factors affecting the results.

6. CONCLUSION, LIMITATION AND FUTURE RESEARCH

This study explores the ways and extents of perceived value affecting consumer behaviors from the perspective of consumers' mental accounting. It is important for organizations to improve customer satisfaction and build knowledge management system.

Although it is very difficult to generalize from a sample of only 151 young people, these results suggest that organizations need to pay attention to the external performance of the website (such as ease of use and entertainment), but also need to pay attention to the intrinsic perceived value of consumers. Cultivating a positive core value experience will help build a win-win situation.

The survey found that more than 80% of respondents frequently shop online and use mobile payment, indicating that consumers have a considerable level and scale in the market awareness of online shopping. Perceived price plays a role in website features and trust via perceived quality mainly. These demonstrate that China's online shopping group has entered a relatively mature, rational and stable stage, therefore enterprises should strive to build a brand image, increase the psychological reference price of consumers, and focus on guiding consumers to establish a value system consistent with the company and improve the perceived utility of consumers.

In addition, most of the respondents in this study are younger groups. They are more able to accept new technologies, and have a relatively high-risk tolerance, distinct personality requirements and group characteristics, so they are the main target groups of online shopping and mobile payment in the next 5-10 years. Enterprises should focus on exploring their behavioral characteristics and satisfaction factors, which help to develop differentiated marketing strategies. Further, enterprises should pay special attention to accurately grasp the psychology of all kinds of consumers, promote experiential marketing in a timely and appropriate manner, and launch different marketing strategies for practical products and hedonic products to stimulate their purchasing power, reduce complaints, and increase loyalty.

This study has some limitations that need be addressed through future research. First, the sample data are all from young consumers, which may reduce the accuracy and universality of the results. In the future, we can consider consumers with different “comprehensive backgrounds” (such as different working and education backgrounds, different ages, different incomes and consumption levels) as data research objects. Secondly, the choice for e-commerce websites is very time-sensitive. Over time, some companies may no longer be liked by consumers or even disappeared. Later we will select a number of typical websites (such as fresh food e-commerce platform, cross-border e-commerce companies, and maternal and child supplies e-commerce companies) for comparative research. Third, “mental accounting” and “perceived value” are relatively new concepts in the e-commerce field. Many consumers and organizations don’t know much about their connotation. There are also some drawbacks in the design and investigation of questionnaire. In the future, scenario design studies for mental accounting should be added.

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Do Free Users Make Seller Pay? The Asymmetry Network Effect of Free Users on Fee Sellers in Business-to-Business Electronic Platform

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Abstract: With the prosperity of worldwide e-commerce, platforms generally conduct premium model to convert customer assets. Extant research has investigated the network effect at e-commerce platform, but no study to date has analyzed whether the influx of free users can stimulate sellers to pay for the membership or backfire. In the context of B2B electronic market, we examine the dynamic network effect of free users in different participation quality on fee sellers with a VAR model. The results show that (1) the rise of registered regular sellers can incite more fee sellers to pay for the membership than that of regular buyers; (2) external users attracted by advertising (search advertising and social media advertising in this paper) can impact targeted internal user base. These findings emphasize more exploration should be pay attention to the engagement quality of user base in two-sided markets, and provide guidance related to advertising strategy.

Keywords: B2B Electronic Platform, Network Effect, Customer Engagement, Premium, VAR

1. RESEARCH QUESTION

The domain of membership decision has received significant attention in the online community and marketing strategy literature, with scholars attempting to explain the existence of peer influence^{[1]-[2]} and the marketing action of platform firms^{[3]-[4]}. However, showing the influence of free users on fee sellers does not suffice for platform-related research; instead, researchers as well as practitioners need to know the critical characteristics of free users, especially how the network effect scheme concerning free users on fee sellers occur. In such a context, we propose a taxonomy of free users according to the quality of participation and investigate the following question: whether and how the influx of free users with different participation quality can facilitate the growth of membership group and further the sustainable competitiveness of platform?

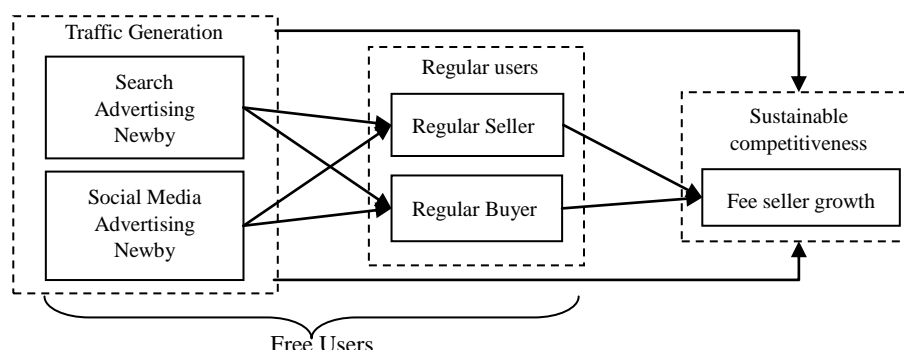


Figure 1. Framework of research: relationship between platform users

2. MAIN FINDINGS

We adopt a five-variable Vector Auto Regression (VAR) model to capture the interdependent evolution of variables, and further IRFs up to 4-week lags to gauge their short-term and long-term interactive relationship. The data set was collected from Alibaba, a world famous electronic B2B platform, and covers from March 31st in 2008 to March 31st in 2009 on a daily basis, altogether 366 valid days.

The results show that (1) the advertising strategies stimulate the growth of regular sellers and buyers differently. Specifically, the growth of traffic newbies from search advertising brings more regular sellers than newbies from social media advertising, while the later performs better in the inciting of regular buyers; (2) the growth of regular sellers can significantly increase the number of fee sellers in the short-term, while that of regular buyers is insignificant no matter in the short-term or long-term; (3) the advertising strategy has no direct effect on the growth of fee sellers and sustainable competitiveness of platform.

3. CONTRIBUTION

Different with traditional researches narrowing scope on the user base, we focus on the quality of free users and uncover the mechanism of how free users with different degree of participation influence fee sellers. There are two main theoretical contributions: (1) the participation quality of two-sided users significantly influences the sustainable competitiveness of platform, the effectiveness of which deepens as the degree of participation; (2) we indicate that advertising strategy enhances the performance of platform through increasing two-sided user base, which is totally different from most prior studies identifying it as invalid.

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Measuring Immediate Effect and Carry-over Effect of Multi-channel Online Ads

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Abstract: Faced with various online ads, firms are hard to choose the most appropriate advertising channels which have best advertising effects. Online advertising has immediate and carry-over effects. We constructed a comprehensive evaluation model of multi-channel online advertising effects which can evaluate not only immediate effect but also carry-over effect based on lag effect factors. Then, we conducted a restricted grid search and multiple linear regressions to estimate the immediate effect and carry-over effect of paid search ads, mobile phone message ads and e-mail ads based on user behavior data and transaction data of an e-commerce website. The results show that the immediate effect intensity of paid-search ads is the highest, the carry-over effect duration of e-mail ads is the longest, and the cumulative carry-over effect intensity of e-mail ads is the highest. This study puts forward suggestions on how to evaluate the effects of multi-channel online ads more accurately, which can guide this e-commerce website to make better advertising strategy for online marketing.

Keywords: online ads, carry-over effect, immediate effect, advertising effect evaluation, multi-channel

1. INTRODUCTION

With the development of China's online advertising market, more and more online advertising channels have appeared, including user-initiated advertising channels(UIACs) and firm-initiated advertising channels(FIACs) shown in Figure 1. UIACs, such as search engines, are triggered by users' actions. Conversely, FIACs, such as mobile phone messages and e-mail, focus on pushing the message to the user. Different online advertising channels play different role on attracting consumers to purchase^[1]. Multi-channel online ads have become an important online marketing tool for e-commerce firms. Multi-channel online ads is a kind of advertising operation pattern, which make use of banners, text links, multimedia to attract Internet users (including mobile users) in a variety of online channels. Faced with multi-channel online ads and limited advertising budget, firms need to evaluate the advertising effects to decide which channel is worth advertising.

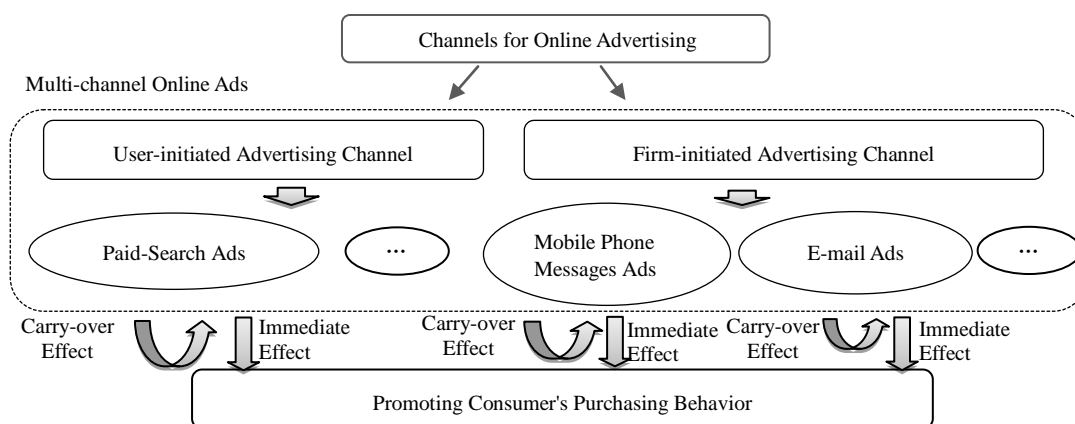


Figure 1. Online advertising channels and advertising effects

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Online advertising has many kinds of advertising effects^[2], including immediate effect and carry-over effect. The immediate effect is defined as the impact of advertising on consumer behavior (such as clicking, buying, etc.) in a short period of time after the advertising displaying^[3], while the carry-over effect refers to a long term advertising impact on consumer behavior^[2]. However, in the existing research, most scholars only evaluate the immediate effect of online ads by measuring click-through rate or conversion rate to assess advertising effects, without considering the widespread carry-over effect of online advertising^[4]. Immediate effect can only reflect the short-term impact of online advertising, ignoring the continuous impact of online advertising on user behavior. Managers may tend to be short-sighted in choosing the channel of online advertising if they just pay attention to the immediate effect evaluation results. Besides, only considering the carry-over effects will also make the effects of online ads underestimated. Therefore, in order to obtain more accurate evaluation results, it is necessary to conduct a comprehensive evaluation of the immediate effects and carry-over effects of multi-channel online ads.

In the previous research of carry-over effect evaluation, one part of studies focus on evaluating the impact intensity of the carryover effect which is accumulated over time and reflects the influence of advertisements over a period of time^[5]. The other part only focuses on the duration of the carry-over effect^{[6][7]}, but without measuring the impact intensity within the duration. In fact, in order to decide the spending and timing of online advertising, it is necessary to consider both the accumulated intensity and the duration of online ads channels.

Therefore, we address the following question: What are the immediate and carry-over effects of different online advertising channels on sales? Which online advertising channel takes the longest time to create buying behavior? What's the cumulative intensity of carry-over effect of different online advertising channels?

We develop hypotheses and test them based on the user behavior data and transaction data of a B2C e-commerce platform. Next we construct an evaluation model which can measure the impact intensity and duration of advertising effects. Then we describe the data and show the results. Lastly, we conclude by outlining the implications of our findings, the limitations of the study, and opportunities for further research.

2. RELATED LITERATURE

2.1 Evaluation of immediate effect

Many firms usually analyze the effect of online ads through click-through rate and purchase conversion rate which only reflect the immediate effect of online ads^[8]. Previous research that evaluated the immediate effect of online ads based on click behavior only considered whether the online ads can attract users to click, but ignores the purchasing behavior after click^{[9][10]}. Some other studies used the purchase conversion rate to measure the short-term effect of online ads. Purchase conversion rate refers to the proportion of users who generate purchasing behavior among the users who click on advertisements. This indicator can directly reflect the immediate impact of online ads on click-on users' purchasing behavior. Moe uses click stream data to predict purchase conversion rate based on users' historical purchase records^[11]. Rutz et al. develops a two-stage click-to-transform model based on Bayesian model and considers consumer heterogeneity to evaluate the effectiveness of online ads^[3]. Montgomery et al.^[12] used dynamic multi-probit model to model users' behavior data, and used click-stream data of an online bookstore to verify and predict the purchase conversion rate.

Most of the research reviewed on online advertising effectiveness has focused on the short-term effect of an ad campaign without taking the long-term effect into account. However, online advertising sometimes does not immediately trigger user behavior, but first forms an impression that influences later purchases. It is difficult to accurately measure the impact of online advertising in a period of time by only measuring the immediate effect.

2.2 Evaluation of carry-over effect

Some studies have shown that carry-over effect of online advertising exists widely. Carry-over advertising

effect refers to the advertising impact on consumer behavior and even sales after a certain time lag^[13]. Existing research shows that the carry-over effect of online ads varies with the channels of advertising. Early research on measurement of advertising carry-over effects paid more attention on the duration of advertising impact^[6]. Herrington et al.^[7] found that the influence of regional advertisements lasts longer than that of national advertisements. Besides the duration of advertising effects, some other authors usually used dynamic linear models to measure the accumulated impact intensity of advertising. Haan et al.^[5] applied vector auto-regression and impulse response analysis to process user behavior data and estimated the carry-over effects of two kinds of ads. They found that the accumulated advertising intensity of content-aggregated ads was stronger than content-separated ads.

Collectively, although existing studies have assessed the immediate effect or the carry-over effect, there is a lack of comprehensive evaluation of these two kinds of online advertising effects. With the overall consideration of the duration and intensity of immediate effect and carry-over effect, the evaluation results can fully reflect the different effects of online advertising over time^[14], and help firms to choose appropriate channels for online advertising. Therefore, this study will construct a multi-channel online advertising effect evaluation model to measure both immediate effect and the duration and cumulative intensity of carry-over effect.

3. HYPOTHESIS

To evaluate both the immediate effect and the carry-over effect of multi-channel online advertising, we address three online advertising channels in our analysis: paid-search ads, mobile phone messages ads and e-mail ads. Paid-search advertisements on search engines are on-demand advertisements based on users' search requests, which are less intrusive and not easy to arouse users' disgust. By contrast, mobile phone messages ads and e-mail ads, as kind of firm-initiated advertising, are pushed by firms. They not only have low cost, but also can be unlimited duplicated and widely diffused.

Research has shown that user's information needs, user's involvement and the attitude towards advertising can influence immediate advertising effects^[15]. Users are highly involved when they actively search for the information they need and the following paid-search ads are relevant to users' demand. However, consumers passively accept e-mail ads and mobile phone messages ads which may be annoying and not really needed. The information obtained by users through their own search behavior should be more credible and persuasive than that obtained by third-party push. Compared with the firm-initiated advertising, the user-initiated advertising is more likely to meet user's demand and lead to buying in a short time. Therefore, we hypothesize that:

H1a: E-mail ads have a relatively weaker and positive immediate effect.

H1b: Mobile phone messages ads have a relatively weaker and positive immediate effect.

H1c: Paid-search ads have relatively stronger and positive immediate effect.

According to Vakratsas and Ma's^[16] research, the different long-term effects of advertising channels can be attributed to two factors: the lifespan and content of advertising information.

In terms of the lifespan of advertising information, e-mail ads and mobile phone messages ads usually have a longer lifespan than paid-search ads, which can be stored in e-mail and mobile devices and be repeatedly accessed even after a long time. Comparing e-mail ads with mobile phone messages ads, the former can be stored in mobile and PC, while the latter can only be stored in mobile devices, so e-mail ads have a greater possibility of repetitive exposure. However, the paid-search advertisement is hard to be contacted repeatedly because the content presented by search engines is not static. Therefore, the following assumptions can be made:

H2a: E-mail ads have the longest carry-over effect of the three advertising channels.

H2b: Mobile phone messages ads have shorter carry-over effect than e-mail ads and longer than paid-search ads.

H2c: Paid-search ads have the shortest carry-over effect of the three advertising channels.

In fact, the cumulative impact intensity of advertising carry-over effect needs to consider both the immediate effect and the duration of advertising carry-over effect. In view of users' information needs and the information lifespan, we assumed that mobile phone messages ads have weaker carry-over effect intensity than the other two advertising channels. In addition, from the perspective of advertising information content, Some research reveals that rich advertising content has positive impact on users^[17]. Paid-search ads and mobile phone messages ads are usually presented in the form of text and links restricted by search engine typesetting, investment funds and mobile screen. E-mail ads don't have so many restrictions and the content is more of variety, usually with pictures to enrich the advertisement content and enhance attraction. Thus, according to the discussion in the three aspects, we hypothesis that:

H3a: E-mail ads have the strongest cumulative carry-over effect of the three advertising channels.

H3b: Paid-search ads have a weaker cumulative carry-over effect than e-mail ads and stronger than mobile phone messages ads.

H3c: Mobile phone messages ads have the weakest cumulative carry-over effect of the three advertising channels.

4. RESEARCH METHOD

In order to explore and compare the immediate effect and carry-over effect of different online advertising channels, we construct an effect evaluation model of different online advertising channels based on the direct aggregation approach^[1] and shown in model (1):

$$S_t = \beta_0 + \beta_1 x_{1t}^* + \beta_2 x_{2t}^* + \beta_3 x_{3t}^* + \varepsilon_t \quad (1)$$

where x_{1t}^* , x_{2t}^* , x_{3t}^* respectively capture the online advertising click stock of the paid-search ads, mobile phone messages ads and the e-mail ads on day t . And the coefficient β_1 , β_2 , β_3 respectively refer to the immediate effect of paid-search ads channels, mobile phone messages ads channels and e-mail ads channels, taking into account the carry-over effects. S_t is the sales volume of day t . Given that the online advertising click stock on day t (x_{it}^*) probably can be affected by previous clicking and browsing behavior of the day before, x_{it}^* is built recursively in the following manner:

$$\begin{aligned} x_{i1}^* &= x_{i1} \\ x_{i2}^* &= (1 - \lambda_i) x_{i2} + \lambda_i x_{i1}^* \\ x_{i3}^* &= (1 - \lambda_i) x_{i3} + \lambda_i x_{i2}^* \\ &\dots\dots\dots \\ x_{it}^* &= (1 - \lambda_i) x_{it} + \lambda_i x_{i,t-1}^* \end{aligned} \quad (2)$$

where x_{it} captures the number of clicks on the online advertising channel i ($i=1$, for paid-search ads; $i=2$, for mobile phone messages ads; and $i=3$, for e-mail ads) on day t . The lag effect factors of different online advertising channels is denoted by λ_i which are used to reflect the carry-over effect^[1].

To estimate the parameters of the model, including the immediate effect values (β_1 , β_2 , β_3) and the lag effect factors of the three channels (λ_1 , λ_2 , λ_3), we firstly used the method of restricted grid search in increments of 0.05 within a range of $0 < \lambda < 1$ to find the values of λ that minimize the residual sum of squares (RSS). Specifically, we used 19 different values of λ of each online advertising channel to calculate the online advertising click stock (x_{it}^*) of each channel. Then we can obtain 6859 combinations of different values of λ_i . Therefore, model (1) was run 6859 times, calculating the corresponding residual sum of squares of each time to find the optimal combinations of different values of λ_i (λ_1^* , λ_2^* , λ_3^*), which minimizes RSS. The optimal combinations of λ_i^* is used to calculate the optimal online advertising click stock x_{it}^* through the formula (2). Finally, the immediate advertising effects (β_1 , β_2 , β_3) are estimated using ordinary least squares (OLS) regression by inserting the optimal online advertising click stock (x_{it}^*) into model (1).

5. EMPIRICAL RESEARCH

5.1 The data

We cooperated with an E-Commerce firm in Nanjing of China to obtain empirical data. The consumers can browse, consult and purchase various products on their website. In order to improve the brand recognition and expand their product sales, the firm mainly guides consumers to the website by external advertising. Our data is collected from the log data of the firm's websites that tracks the daily user's accessing behavior. Each visit to the website is recorded and stored in the firm's log database with *User IP*, *Access Time Stamp*, *Access Date*, *Access Source*, *Access Request*, *User Agent*, *User Cookies*, *URL of websites* and so on.

We firstly collected 9,209,079 log data as original data using a time span of 90 days (from 01/01/2017 to 03/31/2017). Then, we delete some dirty data like spider and abnormal access records. To track each user's advertising clicking path and purchase behavior, we need to do user identification and session partitioning first. We mainly used cookies to identify unique user. If there is no cookie, we used IP, and *User Agent* (recording the type of the device and browser the user is accessing) to identify individual. Then, we can extract the behavior characteristics of each user in a single session. The behavioral characteristic variables generally include the number of ad clicks and the purchase conversions volume of the three channels. We can know which advertising channel the user is coming from by *Access Source* in the log data. And when visiting a web page, if the keyword "confirm" appears in the URL of the web page, it means that he/she has entered the order confirmation page and finished the purchase. So we use this URL to extract the purchase conversions volume from the database. Finally, we consolidated the behavior characteristics data records for three channels in time sequence into one basic data set with a total of 355241 pieces of data.

However, we find that the data set is unbalanced. The proportion of data records having purchasing behavior is very small, which is only 2% of all data records. The proportion of non-purchasing is much larger than purchasing. Obviously, it's likely to cause deviation when directly using this imbalanced data set to perform a regression. To solve the problem of the unbalanced large-scale binary data (buy/not buy), Lu, Jerath and Singh^[19] proposed that a large number of non-purchase data can be randomly sampled to construct a new sample set for model estimation, which can not only reduce the estimation time, but also obtain accurate estimation of parameter. Therefore, we used this method to re-sample our data by extracting all the data that have purchasing and randomly extracting 10% of the data records that have no purchasing. A new sample data set is constructed, including 34,736 users that do not have purchase behavior and 7881 users that have.

Lastly, by summing up the daily advertising clicks and purchase volume of each user on each advertising channel, we obtained the time series data of advertising clicks(x_i) and purchase volume(S_i) on the three advertising channels for modeling shown in Table 1.

Table 1. Time series data set of user behavior characteristics

<i>time</i>	x_1	x_2	x_3	S_i
2017-01-18	705	3	2	315
2017-01-19	630	4	3	301
.....
2017-03-31	1005	0	2	221

5.2 Research results

Due to the influence of the distribution of advertising resources and advertising policy, the daily visits of the three advertising channels are not balanced, and the daily visits of the paid-search channel have the different magnitude from the other two channels. In order to improve the curve fitting effect of multi-dimensional data of different magnitude, we standardized the data between 0 and 1 with the equation (3) specified as below:

$$x^{**} = \frac{x - \min}{\max - \min} \quad (3)$$

where x^{**} is the normalized value, max is the maximum value in the sample and min refers to the minimum in the sample. Then we used this standardized data to run the restricted grid search.

As shown in Table 2, by means of restricted grid search, we found the optimal combinations of different values of λ_i (λ_1^*) that has the minimum value of RSS (about 2.03565).

Table 2. Optimal lag effect factors λ_i^* of multi-channel online advertising

Parameter	Optimal λ value	Standard error	Minimum standardized residuals	Minimum RSS
λ_1^* (Paid-search ads)	0.05	0.064***	0.153851732459254	2.0356505799414
λ_2^* (Mobile phone messages ads)	0.35	0.122**		
λ_3^* (E-mail ads)	0.55	0.112**		

Note: * $p < .10$, ** $p < .05$, *** $p < .01$

It can be seen in the Table 2 that e-mail ads have the largest value ($\lambda_3^* = 0.55$) of optimal lag effect factor in the three advertising channels, followed by the mobile phone messages ads ($\lambda_2^* = 0.35$). The optimal λ value of paid-search ads ($\lambda_1^* = 0.05$) is the least. The lag effect factor λ here means the carry-over effect, which is the percentage of advertising effect that carries over from time period t to time period $t+1$.

After calculating the optimal advertising click stock through formula (2) based on the optimal combinations of λ_i^* mentioned above, we estimated the parameters of model (1) using OLS regression. The estimation results summarized in Table 3 show that the immediate effect of paid-search ads is strongest of the three channels with the value of 0.47, supporting Hypothesis 1c. The immediate effect of mobile phone messages ads ($\beta_2 = 0.349$) is slightly stronger than that of e-mail ads ($\beta_3 = 0.317$). E-mail ads have less influence on customers' immediate purchasing behavior than paid-search ads, and instead play a more important role in their subsequent purchasing behavior. As can be seen in Table 3, the adjusted R-square is 43.69%, which shows that the model has a good fitting effect.

Table 3. Model fitting results

Immediate effect	β_1 (Paid-search ads)	β_2 (Mobile phone messages ads)	β_3 (E-mail ads)
Parameter values	0.470	0.349	0.317
Adjusted R-square	43.69%		

In order to further obtain the duration and the cumulative intensity of carry-over effect of different advertising channels, we use the methods mentioned in the research of Greene^[18] as shown in below equations:

$$T = \beta / (1 - \lambda) \quad (4)$$

$$t = \log(1 - 90\%) / \log \lambda \quad (5)$$

where T refers to the cumulative intensity of carry-over effect. t means the duration of the carry-over effect which is defined as the number of days until 90% of the carry-over effect of advertising has happened.

Finally, we estimated the immediate effect, the lag effect factor, the duration of carry-over effect and the cumulative intensity of carry-over effect as illustrated in Table 4.

Table 4. Advertising effect of multi-channel online ads

Online Advertising Channels	Immediate effect (β_i)	Standard error	Lag effect factor (λ_i)	Duration of carry-over effect (days)	Cumulative intensity of carry-over effect
Paid-search ads	0.470	0.064***	0.05	0.769	0.495
Mobile phone messages ads	0.349	0.122**	0.35	2.193	0.537
E-mail ads	0.317	0.112**	0.55	3.852	0.704

Note: * $p < .10$, ** $p < .05$, *** $p < .01$ * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$

Comparing the data results with the research hypothesis, we can find that:

(1) The estimation results in Table 4 support the three hypotheses of Hypotheses 1. The H1c is supported since the paid-search ads channel has the strongest immediate effect ($\beta_1 = 0.47$). The other two advertising channels both have a weaker and positive impact on consumer's currently purchasing behavior (c.f. Table 4), which supports H1a and H1b. The paid-search ads can more quickly identify and satisfy the user's needs according to the user's requests and prompt the user to purchase immediately or in a short period of time. This is why it has the strongest immediate effect in the three online advertising channels. In addition, the reason why the immediate effect of mobile phone messages ads is stronger than that of e-mail ads may be that short messages are sent directly to the customer's mobile phone, which can immediately inform people to check it. What's more, consumers can click on the short message advertising link more conveniently on the mobile phone and view more details, which can also increase the chances of consumer's purchasing.

(2) The hypothesis H2 are all supported because e-mail ads channel has the longest duration of the carry-over effect of 3.852 days, almost double of that of mobile phone messages ads ($t=2.193$ days) and four times of that of the paid-search ads ($t=0.769$). The duration of carry-over effect of paid-search ads channel is the shortest of 0.769 days, less than one day, which is consistent with the conclusion that it has the strongest immediate effect. It can be seen that paid-search ads channel is a powerful channel for immediate sales.

(3) In the hypothesis H3 about the cumulative intensity of the carry-over effect, only H3a is supported since e-mail ads have the strongest cumulative intensity of carry-over effect of all the online advertising channels analyzed, reaching 0.704. Hypothesis 3b and 3c have to be rejected because it is the mobile phone messages ads channel that has the second strongest cumulative intensity of carry-over effect (about 0.537) of the three channels analyzed instead of paid-search ads whose cumulative intensity of carry-over is 0.493. The results indicate that e-mail ads channel with richer content and more diversified forms works much better to win the purchases in the long term than the other two channels. Therefore, the richness and diversity of advertising content are important factors to attract consumers to purchase. In addition, it may be because e-mail ads and mobile phone messages ads are likely to meet more needs beyond our expectation that makes the empirical results different from our hypothesis. Besides promoting all registered users with e-mail ads and mobile phone messages ads, the firm may also identify latent customers who often browse and buy products on their websites based on their historical data and push these ads to these customers inclined to buy things. In this case, e-mail ads and mobile phone messages ads can be further cater to user's demand compared with paid-search ads.

6. CONCLUSIONS

Most of the existing online advertising effect evaluation studies focus on the immediate effect evaluation using the user data obtained by the questionnaire or the overall sales and advertising data provided by the enterprise, which does not make full use of the firm's log data derived from the online ads. However, the carry-over effect of advertising differs significantly from immediate effect. For strategic brand-building purposes, firms also need a better understanding of how online ads affect consumers in the long run. Therefore, our study responds to deficiencies in these studies by conducting a comprehensive evaluation study on the immediate effect and carry-over effect of multi-channel online ads using click-stream data of users on different advertising channels. Managers and practitioners can use the approach described in this paper to analyze their own online advertising log data to determine which advertising channel has the appropriate effect on sales and improve the effectiveness of their online advertising marketing.

There are still some limitations to be further discussed and improved in the future:

(1) When evaluating the effect of multi-channel online ads, we choose to sum up the number of advertising channel clicks and purchases of a single user by the day. Further research should evaluate the advertising effects

at user's individual level for more granular analysis.

(2) This study is limited to the advertising policies of the firm we cooperate with. It only evaluates the effects of paid-search, mobile phone messages and e-mail advertising channels. With the development of social media advertising, we can evaluate the effects of social media advertising channel and make a comparison with other channels in future research.

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The moderating role of demand-side usage of O2O platforms and offline competition intensity for the outcome of proprietary platforms

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Abstract: Online to offline (O2O) platforms have risen in the digital era and have produced great impacts on local service providers. How online and offline attributes of local service firms influence the outcome of establishing proprietary platforms is understudied. The paper takes 528 cinemas in Nanjing from June 2017 to September 2017 as a sample. Based on network effects and the red queen theory, this paper focuses on the moderating effect of competition intensity and the demand-side usage of O2O platforms on the relationship between the choice of proprietary platforms and cinemas' performance. The findings show that competition intensity has a significantly positive moderating effect, while the demand-side usage of O2O platforms has a significantly negative moderating effect. Implications of the findings are discussed.

Keywords: competition intensity, platform usage, O2O platforms, proprietary platforms

1. INTRODUCTION

With the "Internet+" concept proposed and the continuous development of e-commerce, the online-to-offline (O2O) commerce has become increasingly popular and gradually penetrated the local service industry, including catering, travel and entertainment sectors. In the digital era, local service industries seize the opportunities of O2O commerce by joining third-party O2O platforms or establishing proprietary O2O platforms. O2O commerce brings online customers to offline physical stores and improves the efficiency of physical stores. The process from online to offline is conducive for merchants to improve their products, cater to market demand and expand the size of users ^[1].

However, offline firms in O2O commerce differ from online firms in traditional B2C or C2C commerce in some aspects. The attributes of offline firms are very important in O2O commerce, among others, location selection. The location of an offline firm influences not only the competition intensity faced by the firm, but also spill over from geographical agglomeration ^[2]. Meanwhile, the O2O model is different from the traditional B2C and C2C model. O2O commerce emphasizes the organic interaction and fusion of online and offline components and highlights positive feedback between online and offline components. Existing literature on O2O commerce focuses on demand-side consumer groups or the nature of the offline business. Chintagunta and Pradeep (2010) study the effects of online user reviews on movie box office performance ^[3]. Dellarocas and Chrysanthos (2007) study the value of online product reviews for forecasting sales ^[4]. Song and Huang (2019) build a prediction model of movie box office revenue by empirically exploring its intricate relationships with different content published on different platforms ^[5]. Zhu and Zhang (2010) examine how product and consumer characteristics moderate the influence of online consumer reviews on product sales. Wan and Chen (2019) study the impact of the interaction between vertical integration and platform choice on the performance of offline firms ^[1]. The role of online and offline features of physical stores joining O2O platforms are understudied. Specifically, on the one hand the paper considers a physical store's online feature-its demand-side usage of O2O

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platforms. Even if a physical store joins O2O platforms, some customers are likely to come from offline channels. The variable of demand-side usage of O2O platforms reflects demand side's engagement with the platforms. On the other hand, the paper takes into account an offline feature of a physical store-local competition intensity. Local stores face competition with rivalry firms, especially those neighboring ones.

The paper chooses China's movie theater industry as the research context. The industry has been reshaped by O2O platforms. In 2011, some online platforms in China launched group-buying service for movie tickets. Since then, the share of online sales has soared. In the second quarter of 2015, online ticketing accounted for 69.18% of the total box office revenues. With the advent of online platforms, the annual growth rate of the movie industry has exceeded 30%, far exceeding the growth rate of the country's GDP^[6]. Furthermore, digital platforms play an important role in reshaping the industrial structure and changing the boundaries of the industry. O2O platforms, including third-party platforms and proprietary platforms, not only become the main channel for movie ticket sales, but also move into the stage of movie production and distribution by leveraging their advantages such as big data and IT capability. While O2O platforms rise in the movie theater industry, the influence of the competition intensity between the offline supply side is also very important.

The paper makes the following contribution. Firstly, it investigates the moderating effects of local competition intensity on the relationship between the choice of proprietary platform and firm performance. It helps understand the role of O2O platforms for offline firms that confront local competition. In this way, our research highlights and integrates offline features of firms joining digital platforms. Secondly, this paper examines the moderating role of the demand-side usage of O2O platforms on the relationship between the choice of proprietary platform and firm performance. It means that we incorporate the demand side into our empirical research, which is important as two-sided market platforms feature interaction between demand side and supply side. The interaction on O2O platforms may differ from the interaction on B2C or C2C platforms. In this way, this paper extends our understanding on platform-enabled two-sided interaction in the context of local markets.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

The main effect of this paper is about the relationship between the choice of proprietary platforms and cinemas' performance. Literature has confirmed the positive impact of the relationship^[7]. This paper focuses on two moderating effects. One is about the customers' usage of O2O platforms, which represents the online feature of the demand side. The other is about the competition between physical cinemas, which represents the offline attribute of the supply side.

2.1 Theoretical framework

2.1.1 The red queen effect

The red queen effect is based on the dialogue between the red queen and Alice in *Through the Looking Glass* by Lewis Carroll. Barnett applied this hypothesis to management & organization research and developed it into the red queen theory. Barnett (1996) proposes that the success or failure of organizational competition can be attributed to learning effect and screening effect^[8].

The learning effect can be explained by the fact that, in a complex and rival business environment, the performance of a firm depends on whether or not it can outperform its competitors. The premise is that it needs to continuously learn to improve organizational vitality and performance, which is called organizational learning^[9]. On the one hand, forced by fierce competition, a firm has to continue to learn and improve so as to keep up with its competitors. On the other hand, the learning ability of competitors is also stimulated and the competition becomes fiercer, thus continuing to initiate the process of the next round of search and learning.

The screening effect is similar to the evolutionary theory of survival of the fittest, which eliminates firms

with weak competitiveness. In the embarrassing situation of self-upgrading and co-evolution, only by maintaining strong competitiveness and passing the fierce selection can firms survive in the dynamic competitive environment. Screening can be explained by internal and external mechanisms^[10]. The internal screening depends on the cognition and decision of the manager based on the actual situation. External screening is more influenced by the surrounding environment. The two mechanisms complement each other and work together.

2.1.2 Network effects

E-commerce platforms feature network effects that facilitate interaction between same-side or cross-side customers. Network effects comprise of cross-side network effects and same-side network effects^[11]. Same-side network effects, also known as direct network externalities, refer to that the utility of users in a network depends on the number of users on the same side. When the number of users using the same or compatible products increases, the utility of the products for users increases^[12]. Cross-side network effects refer to the influence of users of one side of the market on users of the other side of the market. Specifically, the value of the platform to merchants (or consumers) depends largely on the number of consumers (or merchants).

2.2 Moderating effect

The proprietary platforms can help cinemas to streamline business process, improve the loyalty of users, expand the user base and thus improve the cinemas' performance. Meanwhile, attributes of offline firms such as the location of cinemas play an important role in moderating the main effect. According to the red queen theory, the competition among organizations can stimulate the learning effect. Proprietary platforms of cinema chains can provide various resources for affiliated cinemas, including a large installed base of customers, big data and business analytics capabilities. With platform-enabled resource and capabilities, cinemas can better understand and predict demands of consumers and improve their decision making such as movie scheduling. In this way, faced with higher competition intensity a cinema will be more motivated to improve its organizational learning by exploring knowledge from proprietary platforms. Such a cinema can give more play to the advantage of proprietary platforms, such as customer loyalty and streamlined business process. Meanwhile, the screening effect means that surviving cinemas are those that fit both the offline environment and the digital environment. The surviving cinemas can better handle offline competition by leveraging online platform resources. Therefore, we present the following hypothesis:

H1: The higher competition intensity faced by a cinema, the larger the impact of proprietary online platforms of a cinema chain on the performance of the cinema.

On one hand, the platform has cross-side network effects. The combination of proprietary platforms and offline physical stores can provide users with personalized value-added services and greatly improve consumer satisfaction and then continue to expand and consolidate user base. On the other hand, the platform has the same-side network effects. With the increase of the number of consumers on one side of the platform, more consumers will be attracted and the utility of users will be enhanced. The same-side and cross-side network effects can improve cinemas' performance.

In addition to the proprietary platforms, the choice of Internet platforms also includes joining the third-party platforms^[7]. They refer to the Internet platforms that provide services for the two parties independent of the supply and demand sides of products or services, mainly including MaoYan, TaoPiaoPiao and Baidu Nuomi in the movie theater industry^[7]. The types of firms on the proprietary platforms are generally the same and the number of them is limited. By contrast, the third-party platforms provide function repertoires, including transaction matching, online communities and value-added services. Therefore, third-party digital platforms have a larger installed base of customers than proprietary platforms. Because third-party digital platforms account for a majority of demand-side users, the higher the demand-side usage of digital platforms,

the stronger the network effects brought by third-party platforms and the weaker the network effects brought by proprietary platforms. The weaker the network effects brought by proprietary platforms of cinema chains, the lower performance affiliated cinemas can achieve. In sum, we present the following hypothesis:

H2: When the demand-side usage of digital platforms is higher, the relationship between the choice of proprietary platforms of cinema chains and the performance of affiliated cinemas becomes weaker.

3. METHODOLOGY

3.1 Data

This paper treats cinemas as the unit of analysis and uses a panel-data model. The sample covers cinemas in six major urban districts of Nanjing with the sampling period from June 2017 to September 2017. We adopt a week as the time interval as movies are generally released weekly. The year of 2017 was chosen because according to statistics from the China Report Network, online ticketing accounted for 83.9% market share of the movie theater industry in China's first-tier cities in 2017, 83.5% market share in the country's second-tier cities, and 81.3% and 77.5% market share in the country's third and fourth-tier cities respectively ^[13]. It shows that O2O platforms have become the main outlet for ticket sales in China's movie theater industry. The O2O commerce is gradually maturing in the movie theater industry. In this paper, we choose June to September as the sampling period because it includes the summer holiday, which is one of golden periods for movie exhibition. We choose the six major urban districts because the six major urban districts have superior geographical locations and advantages over the other five suburban districts in terms of population density, economic, development, and culture consumption. Data are collected from Entgroup database, a professional database about China's motion picture industry.

3.2 Variables

(1) Dependent variable. In this article we use cinema's performance Rev_i as the dependent variable, which is measured by the cinemas' box-office revenues. In china, box-office revenues are the main source of income for theaters. Therefore, it is reasonable to regard it as the cinemas' performance.

(2) Independent variable. $Selfplat_i$ captures the number of self-established platforms of the cinema chain. So far, there have been three types of proprietary platforms for cinemas, i.e., a web page platform with online ticketing function, a mobile terminal platform in the form of App and a public account platform embedded in WeChat App. Based on the collected data of proprietary platforms of every cinema chain, this paper assigns 3 to the cinema chain with three types of self-established platforms, 2 to the cinema chain with two types, 1 to the cinema chain with one type, and 0 to the cinema chain without any proprietary platform.

(3) Moderating variable. There are two moderating variables, $Cominten_i$ and $Onratio_i$. $Cominten_i$ represents competition intensity faced by a focal cinema. The variable is measured by the following formula:

$$Cominten_i = \sum_{\substack{j=1 \\ j \neq i}} \frac{1}{Dc_i c_j} (Dc_i c_j \leq 5km)$$

Where $Dc_i c_j$ represents the distance between Cinema C_i and Cinema C_j

Using a program called Anaconda, we can measure the distance between any pair of cinemas. The more neighboring cinemas a cinema has, the higher competition intensity the cinema confronts. The inverse of distance between a pair of cinemas represents their competition intensity. By adding all the inverses regarding a focal cinema together, we can get the measure of competition intensity for the focal cinema. We set the upper bound of cinema distance as 5 kilometers ^[2]. In robustness check, we will change the upper bound from 5 kilometers to 3 kilometers.

The moderating variable $Onratio_i$ represents the utilization rate of O2O platforms on the demand side. This

variable is measured by the proportion of box office revenue realized through the online sales channels in the total box office, reflecting the frequency of demand-side usage of O2O platforms.

(4) Control variables. This paper includes four control variables, i.e. $Seat_i$, $Screen_i$, $Price_i$ and $Density_i$. Control variables capture the characteristics of the cinemas. $Seat_i$ represents the capacity of a cinema to accommodate customers, measured by the total number of seats of the cinema. $Price_i$ reflects the market power of a cinema, measured by the average price set by the cinema in the sample week. $Screens_i$ represents the capacity of a cinema to exhibit films simultaneously, measured by the total number of screens of the cinema. The variable $Density_i$ is measured by the population density of the administrative district where a movie theatre is located. We adopted the data of the residential population in each district at the end of 2017 from Nanjing Municipal Annual Statistics. The variable is calculated by dividing the data by the area of the corresponding district. Density determines the potential scale of a cinema's audience and may influence the cinema's decisions.

4. RESULTS

4.1 Descriptive statistics

To keep the sequence stable, we take the logarithm of the variable Rev_i and $Seat_i$. Table 1 gives descriptive statistics of variables and their correlations. For all variables, the standard deviations are smaller than their mean value. Variance inflation factor(VIF) was used to check whether the variables have the potential problems of multicollinearity. Results show that the mean value of VIF is 1.81 and the maximum value of VIF is 2.8. Consequently, the potential possibility of multicollinearity could be excluded.

Table 1. Descriptive statistics and correlations

Variables	Mean	SD	VIF	Rev	Selfplat	Onratio	Cominten	Seat	Screen	Price	Density
Rev	11.98	1.337		1.000							
Selfplat	1.23	1.097	2.8	0.117***	1.000						
Onratio	85.99	15.698	2.45	0.439***	-0.167***	1.000					
Cominten	4.97	3.672	2.11	0.178***	0.211***	0.114***	1.000				
Seat	6.76	0.685	1.63	0.813***	0.123***	0.266***	0.128***	1.000			
Screen	7.90	2.868	1.24	0.674***	0.194***	0.151***	0.426***	0.662***	1.000		
Price	31.02	4.202	1.23	0.479***	0.259***	0.018	0.098**	0.238***	0.389***	1.000	
Density	0.76	0.601	1.22	-0.009	0.050	0.051	0.600***	-0.009	0.117***	-0.124***	1.000

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.2 Regression results

Table 2 gives regression results. Model 1 is a baseline model, including all control variables. Model 2 adds the independent variables $Selfplat_i$ based on Model 1. Model 3 includes moderators $Onratio_i$ and $Cominten_i$. Model 4 includes interaction terms between the independent variables and moderators.

The result of Model 2 reveals that $Selfplat_i$ has a significant and positive impact on the cinemas' operating performance. According to the results of Model 4, the coefficient of the interaction terms $Selfplat_i * Onratio_i$ is negative and significant, thus supporting H2. It demonstrates that the higher the proportion of online box office revenues, the weaker the impact of the number of proprietary platforms on the performance of affiliated cinemas. The coefficient of the interaction term $Selfplat_i * Cominten_i$ is positive and significant, thus H1 is supported. The stronger the competition intensity between offline cinemas, the stronger the impact of the number of cinema chains' proprietary platforms on the performance of affiliated cinemas.

Table 2. Regression result

	Model 1	Model 2	Model 3	Model 4
Screen	0.057 ^{***} (0.006)	0.053 ^{***} (0.007)	0.071 ^{***} (0.004)	0.080 ^{***} (0.005)
Seat	1.553 ^{***} (0.024)	1.582 ^{***} (0.029)	1.337 ^{***} (0.037)	1.323 ^{***} (0.042)
Price	0.084 ^{***} (0.002)	0.088 ^{***} (0.002)	0.086 ^{***} (0.002)	0.083 ^{***} (0.002)
Density	-0.104 ^{***} (0.017)	-0.106 ^{***} (0.022)	-0.013 (0.020)	0.033 (0.022)
Selfplat		-0.070 ^{***} (0.006)	0.004 (0.008)	0.720 ^{***} (0.132)
Onratio			0.019 ^{**} (0.001)	0.035 ^{***} (0.003)
Cominten			-0.020 ^{***} (0.004)	-0.041 ^{***} (0.005)
Selfplat*Onratio				-0.009 ^{***} (0.001)
Selfplat*Cominten				0.010 ^{***} (0.003)
_cons	-1.554 ^{***} (0.142)	-1.771 ^{***} (0.161)	-1.881 ^{***} (0.181)	-3.113 ^{***} (0.312)
<i>N</i>	528	528	528	528

5. DISCUSSION AND CONCLUSIONS

The paper explores the moderating effects of the demand-side usage of O2O platforms and offline competition intensity on the relationship between the number of proprietary platforms and cinemas' performance. The findings show that competition intensity has a significantly positive moderating effect, while the demand-side usage of O2O platforms has a significantly negative moderating effect.

Offline competition intensity positively moderates the main effect, indicating that there is a complementary relationship between offline competition intensity and multiple proprietary online platforms. The emergence of online platforms has changed the pattern and situation of offline competition. As O2O platforms rise in Chinese economy, cinemas have built their own or joined third-party O2O platforms. Intensified offline competition urges movie theaters to leverage platform resources and capabilities, including a large user base and big data. With the platform resources and capabilities, offline cinemas can improve movie marketing, and develop a positive feedback between online customer behavior and comments and offline consumption.

The demand-side usage of O2O platforms negatively moderates the main effect. The final results do not support the complementary relationship between demand-side usage of O2O platforms and the choice of proprietary platforms, indicating that the influence of proprietary platforms is limited. In contrast, the third-party platforms are more influential in China's O2O commerce. When a cinema decides to join third-party platforms or to establish proprietary platforms, it needs to make a careful decision based on its own reality and the characteristics of the external environment. For small-scale firms, if they cannot accumulate enough users to achieve the critical mass for igniting network effects, it is a better choice for them to join third-party platforms.

There are some limitations of this paper, which give directions for future research. First, the paper takes

528 cinemas in six major urban districts of Nanjing from June to September in 2017 as samples. Future research can examine our research question with a sample of a longer time horizon and from different cities. Second, we investigate our research question in the context of China's movie theater industry. To generalize the conclusion of our paper, the hypotheses can be tested in the context of other local service sectors in more countries. Third, future research can further dig into the quadratic effect of the moderating term, instead of the simple linear relationship. There may be more interesting discoveries. Fourth, we examined the moderating impacts on the relationship between the choice of proprietary platforms and cinemas' performance. When O2O platforms rise in the local service industry, they can empower participating firms to improve their decision making. It heralds a future direction about the moderating impact on the relationship between participating firms' decision making and their performance.

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Dynamic Characteristic of Consumer Attention in Online Reviews

—Empirical Research Based on Mobile Store Reviews

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Abstract: Nowadays consumer online reviews are becoming more and more important for enterprise decision-making. While the existing research seldom discussed review data from a dynamic perspective, especially ignored consumers' attention change during the product life cycle. To study whether there are dynamic changes and the characteristics of changes in the attention degree of consumers in each phase of the product life cycle, this paper coded a specific node program to collect the online reviews data of the four mobile phones in the entire product life cycle and used python's Chinese automatic word segmentation tool library to segment each word and count word frequency, and then a stepwise regression method was used to analyze the dynamic changes of consumer attention. The paper finds that consumers' attention on logistics and products presented in online reviews show a downward trend, and the attention on brands shows an upward trend; There is no obvious change in the attention degree on services, prices, and promotion; On the different dimensions of products, there is a significant difference in the attention degree. The research results broad the research ideas of online reviews, provide decision-making basis for enterprises to grasp the characteristics of consumers at different stages and to formulate production and marketing strategies.

Keywords: online reviews, attention degree, dynamic, stepwise regression

1. INTRODUCTION

With the upgrade of online shopping, the massive amount of e-commerce data has provided enterprises with many structured or unstructured data related to user behavior. Evaluations made by consumers on e-commerce sites after purchasing products or services can be used by businesses. After researching consumer concerns through data analysis, the available information will be of great significance to the organization of production and marketing.

At present, data analysis has been widely used in various industries such as e-commerce, finance, and medical care. Using big data to analyze massive review data can provide useful guidance for the production and sales of enterprises. The development of natural language processing technology, especially Chinese word segmentation technology, has facilitated massive review analysis. With these technologies, it is very convenient to extract information from reviews.

Based on most of the static perspectives, the extraction of existing review opinions, sentiment analysis, and usefulness analysis methods for review data acquisition cases are improved. The research emphasizes that consumers' attention in different aspects may change regularly in the product life cycle analysis. This essay will be based on the empirical research of mobile phone store reviews to explore the changes of consumer concerns and their attention levels in the product life cycle reflected in e-commerce website reviews and consumer attention to different concerns in e-commerce website reviews. Four basic mobile phone review data were collected from two mobile phone official malls, extracting consumer concerns, and trying to find the consumer's attention to the changes in the different concerns of mobile phones and different concerns. The differences and connections between the two provide a basic idea for analyzing reviews from a dynamic perspective. The

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purpose is to analyze the dynamic characteristics of consumer attention in online reviews in order to provide guidance for the production of enterprises, provide solutions for marketing planning. Specifically, the research can not only provide guidance for enterprises to organize production, R & D and product improvement, and enhance customer value, but also guide enterprises to follow the product life cycle and scientifically formulate or adjust marketing strategies in different stages. In a nutshell, the essay will provide various and specific solutions for production of enterprises, marketing planning and provide new ideas for the whole field of e-commerce website review analysis.

2. LITERATURE REVIEW

2.1. Research on Review Data Mining Methods

Analysis of data mining for review of e-commerce websites mainly involves three aspects:

First, the extraction of review opinions, that is, identifying what the review is talking about: Ji Yahui^[2] improved the two-way propagation algorithm. By adding many product features, viewpoints, and interdependences between sentences, and adding verbs describing the products, the selected viewpoints and features were ranked using the HITS algorithm. Wang Hongwei^[3] combined the artificial rule base and the rules generated by the class sequence to construct a hybrid rule base comparison sentence and judged the comparison entity name again to extract the comment point. Jiang Lin^[4] innovatively used the word polarity algorithm, and proposed the extraction algorithm based on statistically relevant product keywords, using opinion association pairs, based on structured syntax analysis, and the word polarity algorithm to extract the Negative perspective approach. Xu Bing^[5] added shallow syntactic, location, part-of-speech, and contextual features to the conditional random domain model, and proposed a method for extracting review opinions without the help of a domain dictionary.

The second is the sentiment analysis of comments, that is, to analyze whether the comments are ambiguous or derogatory texts, and the degree of derogation: Song Xiaoyong^[6] constructed a PORSC model for emotion classification by introducing a global emotion classification model and a specific type of user classification model, and Use distributed acceleration algorithms to speed up calculations. Gong An et al.^[7] selected monogram features, syntactic features, and dependent word features as text features, and processed these features through machine learning methods. Each clause in the sentence was treated as a unit, and each unit was processed by the emotional rule method. Taking each small clause in the sentence as a unit, the emotion tendency calculation is performed for each unit by the emotional rule method, and the score values of all units are superimposed to obtain the emotional tendency of the entire review text. Zhang Jing et al.^[8] constructed a support vector machine classifier to analyze the sentiment tendency of comments by selecting multiple features. Shi Wei et al.^[9] segmented comments, marked product features, emotional polarity, and intensity based on fuzzy emotional ontology, and completed the sentiment calculation from the dimension of the word to the dimension of the entire document in turn, improving the semantic processing ability of sentiment analysis.

The third is the research on the identification and usefulness of false reviews, that is, to study the characteristics of fake reviews and the quality of reviews, and to identify non-worthy and meaningless reviews: Guo Shunli^[10] proposed an index to measure the usefulness of comments. He weighted and quantified the eight selected indexes through fuzzy analytic hierarchy process, calculated the usefulness and ranked them by weighted grey correlation analysis, and constructed a Review usefulness ranking model. Liu Junqing^[11] used in-depth interview method and inductive summary method to study the characteristics, influence and identification of false comments.

2.2 Research on the dynamics of reviews

Godes D, Silva JC^[12] calculated the Amazon website review scores. By studying the ratings in the time dimension, it was found that the review scores showed a downward trend, explaining that people's ability to

analyze previous reviews weakened over time. When previous reviewers vary widely, more reviews may lead to more lower ratings. Shao Jingbo et al.^[11] found that the sentiment polarity, sentiment intensity, and subjectivity of the comment content have certain dynamic changes. It was found that the comment content tended to be objective and complex, while the sentiment polarity and sentiment intensity of the comment had a significant negative correlation with time. He thinks that this regulation is related to the ability level of consumers. Wenjing Duan^[13] analyzed the positive feedback mechanism of sales volume and word of mouth. He characterizes this process through a dynamic simultaneous equations system in which the influence of online word of mouth is used as a factor for retail sales, and sales are used as dependent variables. Zhou Shuling^[14] based on the review valence, by studying the initial reviews and additional reviews given by the same reviewer, attitude changes will occur, and this easily overlooked change will have an impact on consumers' perceived usefulness and purchase intention. To conduct more detailed and more research on the dynamics of reviews in the field of online reviews. The study takes consumers' perceived usefulness as an intermediary variable and self-efficacy as a moderating variable, and analyzes the initial comments and additional comments of Taobao sneakers. The two types of dynamic changes have a difference on consumers' purchase intention. Combining with the product cycle, Hu Wei^[15] analyzed the logistics strategies that should be adopted at each stage, and pointed out the differences in the influencing factors of logistics strategies at the stages of each product life cycle. Pan Chengyun^[16] pointed out the deficiency of the traditional product life cycle theory and proposed to classify the product life cycle according to the product category. Based on this, it analyzed how to develop marketing strategies for different types of life cycle.

2.3 Application of online review data

For the usefulness analysis of online reviews, Guo Shunli^[10] also built a usefulness model for O2O online reviews based on fuzzy analytic hierarchy process. Text mining techniques in online review research include Hidden Markov Mod-el (HMM) model^[17], Support Vector Machine (SVM) model^[18], and Condition Random Fields (Condition Random Fields, CRFs) model^[19] and other typical machine learning algorithms for text feature extraction. As an effective information for scholars to analyze, online reviews provide help and support for countless researches.

By using various natural language analysis methods, user review data is used for product analysis, user analysis and marketing strategy analysis, recommendation systems, etc. Judith A. Chevalier and Dina Mayzlin^[20] studied the impact of user reviews on Amazon.com and Bonnard NoBuff.com on book sales. It is found that the number and quality of user reviews have a significant impact on book sales. The more reviews and the higher the quality, the higher the book sales. Liu Jiaxue et al.^[21] proposed a method for measuring consumer satisfaction based on consumer reviews, using automated text analysis software to extract review dimensions. The values of the dimensions are weighted to obtain the main factors affecting consumer satisfaction. Liping et al.^[22] also conducted research on consumer satisfaction based on review data, and conducted sentiment analysis on reviews to obtain evaluation attributes and their emotional intensity weights. Then VIKOR multi-attribute decision-making method was used to measure customer satisfaction. Fan Weihao et al.^[23] measured the urgency of the user's pain points from the aspects of attention and emotion in the comments, quantified the user's pain points through sentiment analysis, gave the user pain point calculation formula, and derived the user pain point model. Tu Haili^[24] etc. used KANO model and LDA model to analyze reviews, researched the degree of satisfaction of product attribute requirements, built a product demand model based on reviews. Wang Yubin^[25] etc. used the LDA model to analyze the distribution of user review topics, and performed user similarity analysis from multiple dimensions such as user rating similarity, preference similarity, and trust similarity to implement a recommendation algorithm. Wang et al.^[26] improved the traditional filtering algorithm and added the sentiment polarity similarity to the traditional filtering algorithm. Zhang Duo^[27] first analyzed the reviews syntactically, then judged and clustered them, and

finally used the multi-attribute decision-making method to rank the products, recommending products with high similarity. Based on the time dimension, research on the time series of online reviews of experience products with different text lengths, with the purpose of grasping regular information such as online review behavior habits and demand preferences of e-commerce platform consumers, Wang Jun ^[28] and other researchers use python crawler language Tool to grab online reviews from movie review sites. First, the information in the review database is extracted, divided by the content of the review, the review time, the user rating, and the user level, and then the number of characters is counted and the type is divided (long text / short text). According to different types of comment data, perform time feature analysis to construct time interval sequences, and text content analysis, and explore comment feature segments and keyword word frequency statistics.

2.4 Summary of related research

Scholars have conducted extensive research on text analysis, online reviews, and product life cycles, and have proposed many data mining methods based on reviews. They have deeply studied product information, user information, and emotional information contained in reviews. There have also been some useful explorations in big data and marketing, focusing on the use of data analysis for precision marketing. However, the existing research still has the following deficiencies. First, it only analyzes reviews from a static perspective, and few studies focus on the dynamic changes of reviews. Although Shao Jingbo and others ^[1] paid attention to the dynamic characteristics of reviews, they only studied from three dimensions: emotional polarity, emotional intensity, and subjectivity, and did not reflect the changes in consumers' concerns. Second, it is not enough to show the dynamic change characteristics in the product life cycle, and the data support for describing the dynamic change process of certain indicators in the product life cycle is not enough. the study.

3. RESEARCH MODEL AND HYPOTHESIS

3.1 The degree of consumer attention

The statistics of certain words in the comments can be used to measure the consumer's attention to a certain extent. In general, if consumers have a lot of words related to a certain aspect of the comments in a certain period of time, that is, the focus point of the focus point related words occur with the high frequency. It can be judged that consumers in this period are particularly concerned about this aspect; otherwise they are not particularly concerned. Based on this, the formula for calculating consumer attention can be obtained:

$$\text{The of consumer attentio} \text{degree n F} = \frac{\sum_1^n p k_i}{p t} \times 100\% \quad 3.1$$

(Where n is the number of words related to a certain point of interest, which means the number of comments containing words related to the i-th point of interest in a period of time, and pt is the total number of comments in the same period.)

3.2 Dynamic changes in the degree of consumer attention

According to the related research on the product life cycle by this scholar and other related scholars ^[29], it can be inferred that the degree of consumer attention on certain concerns may show certain characteristics of change as the product life cycle progresses.

3.3 Hypothesis presentation

This paper divides the aspects of consumer attention into six aspects includes product attention, logistics attention, price attention, promotion activities, service attention and brand attention:

(1)At the initial stage of product introduction into the market, consumers are completely unaware of the product. In addition, the product itself has limitations which will prompt consumers to be more cautious in their purchase decisions and pay more attention to product information. However, during the product growth stage, the market scale has expanded, in order to facilitate consumers to distinguish the same type of products, brand

awareness has gradually emerged. At the mature stage, market demand tends to be saturated, intensifying market competition, and the market transitions from a seller's market to a buyer's market. At the same time, the quality competition of this product will also change into brand competition. Consumers who have a thorough understanding of the product will pay more attention to the brand image that represents the characteristics of the product to a certain extent and rely more on the brand's personal preferences to make purchasing decisions.

Accordingly, the following hypothesizes are proposed:

H1: The degree of consumers' attention to the product is negatively related to the time of comment

H3: The degree of consumers' attention to brands is positively correlated with review time

(2) More and more companies choose to rely on third-party logistics or self-built logistics systems in their e-commerce business. The general improvement in the efficiency of logistics services and the general decline in time costs have made consumers generally trust the speed of product logistics. Products that rely on universal third-party logistics services will gradually lose their differences in logistics factors. Therefore, the continuous improvement of the logistics network has caused the market to pay less attention to product logistics factors.

Accordingly, the following hypothesis is proposed:

H2 Consumers' attention to logistics has a negative correlation with the time of comment posting

(3) Though price and promotion also promote consumers to make purchases behavior within the time pass, the following hypothesizes are proposed:

H4 Consumers' attention to price is positively related to the time of comment

H5 Consumers' Attention to Promotions Is Negatively Relevant to the Time of Comment Posting

(4) The growth of the service industry has deepened consumer attention to merchant services. Merchant services as a by-product of products are also closely linked to consumers' overall experience. With the passage of time, consumers who have sufficient knowledge of the product have shifted their attention to the service level that distinguishes similar products. The quality of the service provided by the product has become the key to competition. Excellent service improves the consumer's shopping experience, while also promote its brand loyalty.

Based on this, this study makes the following assumptions:

H6 Consumers' attention to merchant services is positively related to the time of comment posting

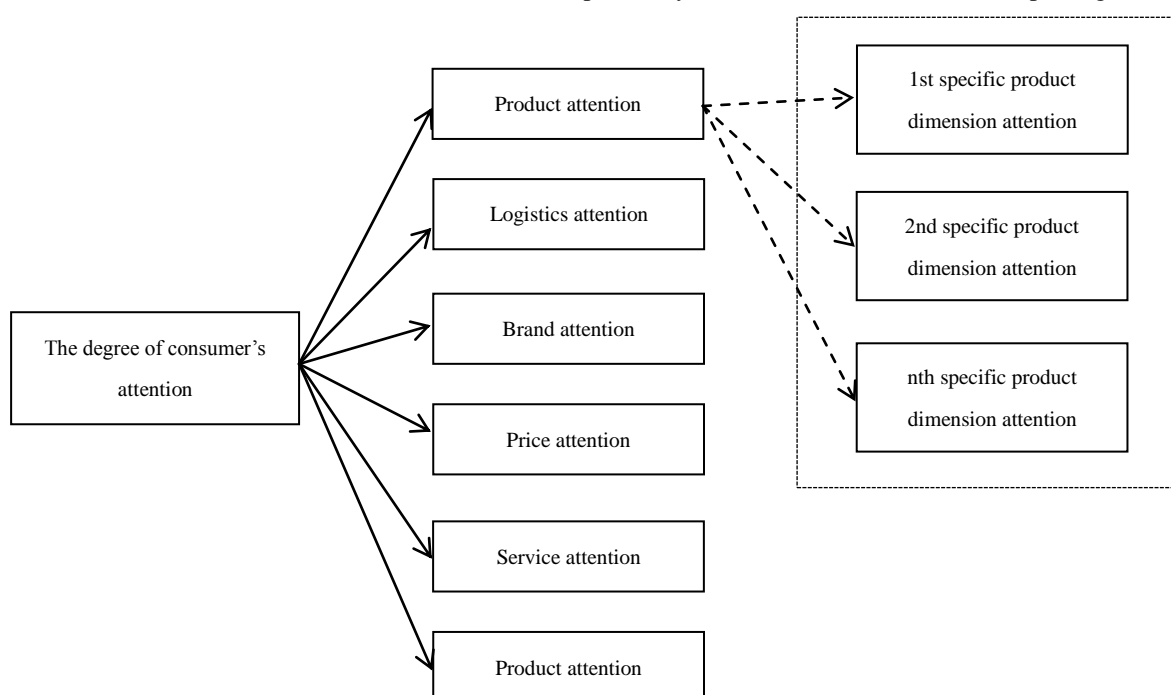


Figure. Research model

4. DATA COLLECTION AND ANALYSIS

4.1 Data collection

This essay uses the web crawler to selectively crawls pages related to a predefined topic. By visiting several mobile phone brand online malls to be researched, we got 23754 comments were collected for Huawei P10, 17350 comments for Huawei Enjoy 7plus, 17340 comments for vivox9, 12386 comments for vivox9s, and 70380 data in total, generating four xlsx format files. The collected data period can basically be considered to cover the entire life cycle of the product.

4.2 Taxonomy construction

4.2.1 Keyword extraction in comments

The python file system open method and the csv file processing class library csv are used to read the four collected data sets. Read the comment content line by line from the csv file, first use snownlp to segment the comment, then traverse the clause, use snlp to segment each clause. Finally, the dictionary traversal is written to a csv file and a word cloud is generated using the word_ cloud library. After the above processing, 21,825 unique words were obtained from the four data sets, and a noun word cloud was generated.

4.2.2 Focus point extraction and focus point related word thesaurus construction

Sort the extracted words according to their frequency of occurrence, and select all words that appear more frequently and may be meaningful to the analysis. There are 13 points of focus this time, namely appearance, price, promotion, logistics, brand, screen, running speed, memory, sound effects, camera, battery, games, and services. Among them, appearance, screen, running speed, memory, sound effects, photos, batteries, and games are the concerns that describe the attributes of the product itself. Consumers' concerns can be divided into six aspects: products, services, prices, promotions, brands and logistics.

4.3 Consumer attention calculation analysis

4.3.1 Frequency of focus points

Process the four review data sets separately, read the review data set line by line, use the snownlp clause to segment each clause, find the word in the thesaurus where the focus is concerned, and find all the thesaurus if it is not found. Record the number of focus point in the comments statistics.

4.3.2 Summary of attention frequency and calculation of attention

The specific method is to divide the life cycle of the four mobile phones into 25 phases, summarize the data of the first phase of the four mobile phones as the first data, and summarize the data of the second phase of the four mobile phones as the second data. By analogy, the statistical results are written to a csv file. Finally, the statistical results of word frequency summary of four data sets are obtained.

4.3.3 Stepwise regression analysis

This study uses stepwise regression to find several points of interest that have the most stable changes in attention over time. Based on the positive and negative coefficients, we can determine whether the degree of interest in the point of interest is rising or falling.

Table 4.2. Definition of variables

variable name	Variable identification
Natural logarithm of the cycle number	Int
Screen attention	X1
Running speed attention	X2
Internal storage attention	X3
Sound effect attention	X4
Photograph attention	X5

variable name	Variable identification
Battery attention	X6
Game attention	X7
Appearance attention	X8
Price attention	X9
Promotion attention	X10
Logistic attention	X11
Brand attention	X12
Service attention	X13
Product attention	X14

The regression results are shown in Tables 4.4 and 4.5. Table 4.4 reflects the degree of fitting of each regression model. The deterministic coefficient R^2 is a statistic that measures the goodness of fit of the regression model. The closer the value is to 1, the better the model's fitting effect.

The regularity of the attention of consumers at different points of concern over time can be described by (4.1):

$$\ln t = -0.092X_{14} - 0.146X_{11} + 0.073X_{12} + 6.448 \quad (4.1)$$

Consumers pay attention to the product in many ways. The resulting regression equation is shown in (4.2):

$$\ln t = -0.126X_8 - 0.371X_3 - 0.150X_5 + 0.224X_6 + 3.834 \quad (4.2)$$

Table 4.3. Summary of stepwise regression results

Model	R	R	R^2	Deviation. Error
1	.864a	.746	.735	.429471376676
2	.918b	.843	.829	.345473499171
3	.930c	.865	.846	.327895410177

Note: a. Predictors: (constant), product attention X14; b. Predictors: (constant), product attention X14, logistics concern X11; c. Predictors: (constant), product concern X14, logistics Attention X11, Brand Attention X12

Table 4.4. Variables that ultimately enter the model

Model	Non-standardized coefficient		Standardized coefficient	t	Sig. Value
	B	Error	β		
1	(Constant)	5.569	.404	--	13.769 .000
	Product attention X14	-.094	.011	-.864	-8.220 .000
2	(Constant)	7.612	.643	--	11.831 .000
	Product attention X14	-.092	.009	-.853	-10.084 .000
	Logistic attention X11	-.155	.042	-.311	-3.680 .001
3	(Constant)	6.448	.876	--	7.357 .000
	Product attention X14	-.092	.009	-.850	-10.591 .000
	Logistic attention X11	-.146	.040	-.293	-3.627 .002
	Brand attention X12	.073	.039	.150	1.850 .078

4.4 Result analysis

(1) Analysis of the first regression results

Through the first regression, it was found that the product attention coefficient is -0.092, and the Sig. Value is 0.000, which is less than the significance level of 0.1. Assuming H1 is established, that is, consumers' attention to the product information (X14), logistics (X11), and brand Degree (X12) shows a steady downward trend with the time of product launch.

It shows that consumers in the early stages of product listing pay more attention to some characteristics of the product itself, while the latter pay less. This may be related to the cyclical changes in consumer maturity. Consumer maturity is a dynamic evolution process. As the product life cycle advances and consumer experience and knowledge increase, the consumer's level of cognition of the product tends to mature^[25]. As consumers become more aware of the product, their attention to the product itself has declined.

Table4.5. Summary of stepwise regression results

Model	R	R ²	Adjusted R ²	Deviation. Error
1	.895a	.800	.792	.380914757840
2	.909b	.827	.811	.362413178809
3	.922c	.850	.828	.345853536468
4	.939d	.881	.857	.314968283357

Table4.6. Variables that eventually enter the model

Model		Non-standardized coefficient		Standardized coefficient	t	Sig. Value
		B	S.E.	Beta		
1	(constant)	4.659	.255	--	18.250	.000
	Appearance attention X8	-.225	.023	-.895	-9.598	.000
2	(constant)	4.949	.289	--	17.104	.000
	Appearance attention X8	-.215	.023	-.854	-9.360	.000
	Internal storage attention X3	-.433	.234	-.169	-1.846	.078
3	(constant)	4.830	.284	--	16.995	.000
	Appearance attention X8	-.162	.037	-.646	-4.422	.000
	Internal storage Attention X3	-.411	.224	-.160	-1.834	.081
	Photography attention X5	-.107	.060	-.259	-1.777	.090
4	(constant)	3.834	.503	--	7.615	.000
	Appearance attention X8	-.126	.037	-.500	-3.394	.003
	Internal storage attention X3	-.371	.205	-.145	-1.813	.085
	Photography attention X5	-.150	.058	-.362	-2.588	.018
	Battery attention X6	.224	.097	.199	2.307	.032

The coefficient of logistics attention is -0.146, and the value of Sig. Is 0.002, which is less than 0.1. Assuming H2 is established, it indicates that logistics attention has a significant negative correlation with time, that is, consumers' attention to logistics will decrease with time. In the early stages of product introduction, consumers have high levels of desire for higher logistics speeds, and vice versa in later stages.

The coefficient of brand attention is 0.073, and the value of Sig. Is 0.078, which is less than 0.1. Assuming that H3 is established, it indicates that brand attention is positively correlated with time, that is, consumers are paying more and more attention to brand comparison. Brand attention here mainly refers to the situation where consumers compare multiple brands in reviews. The results show that consumers have fewer choices in the early

stages of product launch, high loyalty to a certain brand, fierce competition among brands in the later stages, and consumers tend to compare multiple brands.

The variables X9 (price attention), X10 (promotional attention), and X13 (service attention) are not included in the model. It is assumed that H4, H5, and H6 do not hold, that is, consumers' attention to these concerns has a certain randomness. Possibly due to the difference in price sensitivity between consumers who buy at different times; the time of the merchant's promotional activities may not show regularity; consumers see services as additional attributes of the product.

(2) Analysis of the results of the second regression

The coefficients of appearance attention, memory attention, and photo attention are all less than 0, and the Sig. Values are all less than 0.1. The results are significant, indicating that the attention of these three attention points has a significant negative correlation with time, indicating that consumers are looking at mobile phones. Attention to features such as memory, memory, and photography has declined over time. The battery attention coefficient is positive, and the Sig. Value is 0.032, which is less than 0.1. It shows that battery attention has a significant positive correlation with time. The above proves that consumers' attention to products is generally on the decline, but their attention to different product dimensions is different. The attention on some product dimensions is decreasing, and the attention on some product dimensions is increasing. Attention to other dimensions shows some randomness.

5. CONCLUSIONS AND RECOMMENDATIONS

The research results show that the consumer's focus on some concerns or attention reflected in e-commerce website reviews has obvious dynamic changes, and some do not. This conclusion provides new ideas for researching the product life cycle, online reviews, and e-commerce, and will also provide a useful reference for the organization of production and marketing strategies. This paper takes the research of mobile phone reviews as an example to find that consumers' attention to logistics and products itself is declining, and brand attention is on the rise. Based on this, the companies can cooperate with more efficient logistics partner in early sales and choose a cheaper and less efficient logistics partner in the later period. The research finds that although consumers' attention to the product itself is on the decline, there is still a difference in attention in different product dimensions. For example, this research finds that consumers' attention to mobile phones' appearance, memory, and photography is declining, but attention to batteries is increasing. Therefore, enterprises should focus on analyzing the changes in consumers' attention to different dimensions of the product in order to formulate marketing strategies based on the characteristics of changes in consumers' attention to different dimensions of the product.

Of course, there are still some limitations in this research: The first is that this essay only uses mobile phones as an example, whether other products have this rule needs further research. The second is that the classification of keywords has a certain subjectivity when constructing the thesaurus of attention. In subsequent studies, different products can be researched to check whether this rule is universal; the correctness of the constructed thesaurus can also be tested through investigation methods to reduce subjective impact.

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The Long-term and Short-term Effects of Product Competition on Supply Abundance in an E-commerce Platform

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Abstract: Previous research suggested that both demand stimulation and extrusion effects appeared at an e-commerce platform due to the intense competition for sellers. On the one hand, market competition implies more market opportunities. On the other hand, it also attracts more customers (such as through low price and promoting) and creates network effect obviously on the demand side, which stimulates more products to enter the platform. The seemingly contradictory views were rarely observed and examined from time series analysis in previous studies. In this paper, both the long-term and short-term effects of product competition on the abundance of product supply were tested by using 140,000 outbound tour packaged products from Ctrip.com. FGLS was used to test the econometric model. The result shows that product competition will have a positive stimulating effect on the abundance of product supply in a short-term time window (about one month), but then there is a mixed effect of positive stimulus and negative extrusion, and finally, the effect gradually disappears. This paper provides an important policy implication for the e-commerce platforms to improve governance of product competition and effectively manage complementors and product categories.

Keywords: e-commerce platform, network effect, product competition, supply abundance, long-term and short-term effect

1. Research Questions

E-commerce platforms play an important role in promoting economic growth with the rapid development of Internet technology. A large number of business practices show that the high transaction volume attribute to the abundance of products on e-commerce platforms^[1]. The abundance of product supply (i.e., supply abundance) refers to the network scale of tradable products. Product abundance depends on the supply of complementors, and complementors also face intense competition while providing products. However, inconsistent results have been found on the effect of product competition on supply abundance on e-commerce platforms in previous research. Some studies confirmed the positive effect of product competition on supply abundance^[2], while others hold the opposite view^[3].

Despite these conflicting arguments about the consequences of product competition on supply abundance, there have been scant empirical studies due to the limitations of data. Our research question is as follows, *what is the relationship between product competition and supply abundance in an e-commerce platform?*

2. Research Model and Results

The intense competition implies that the products in this market are favored by consumers, which will stimulate complementors to provide more similar products. However, complementors may adopt the competitive strategy of low-price to gain advantages, reducing their survival rate. Therefore, based on the previous studies on Porter's competition theory and competition neglect, and combined with our research questions, two hypotheses were proposed: H1: in the short term, product competition has a positive effect on supply abundance on an e-commerce platform. H2: in the long term, product competition has a negative effect on supply abundance on an e-commerce platform.

We tested hypotheses by using a half-monthly longitudinal dataset of outbound tour packaged products on Ctrip.com, the largest tourism e-commerce platform in China, from March 1, 2017 to April 1, 2018 (27 periods).

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We use this dataset to calculate variables. The product competition can be quantified by the Herfindahl-Hirschman index(HHI), and the number of tradable tourism products in the market is used to measure the supply abundance. We also include three control variables: the quality of tourism products, location of departure city and seasonality. In addition, we developed an econometric model based on descriptive statistics and correlation analysis of all variables to test hypotheses. The short-term and long-term effects of the product competition on supply abundance are captured by different period lags of the dependent variable in the econometric model. Hence, our econometric model is:

$$\ln(Abundance_{i,t+n}) = \beta_0 + \beta_1 \ln(Competition_{i,t}) + \beta_2 (\ln Competition_{i,t})^2 + \beta_3 \ln Quality_{i,t} + \beta_4 City_{i,t} + \beta_5 Spri_{i,t} + \beta_6 Summ_{i,t} + \beta_7 Autu_{i,t} + v_i + \varepsilon_{i,t} \quad (n = 1, 2, \dots, n, \max(n) = 26)$$

FGLS is used to test the econometric model. Moreover, we verify the robustness of our results by using the ordinary least square with panel correction standard error (OLS-PCSE) to test the econometric model^[4]. The empirical results show that product quality, location of departure city and seasonality all shaped the supply abundance. Our results further show that product competition has a positive stimulating effect on the supply abundance in a short-term time window (about one month). Moreover, in a long-term time window (about a month later), product competition exhibits a mixed effect of positive stimulus and negative extrusion, and finally, the effect gradually disappears. In other words, in the long term, product competition on e-commerce platforms tends to have no effect on the supply abundance, rather than a negative effect.

3. Research Contributions

The main theoretical contributions are as follows: First, we quantify network effects with supply abundance to capture the evolution of network effects. Previous literature on the quantification of network effects has typically been focused on the installed base and the performance, and less research attention has been paid to the supply abundance. However, the importance of supply abundance is confirmed. Second, the relationship between product competition and supply abundance was decomposed based on the time effect in our research, which provides a new perspective to explain the seemingly contradictory results in previous studies.

Beyond the theoretical contributions, we also see a variety of implications for platform management. First, in the early stage of the platform, it is an effective way for platform management to strengthen the positive network effect by stimulating more complementors to enter the platform. Second, when the product competition starts to have a negative effect, platform management should shift their attention from expanding the installed base to platform governance. Third, in the long term, platform management should consider establishing a platform incentive mechanism to encourage the complementors to innovate continuously.

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Trade-off Between Two Advertising Strategies: Coverage or Penetration

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Abstract: Advertising has always been an important way for companies to promote their products and carry out product publicity. With the advent of the information age and the convenience of the Internet, the spread and dissemination of advertising are becoming widespread. There are two different basic advertising strategies, namely expanding market coverage and increasing market penetration. Expanding market coverage is a common advertising strategy for company managers. Through this strategy, they focus on the size of the market. Increasing market penetration is another way to increase demand. Company managers focus on the current market, but gain and maintain greater penetration by improving the quality of products or services. The first (coverage) strategy can be seen as distributing flyers, advertising boards and mass acquisitions. The efforts of the second (penetration) strategy can be seen as improving product quality, service environment and positive reputation. Which one is more effective, coverage or penetration? Under what conditions is it better for the company manager? These problems have not been found in the literature. By establishing a two-stage model, this article discusses the optimal advertising levels of these two strategies. Specifically, this article compares the optimal profits of the two strategies in various market environments and finds more effective advertising strategies. Management insights are generated for decision-making of firm managers.

Keywords: advertising; market coverage; market penetration.

1. Research Questions

Advertising can directly or indirectly increase the visibility and influence of corporate products in various ways, thereby increasing the market's expected profit. Fundamentally speaking, market profit comes from the total size of the market multiplied by the market share. Basically, there are two kinds of advertising strategies. One is focusing on enlarging total market size. We call it market coverage strategy. Handing out leaflets for one restaurant is a common example. Other examples can be easily found in TV and Internet advertising. The other one is to improve penetration level within the current market area by positive word-of-mouth, high product quality, and good services. Rather than handing out leaflets, restaurant managers can also improve food quality, service attitude and eating environment. That can be treated as a strategy to earn customers' hearts and then use the positive effect of word-of-mouth (increasing penetration level in a certain market).

As the increasingly fierce market competition, it is difficult for firms to obtain and maintain long-term competitive advantage. How to choose the two advertising strategies, coverage or penetration, is an important but overlooked question in the literature. This paper investigates the market coverage and penetration strategies in the setting of a two-stage model. After a comparison of the two strategies, this paper provides a choice between coverage and penetration in various market settings.

2. The Theoretical Contributions and Results

Most of the previous literature study the penetration strategy of advertising and coverage advertising strategy separately^[1-3]. Few literatures combine the two strategies comparative analysis. We explore the optimal advertising levels for the two strategies, respectively. After that, we compares the optimal profits under the two strategies in various market settings and finds the more efficient advertising strategy by establishing two-stage

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models.

2.1 The impact of the initial market on optimal profits

In both the first and second phases, the price and cost levels are under moderate conditions, and the profits generated by both coverage and penetration advertising increase as the initial market increases. When the initial market is small, the optimal profit of the coverage advertising strategy is higher than the penetration advertising strategy. At this time, the enterprise should choose to make efforts in the direction of advertising coverage. When the initial market becomes larger, the optimal profit of the penetration advertising strategy exceeds the coverage advertising strategy. At this time, the enterprise should choose to make efforts in the direction of market penetration.

When the product price and cost increase, we can intuitively see that the optimal profit size is consistent with the initial market change trend. The difference is that the intersection of the two advertising strategies shifts to the right, and the optimal profit value also decreases. This shows that when the product price is close to the people and the initial market increases to a certain extent, the enterprise should switch from the coverage advertising strategy to the permeable advertising strategy; when the product price is higher, the enterprise's focus should be on improving the market coverage rate, and the initial In a large market, it is wise for companies to choose permeable advertising.

2.2 The impact of the initial word of mouth on optimal profits

Whether it is an overlay advertising strategy or a permeable advertising strategy, with the increase of initial word-of-mouth, its optimal profit has increased. In the case of a complete market (the initial market value is 1), when the initial reputation is small, the optimal profit of the permeable advertising strategy is higher than the coverage advertising strategy. At this time, the enterprise should adopt the permeable advertising strategy. When the initial word of mouth exceeds a certain threshold, the optimal profit of the coverage advertising strategy is higher than the penetration advertising strategy, then the enterprise should adopt the coverage advertising strategy.

When the size of the initial market is reduced by half, compared with the complete market, the trend of the size of the optimal profit with the initial word of mouth is consistent with the previous example. But what is interesting is that at this time, as the initial word of mouth becomes smaller, the intersection of the two advertising strategies moves to the left. This shows that when the market size is large, the market coverage conditions are relatively complete at this time, and enterprises should make efforts in the direction of advertising penetration, improve word-of-mouth, and grab more market share. When the market size is small, after reaching a certain initial word-of-mouth, the optimal profit of an enterprise depends on the coverage advertising strategy. At this time, the focus is on expanding the market and finding more customers.

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Exploring the Growing Fluidity of Organizational Boundaries with a Value-Creating Perspective

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Abstract: In the era of sharing economy, to get great economic and business value from cloud services, including cost avoidance, cost savings, rapid deployment, scalability, management simplicity, better security and resiliency, the organization transformational flexibility is becoming the core business strategies. As an organization responds to the emergence of digitalization, this study presents four sharing economy models by comparing the sharing economy platforms, then examined a few notable papers that have helped set the stage for current conceptualization, especially concerning the impact of innovative sharing technologies on the organizational boundaries and business value chain system. Finally, the results reconstructed traditional value chains with three stages, including redeploying slack resources, inter collaboration, and value-creating acquisitions. And the finding is that structures digitalization processes through the lens of organizational with cloud service and edge computing. The objective of this article is to advance our understanding of the impact of innovative sharing technologies on the organizational boundaries and business value chain system.

Keywords: sharing economy, organization flexibility, cloud, enterprise architecture

1. INTRODUCTION

The sharing economy and digitization are attracting extensive attention worldwide. In this regard, understanding the sharing economy in these terms enables businesses to identify, and respond to, the threats and opportunities provided by sharing economy platforms, which is of great research significance. With online sharing platforms connecting and facilitating transactions between owners of underused assets and users who pay to use those assets for a limited duration, it poses a threat to traditional value chains, delivers a range of benefits as well, such as driving benefits in service delivery, IT efficiency and effectiveness, and overall value to the organization. Developments like crowdsourcing, open innovation, and open-source software, and social media and big data as well, are predicated on the fluidity of organizational boundaries. In other words, “boundary fluidity” is the coming trend, which describes the loosening of formerly strict distinctions in all organizational fields, contexts, and domains, including boundaries between producer and consumer, insourcing and outsourcing, or product and service.^[1]

The paper gave the four sharing economy models with good examples and a literature review on the organizational and market mechanisms, then clarified the research question that how sharing technologies affect the organizational boundaries and business value chain system, finally, the fluidity of organizational boundaries as the coming trend was explored further in response to the innovative sharing economy.

2. METHODOLOGY

2.1 Mapping sharing economy platforms

Table 1 presents four sharing economy models combining on two key dimensions^[1]. One is the high or low rivalry between participants. High means pricing scheme based on real-time changes in supply and demand; low stands for pricing scheme based on the compensation of the suppliers' costs. The other is loose or tight control over participants. Loose denotes that minimum standards or guiding principles for platform participation are set

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by the platform owner; tight refers that platform participation is specified, standardized and monitored by the platform owner. Each model focuses on a different value proposition and strategic intent.

Table 1. Four sharing economy models combining organizational and market mechanisms

Rivalry between participants	High		Chaperones	Franchisers
		Value proposition	Service differentiation	Low costs and efficiency gains
		Example	Airbnb, HomeAway, Rentomo, Apprentus	Uber, Lyft, Postmates, Caviar
	Low		Gardeners	Principals
		Value proposition	Self-organization and community building	Low costs and risk mitigation
		Example	Couchsurfing, BeWelcome, BlaBlaCar, Peerby	Handy, Taskrabbit, Zeel, Deliveroo
			Loose	Tight
			Control over participants	

Notes: (1) Airbnb: <https://www.airbnb.cn/>; (2) HomeAway: <https://www.homeaway.com/>; (3) Apprentus: <https://www.apprentus.com/>; (4) Uber: <https://www.uber.com/>; (5) Lyft: <https://www.lyft.com/>; (6) Caviar: <https://caviar.global/>; (7) Couchsurfing: <https://www.couchsurfing.com/>; (8) BeWelcome: <https://www.bewelcome.org/>; (9) BlaBlaCar: <https://www.blablacar.com/>; (10) Peerby: <https://www.peerby.com/one>; (11) Handy: <https://www.handy.com/>; (12) Taskrabbit: <https://support.taskrabbit.com/hc/en-us>; (13) Zeel: <https://www.zeel.com/in-home-massage>; (14) Deliveroo: [deliveroo.co.uk](https://www.deliveroo.co.uk)

The above analysis is from the perspective of enterprises, how to obtain economic benefits by sharing social resources with IT. In the new crown epidemic, China implemented large-scale home isolation measures in the early stage and is getting back to work in an orderly way. To ensure the production and operation of basic living materials and key medical materials, fully exploit IT to develop the deep and extensive social cooperation and interconnection, such as health code application based on communication big data trip card. In essence, sharing economy is deep social production cooperation. For examples, (1)accurate and efficient epidemic monitoring and analysis, virus tracing, patient tracking, community management; (2)carry out the precise connection between the supply and demand of medical and epidemic prevention materials relying on the Internet platform; (3)in industrial production, collaborative R&D, unmanned production, remote operation and maintenance, online service, production collaboration and risk warning, and organizes flexible production transfer and capacity sharing in advance for key links that may be shut down or cut off.

2.2 Analyzing path and hypothesis testing

Enterprise Architecture (EA) helps an organization to develop and articulate a vision for its usage of IT to support its strategic business priorities and facilitates the journey to realize this vision. A literature-based framework of MIS Quarterly Executive within five years, let us first examine a few notable papers that have helped set the stage for our current conceptualization, especially concerning the impact of shared technologies (Table 2).

Table 2. Combine organizational and market mechanisms

Paper	Cases	IT	Organization	Benefits
[2]	Buckman	Value stream initiative (VSI)	Assessed by customers	IT efficiency and effectiveness
[3]	Zimride	Organization-sponsored sharing platforms	Prosumer	
[4]	Schlumberger	A collaborative open software architecture	Product-platform	Providing information solutions
[5]	Goget carshare	Product-service systems	Collaborative consumption system	Shared access to products and services
[6]	A U.S. local government	Inter-organizational system	Public-cross-agency	Shared service
[7]	XCMG	A four-phase process model	IT-enabled slack redeployment	To redeploy slack resources into productive use

Paper	Cases	IT	Organization	Benefits
[8]	Trelleborg AB	Assessing IT integration risk in acquisitions	Acquisitions	
[9]	PartnerCo		A cloud service partner	Acquire and deploy(adopt) cloud services(challenges, lessons)
[10]	SMEs		Cloud service	
[11]	Cisco, Wal-Mart and the Arkansas Department of Information Systems	A four-wave model	Bring-your-own-device (BYOD) policies	

3. Results: reconstruct the organization in response to the sharing economy

To keep up with a fast-moving business environment, organizations' platforms are changing from closed to open with more interoperability and "value" as the focal point. As Figure 1, firms need to devise strategic responses to the threats, which combine organizational and market mechanisms in innovative ways to do business and to gain competitive advantages over incumbents.

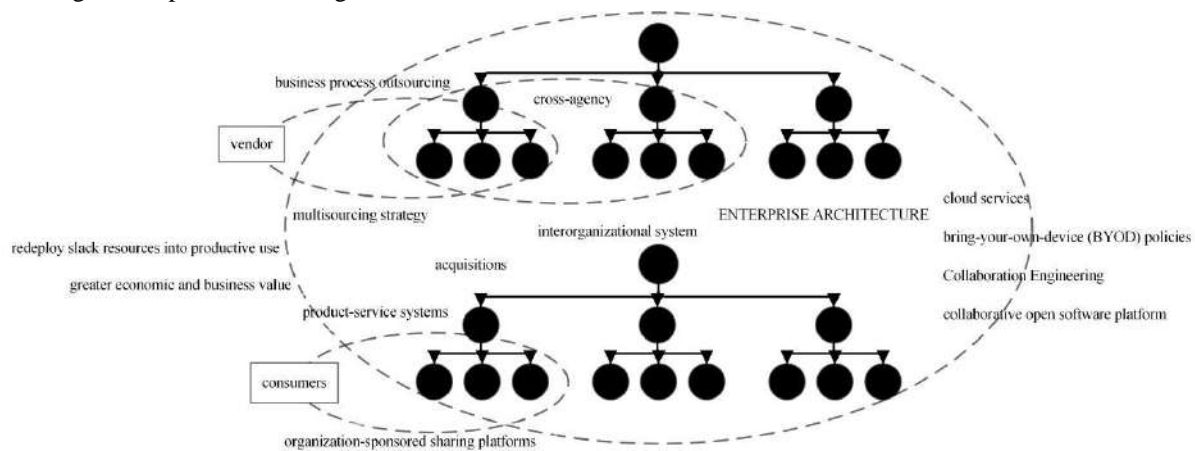


Figure 1. Exploit the growing fluidity of organizational boundaries with online sharing economy platforms

To getting great economic and business value-creating and achieve a competitive position as the leader, as eco-friendly strategies, group the digitalize organizations with an online sharing platform into the three stages as Section 3.1.

3.1 Stage of the fluidity of organizational boundaries

3.1.1 Stage I: to redeploy slack resources into productive and provide mobility services

To discover the business value derived from IT activities (customers' data) and make necessary changes, a four-phase process model of IT-enabled slack redeployment is derived and six recommendations based on the digital transformation completed by incumbent XCMG, the largest construction machinery manufacturer in China, are provided^[7]. AUDI AG(<https://www.audi.com/en.html>) has begun to experiment with providing mobility services, built around car sharing, rather than the less segmented services provided by competitors such as BMW and Zipcar(<https://www.zipcar.com/>)^[12]. Buckman's (<https://www.buckman.com/>), a U.S.-based chemical manufacturer, Value Stream Initiative used a micro-level, individual view of value as assessed by customers for analysis to redefine itself and its IT organization^[2].

3.1.2 Stage II: inter collaboration and shared service

Collaboration Engineering helps organizations achieve significant business improvement by releasing untapped potential through streamlining their collaborative work practices, which more productive and effective than traditional approaches^[13]. The approach enables organizations to design and deploy collaboration engineering processes using professional collaboration techniques and technology for recurring high-value collaborative tasks. For example, manage the complexities of inter-organizational system projects by the public-cross-agency case

from a U.S. local government, which successfully embraced the complexities of aligning the regulated processes of multiple independent departments as it developed a criminal justice court and case management system for a new shared service center to support them.^[6]

To sustain its competitive position as the leader in providing information solutions to the oil and gas industry, Schlumberger(<https://www.slb.com/>) transitioned to a collaborative open product-platform software architecture by embedding a geological modeling software product-Petrel-within Ocean^[4]. Another example, GoGet CarShare(<https://www.goget.com.au/>), an Australian car-sharing service, incorporates shared access to products and services via Product-service systems (PSSs), a type of collaborative consumption system that combines products with (often digital) services^[5]. Furthermore, the Zimride ridesharing platform (<https://www.zimride.com/>) build prosumer engagement in which organization-sponsored sharing platforms^[3]. A new class of IT that facilitates collaborative consumption within a private social network restricted to organizational members. They leverage and integrate employees' roles as consumers and providers ("prosumers") in working environments and therefore offer a new way to build employee engagement. Coworkers and students connect through a private network to carpool to the same destination, relieving parking and traffic congestion, reducing the carbon footprint and improving sustainability - not to mention sharing the savings on gas.

3.1.3 Stage III: value-creating acquisitions

To rapidly capture value from acquisitions and to sustain its acquisition-based growth strategy over time, by the case of Cisco Systems an advanced EA capability can assist in the four phases of the acquisition process: pre-acquisition preparation, acquisition selection, acquisition integration, and post-integration management.^[14]

With the experience of Trelleborg AB (<https://www.trelleborg.com/en>), a serial acquirer, IT integration risk in acquisitions assesses, high-risk acquisitions management and low-risk acquisitions identify^[8].

3.2 Cloud service and edge computing

As early as SMEs adopt cloud services^[10]. Based on the case of "PartnerCo" (<https://www.launchpartner.co/>), a multinational cloud service partner can play four roles in helping organizations to acquire and deploy cloud services^[9]. With edge computing, organizations are increasingly adopting bring-your-own-device (BYOD) policies. For example, cloud work and online education relied on various personal smart devices (smart phones, iPads) and home smart TVs, which greatly reduces the office cost of enterprise access (fixed capital investment in office space and office computers). Based on case studies of Cisco, Wal-Mart and the Arkansas Department of Information Systems, a four-wave model for the evolution of BYOD developed^[11].

4. CONCLUSIONS

This paper showed the great economic and business value derived from online sharing platforms, and the organization's transformational flexibility is becoming the core business strategy in the era of sharing economy. Understanding the sharing economy in these terms enables businesses to identify, and respond to, the threats and opportunities provided by sharing economy platforms. It is never too late to improve performance, transform its organizational structure, process, and architecture to balance autonomy for innovation and integration for competitiveness.

The literature on the influences of digitalization on organizations indicates that it implies a period of exploration of potential implications and opportunities for organizations, the so-called "fuzzy front-end of innovation", which can be chaotic, ill-defined, and difficult. While there are different strategies to manage the fuzzy front-end of digitalization it seems to require a high level of flexibility from an organization. This requires organizations to keep up with and integrate digital technologies into their organization while continuing to use current methods and knowledge, thus having to adapt their practices, skills, and roles to remain relevant and avoid potential redundancy of expertise and services. With 5G, the offline application scene will be further integrated

with the cloud, such as 5G+telemedicine, 5G+telecommuting, 5G+teleconference. 5G+VR panoramic virtual shopping guide cloud platform, users can instantly browse the cloud shelf and cloud window with their mobile phones at any time, realizing 360 degrees panoramic and 720 degrees dead angle free shopping experience. 5G+VR, AR and edge computing realize live broadcasting in venues such as cultural performances, sports events, scenic spots and outdoors, aggregate 5G high-definition film and television, cloud games and other content, and promote VR glasses and game handles.

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Influence of Platform Authentication on Payment Behavior on Online Knowledge Platforms

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Abstract: Paid knowledge products have rapidly risen in prevalence and popularity in recent years. Online knowledge platforms have adopted many governance measures to attract more users and protect their needs. We explore the influence of such governance measures on the payment behaviors of knowledge acquirers by constructing a research model based on signal theory. The results show that the characteristic signals of both knowledge products and knowledge providers are positively associated with the number of participants. Authentication marks from the platform do not directly influence knowledge acquirers. The platform authentication marks have a moderating effect by partly replacing the effect of the knowledge providers' characteristic signals. The results suggest that such authentication measures can help knowledge acquirers identifying high-quality knowledge products and enable them to participate more actively in buying knowledge. Our work has academic as well as practical implications for the operation and management of online knowledge platforms.

Keywords: paid knowledge products, signal theory, platform governance, empirical research, moderation effect

1. INTRODUCTION

With the increasing demand for fragmented learning from knowledge acquirers, acceptance of premium and paid content, and the maturity of payment technologies, paying for online knowledge is becoming a new way for users to acquire knowledge to learn. Although online knowledge platforms are establishing an important channel to exchange and share knowledge between the supply and demand sides of the knowledge economy, the quality of paid knowledge products is an issue that need to be addressed and self-corrected by these platforms through governance mechanisms. Based on the development status and problems of paid knowledge industry, scholars have clarified the importance of platform governance. Although researchers have studied the influential factors from paid knowledge products and providers^[1], they have not yet empirically verified whether and how to measure affect acquirers' participation behaviors from the perspective of platform governance.

As a new kind of online tradeable goods, paid knowledge face the problem of information asymmetry inevitably. Signal theory can explain how consumers rely on signals from sellers to form expectations about the quality of the seller's products or services^[2]. Examples of paid knowledge signals are review scores, experience of the knowledge provider, personal identity authentication, and excellent respondent authentication by the platform. When many signals of many products are sent, related signals are usually processed at the same time, which means a signal does not work alone or signals have an overall effect as a combination^[3]. As a typical type of third-party signal, authentication information can effectively reduce risk perception, establish consumer trust, and promote online consumption^[4]. However, the impacts of authentication marks on participants' trust and behaviors and the interactions of authentication marks with other signals have not received much research attention.

Based on the signal theory, we examine information from knowledge products, knowledge providers, and platform authentication marks as signals received by knowledge acquirers and construct a theoretical model. We also captured operation data of an online knowledge platform and analyzed the implementation effects of

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existing governance measures of this platform.

2. METHODOLOGY

Online word-of-mouth indicates users' recognition and reflects a comprehensive evaluation of some product's quality. A higher number of live broadcasts held by a knowledge provider corresponds to greater capability in creating knowledge products. The personal identity and excellent respondent authentication can show the knowledge provider's expertise and knowledge sharing ability. With all other things being equal, signals from products also with the platform's authentication marks can be considered more authentic than those without any authentication mark. In other words, in addition to directly affecting a knowledge acquirer's payment decision, the authentication mark can indirectly affect their payment decision by affecting their degree of trust in other signals. Accordingly, we put forward eight hypotheses of direct effect and moderation effect.

Regression analysis is used to study the impact of platform governance measures on user behavior. Our data were collected from Zhihu Live (URL: www.zhihu.com/lives), including 1,206 valid knowledge products. In order to examine how various signals are transmitted to potential participants in the online knowledge platform and how they affect their payment decisions and behaviors, we constructed the following research model:

$$\begin{aligned} ParticipantNumber_i = & \beta_0 + \beta_1 ReviewScore_i + \beta_2 HostingExperience_i + \beta_3 PersonalIdentity_i \\ & + \beta_4 ExcellentRespondent_i + \beta_5 RS_i \times PI_i + \beta_6 RS_i \times ER_i + \beta_7 HE_i \times PI_i \\ & + \beta_8 HE_i \times ER_i + \beta_9 ControlVariable_i + \varepsilon_i \end{aligned}$$

3. CONCLUSION

This study analyzes online knowledge platform governance through a regression model. We used signal theory and the real data of Zhihu Live, a live broadcast paid knowledge platform, to examine the direct influences and moderation effects of review score, hosting experience and the platform authentication marks signals. We found that the review score of knowledge products and the hosting experience of knowledge providers positively affect acquirers' payment behavior. The platform authentication marks have a negative moderate role on the hosting experience. In other words, knowledge acquirers judge that knowledge products have high quality through high review score and hosting experience, while platform authentication marks, as a kind of mental shortcut judgment, will make knowledge acquirers pay less attention to other quality signals. Our research shows the important role of governance measures in reducing information asymmetry and helping to judge how much of the knowledge sharing content can be referenced. The platform should continue to improve the evaluation mechanism of the authentication marks to make them more targeted and more meaningful.

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An Empirical Research on the Impact of E-commerce Enterprise Reputation on Online Consumer Behavior: A Case Study of B2C Websites

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Abstract: As a means of non-price competition, the reputation of enterprises is valued by e-commerce enterprises. From the perspective of consumers, this paper divides corporate reputation into five elements. Corporate reputation will affect consumer behavior. Based on the trust to the enterprise, consumers show satisfaction to the products and services of the enterprise and customer loyalty behavior. Therefore, the paper constructs a theoretical analysis model, and uses data analysis and data processing to verify the relationship between e-commerce enterprise reputation and consumer behavior, and then puts forward relevant suggestions.

Keywords: E-commerce Enterprise Reputation, Consumer perception, Customer satisfaction, Customer loyalty

1. INTRODUCTION

China's e-commerce enterprises have changed from brutal growth to high-quality development, and gradually changed from price as the main means of competition to non-price competition. Corporate reputation, as a kind of intangible asset that has a dependency relationship with the behavior subject but is relatively independent, is increasingly valued by e-commerce companies^[1]. A good corporate reputation helps to protect the interests of modern corporate stakeholders^[2].

Corporate reputation is defined as the perception of the buyer of goods or services on the popularity, trustworthiness, and evaluation ratio of the production and sales enterprise^[3]. From the perspective of the strategic layout of enterprises, the long-term competition between enterprises will gradually tilt to the side with a good corporate reputation^[4].

In this paper, corporate reputation is understood as the reputation and word of mouth accumulated by a company in its long-term development process. It is based on consumers' comprehensive evaluation of the corporate's business performance, innovation ability, and social responsibility. Based on the research of corporate reputation and the characteristics of e-commerce companies, this paper will explore the relationship between e-commerce corporate reputation and consumer behavior, and analyze the impact of e-commerce corporate reputation on consumer satisfaction and customer loyalty.

2. E-COMMERCE CORPORATE REPUTATION AND CONSUMER BEHAVIOR

2.1 The composition of e-commerce enterprise reputation

From the perspective of consumers, the most important thing is to establish trust with enterprises^[5]. Consumers' attitudes towards a business have a hierarchical effect, that is, consumers obtain information about the business through various channels, and then form a certain awareness of the business and generate a desire to buy. There is a certain emotion in the interaction of the enterprise.

Referring to Saunders and Ross's (2007) discussion on the importance of consumers to corporate reputation, this paper analyzes e-commerce corporate reputation from five aspects.

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- Consumers' perception of corporate social responsibility. Positive network information feedback, the importance that managers and employees attach to reputation management, social responsibility, and a complete reputation management system will all improve consumers' perception of corporate reputation. In fact, customers must first have a sense of the company's image, product or service quality, and then they will have the idea that this company is trustworthy.

- Consumer perceptions based on interactions. Media such as news, advertisements, and the Internet can help consumers obtain information about the companies they care about. These information are combined with the feelings formed during the interaction between consumers and companies, and is transformed into consumers' inner emotional activities, which then dominate their behavior.

- Consumer sentiment to enterprises. It is the attitude of consumers based on whether the services of enterprises meet their expectations and actual needs. Consumers will bring their feelings to the enterprise into every shopping process.

- Consumer privacy protection and online shopping security. The popularity of E-commerce makes online shopping popular. However, this process is accompanied by the disclosure of consumer information and the emergence of a variety of fraud. The risk of online shopping continues to rise, which will affect consumers' trust in the reputation of e-commerce enterprises. Therefore, e-commerce enterprises should take the protection of payment security and privacy as the core task.

- Products and services of enterprises. Products and services are the foundation of enterprise development. A good product and service will leave a pleasant impression on consumers, and enable consumers to realize the importance of enterprises to themselves, thus forming a good corporate reputation in their minds.

2.2 Consumers' response to the reputation of E-commerce enterprises

There is a positive relationship between corporate reputation and customer satisfaction^[6]. A good reputation will make consumers show a satisfactory attitude, can strengthen consumers' confidence in the quality of the company's products or services, and help consumers reasonably adjust their expectations, thereby increasing their willingness to buy and satisfaction. This paper defines customer satisfaction as the degree to which there is a discrepancy between the customer's expectations of the product or service and the post-consumption psychological perception evaluation after the customer makes consumption.

Consumer satisfaction is closely related to loyalty, that is, a consumer who is very satisfied with the company's products and services is far more loyal to the company than other consumers. Consumers' repeated purchase behavior is highly positively related to their preference for the product^[7]. Customer loyalty means that customers who have a preference for a certain company are willing to choose that company when purchasing a certain product or service^[8]. Therefore, when researching customer loyalty in e-commerce transactions, we should fully realize the important status of customer satisfaction, that is, customer satisfaction is the prerequisite for customers to generate higher brand loyalty^[9].

2.3 The relationship between e-commerce company reputation and consumers

Customers need to understand the corporate image and the quality of their products and services before they can decide whether they are satisfied. At the same time, customers can judge the quality of the company's products or the level of services provided based on multi-channel information without actual experience^[10]. Consumers' subjective cognition of enterprises will change with the changes of brand awareness, sales or service attitude, quality and other factors. The final results of these changes can be obtained through the observation of consumer satisfaction, and confirm whether the results are conducive to the direction of enterprise development or contrary to its development direction^[11].

In view of the composition of corporate reputation from the perspective of consumers and consumers' responses to corporate reputation, this paper builds an analytical model between corporate reputation and

consumer behavior, as shown in the figure below (Figure 1).

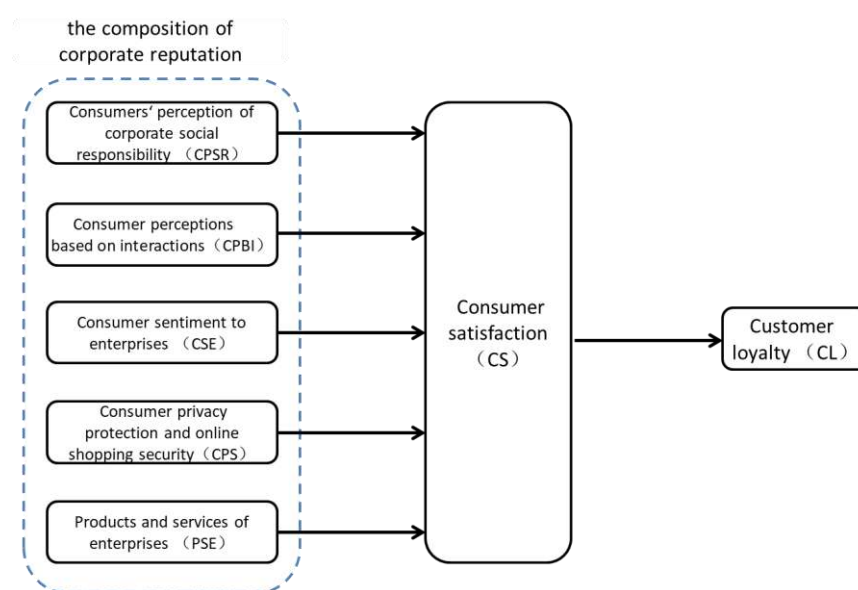


Figure 1. Theoretical analysis model

3. RESEARCH DESIGN AND DATA PROCESSING

3.1 Research design and data sources

Based on the theoretical analysis model, this paper constructs a questionnaire with three parts which are e-commerce enterprise reputation, customer satisfaction (CS) and customer loyalty (CL). Among them, e-commerce enterprise reputation includes five factors which are Consumers' perception of corporate social responsibility (CPSR), Consumer perceptions based on interactions (CPBI), Consumer sentiment to enterprises (CSE), Consumer privacy protection and online shopping security (CPS), Products and services of enterprises (PSE).

The questionnaires in this study were published online to collect data. A total of 102 questionnaires were obtained, of which 82 were valid and the effective rate was 80.39%. Due to the random distribution of questionnaires, the male to female ratio of respondents was basically 1:1, and the majority of the respondents were between the ages of 18 and 30. Most of the respondents have used B2C shopping websites, and the number of online shopping more than 5 times in half a year accounts for 82.35%.

3.2 Reliability and validity of questionnaire

Reliability is reliability, which refers to the consistency or stability of the measurement results, and reflects the degree of compliance of various questions within the measurement scale. Cronbach's Alpha coefficient is a very commonly used method for measuring reliability. When the value of α is greater than 0.7, it represents the credibility of the measurement problem.

In the reliability analysis, except that α value of consumer sentiment to enterprises (CSE) is slightly less than 0.7, the other indicators are all greater than 0.7, indicating that the scale has better reliability. The reliability analysis results are shown in Table 1.

Table 1. Reliability analysis results of each variable

Factors	Question item	Reference	Value of
Consumers' perception of corporate social responsibility	11 Enterprises actively engage in charity and public welfare	[12], [13]	0.741
	12 Employees treat customers well and have patience		
	13 The company attaches great importance to my opinions and suggestions		

Factors	Question item	Reference	Value of
(CPSR)	14 Less negative business news		
Consumer perceptions based on interactions (CPBI)	21 The development prospects of enterprises are relatively bright 22 The company has a high reputation 23 Good corporate leader social image	[14]	0.705
Consumer sentiment to enterprises (CSE)	31 I trust this company 32 I like this company (including products, image, etc.) 33 I am very concerned about the news and information about the company	[15],[16]	0.686
Consumer privacy protection and online shopping security (CPS)	41 No private information leaked after registering on the corporate shopping website 42 The company offers multiple payment methods and provides corresponding security protection 43 Goods item matches description 44 Enterprises have formulated and implemented consumer privacy protection policies	[14],[17]	0.711
Products and services of enterprises (PSE)	51 The service of enterprises can meet the individual needs of customers 52 The logistics company that the company cooperates with has a fast delivery speed and can guarantee that the goods received by customers are intact 53 Simple website operation 54 The products sold by the company are of good quality, 55 Businesses update products and services more often	[18],[19],[20]	0.766
Consumer satisfaction (CS)	61 Actual vs. expected	[21]	/
Customer loyalty (CL)	71 I would recommend this business to friends and family 72 I think I am a loyal customer of this company 73 Under the same circumstances, I will give priority to spending at this company	[22]	0.790

Validity refers to the degree of correspondence between the measurement results and the characteristics of the objects measured by the scale. Bartlett's sphericity test and KMO (Kaiser-Meyer-Olkin) are commonly used factor analysis tools. The KMO statistic usually takes a value between 0-1, and the closer it is to 1, the stronger the correlation between variables, indicating that the variable is more suitable for factor analysis. After the KMO and Bartlett spherical tests were performed on the scale, the following data was obtained. The KMO value was 0.901 and the Sig value was less than 0.001, indicating that the scale has high validity. See Table 2.

Table 2. Test of KMO and Bartlett

Kaiser-Meyer-Olkin measurement sampling suitability		0.901
	χ^2	1184.304
Bartlett's sphericity test	df	253
	Sig.	0.000

3.3 Correlation analysis

The results of correlation analysis show that the five influencing factors are significantly related to customer satisfaction, indicating that customer satisfaction is mainly determined by these factors. Factors such as customer perceived quality, consumer cognition, consumer sentiment, online shopping security, and corporate product and service influence are significantly positively correlated with customer satisfaction at 0.01 levels. See Table 3.

And customer satisfaction is positively correlated with customer loyalty at a level of 0.01. See Table 4.

Table 3. Correlation analysis between corporate reputation factors and CS

corporate reputation factors	Correlation coefficient
CPSR	0.613***
CPBI	0.572***
CSE	0.573***
CPS	0.559***
PSE	0.597***

*** Significant correlation at the 0.01 level (both sides)。

Table 4. Correlation analysis between CS and CL

		CS	CL
CS	Pearson correlation	1	.707***
	Significance (both sides)		.000
	N	102	102
CL	Pearson correlation	.707***	1
	Significance (both sides)	.000	
	N	102	102

*** Significant correlation at the 0.01 level (both sides)。

4. REGRESSION ANALYSIS

Based on the correlation analysis, this paper uses regression analysis to further verify the causal relationship between the components of corporate reputation and customer satisfaction, as well as customer satisfaction and customer loyalty.

Using customer satisfaction as the dependent variable, and using five types of influential factors of corporate reputation as independent variables for stepwise regression analysis, the calculation results are as follows: $R = 0.819$, $R \text{ Square} = 0.671$, $F = 38.377$, and F value significance probability = 0.000. This shows that the 67.1% variation in customer satisfaction can be explained by five factors, such as Consumers' perception of corporate social responsibility (CPSR), Consumer perceptions based on interactions (CPBI), Consumer sentiment to enterprises (CSE), Consumer privacy protection and online shopping security (CPS), Products and services of enterprises (PSE). The significance probability of F value is equal to 0.000. It shows that this regression analysis is more credible in Table 5.

Table 5. Regression analysis of corporate reputation factors and customer satisfaction

Independent variables	Coefficient β	Standard regression coefficient	t	Sig.
Constant	3.853		64.868	0.000
CPSR	0.499	0.613	7.767	0.000
PSE	0.485	0.597	7.442	0.000
CSE	0.466	0.573	7.000	0.000
CPBI	0.465	0.572	6.975	0.000
CPS	0.455	0.559	6.749	0.000
$F = 38.377$				
$R \text{ Square} = 0.671$				

Among them, the standard regression coefficient of CPSR is 0.613, which has the greatest impact on customer satisfaction, and the standard regression coefficient of CPS is 0.559, which has the smallest impact on customer satisfaction. The regression coefficients of the five factors are all greater than 0, so they have a positive correlation with customer satisfaction.

Using customer loyalty as the dependent variable and customer satisfaction as the independent variable for regression analysis, the calculation results are as follows: $R = 0.707$, $R \text{ Square} = 0.510$, $F = 100.021$, and F value significance probability = 0.000. This indicates that the 51.0% variation in customer loyalty can be explained by customer satisfaction.

Table 6. Regression analysis of customer satisfaction and customer loyalty

Independent variables	Coefficient β	Standard regression coefficient	t	Sig.
Constant	3.350		-9.788	0. 000
CS	0.870	0.707	10.001	0. 000
F = 100.021				
R Square = 0.510				

From the regression results in Table 6, the value of the F statistic is 100.021, indicating that the explained variance of the regression model is significantly larger than the unexplained variance, and the significance probability of the F value is 0.000, indicating that the overall regression effect is significant. The regression coefficients are all positive values, indicating that customer satisfaction and customer loyalty have a positive correlation.

5. CONCLUSIONS

This paper analyzes the relationship between E-commerce corporate reputation and consumer behavior, and believes that corporate reputation can be explained from five aspects: Consumers' perception of corporate social responsibility (CPSR), Consumer perceptions based on interactions (CPBI), Consumer sentiment to enterprises (CSE), Consumer privacy protection and online shopping security (CPS), Products and services of enterprises (PSE). It is further believed that consumer satisfaction and customer loyalty will be affected by corporate reputation.

Based on the theoretical analysis, the thesis establishes a theoretical analysis model, designs related questionnaires, and uses related data analysis tools and models to explore the relationship between e-commerce company reputation and customer satisfaction, and customer satisfaction and customer loyalty. Combining with the results of empirical analysis, this paper draws the following conclusions and gives corresponding strategies.

(1) Customer satisfaction is based on consumers' perception of goods or services based on their own experience or the experience of others. Therefore, one of the ways for e-commerce companies to improve customer satisfaction is to make consumers have a better consumption experience as much as possible. Specifically, they can improve product quality, improve cost-effectiveness, choose safer and faster logistics for order delivery, and regulate after-sales service processes.

(2) There is a connection and difference among Consumers' perception of corporate social responsibility (CPSR), Consumer perceptions based on interactions (CPBI), Consumer sentiment to enterprises (CSE). Consumer perceptions based on interactions (CPBI) covers a wider range. In addition to the content of perceived quality, it also includes the brand awareness of the enterprise, and consumer trust and loyalty to the enterprise. In order to obtain closer emotional dependence in the minds of consumers, e-commerce companies must increase their efforts in the construction of corporate image, establish a good corporate image through the use of innovative marketing methods, and improve consumers' trust in the enterprise, so as to help enterprises achieve better performance gains.

(3) The characteristics of e-commerce determine the importance of online shopping security. The

establishment and implementation of privacy policy and the stability of its existence will affect customer trust and customer satisfaction. Therefore, if e-commerce enterprises focus on the longer-term interests rather than the immediate and temporary interests, they should formulate and implement qualified and effective user privacy strategies in strict accordance with national laws, service agreements signed with customers and social ethics, promote them to the height of the company's strategic development, and try to ensure the transaction safety of customers.

(4) The quality of goods and services is one of the most important factors affecting the reputation of an enterprise. Careful after-sales service, beautiful website design, unique marketing methods, good image and good quality brand endorsement will have positive impacts on the construction of a good corporate reputation. However, the key factor for consumers to make purchase decisions is always the goods or services themselves, and other factors may be icing on the cake, but they will never be replaced.

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Implications of Rewards and Punishments for Content

Generations by Key Opinion Leaders

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Abstract: Nowadays, e-commerce platforms have increasingly relied on contents generated by key opinion leaders to engage customers and drive product sales. To stay on top of the growth, e-commerce content platforms have introduced rewards and punishments policies to ensure content quality. However, effectiveness has remained less clear. Besides, there is a dearth of research that focuses on such performance-based output control in the extant platform governance and user-generated content (UGC) literature. In this study, based on the reinforcement theory and UGC literature, we investigate the effects of monetary rewards and punishments on the quantity and quality of contents generated by KOLs in the e-commerce content platform context. Using data collected from JD WeChat Shopping Circle, we empirically testified our hypotheses. Our results indicate that punishments significantly increase the quantity and quality of content generated by KOLs. Monetary rewards only have significantly positive effects on the quality of KOLs' generated content. Nevertheless, the magnitude of the effects of monetary rewards is larger compared with that of punishments. Theoretical and practical implications are discussed.

Keywords: generated contents, key opinion leaders, output control, platform governance

1. INTRODUCTION

Recently, with the increasingly saturated online shopping markets and consumption upgrades, the fusion of e-commerce and online contents has been a growing trend in Chinese e-commerce and has become a new driver of customer engagement and product sales for e-commerce platforms[†]. Rather than conventional price or product differentiation strategies, e-commerce platforms now have invested heavily to develop content platforms[‡] and foster key opinion leaders (KOLs) in generating product-related content. For example, Taobao, the most popular online shopping market in China, has developed more than twenty content channels within its mobile application, such as Taobao Headlines, Weitao, good goods, love shopping, must-buy lists, Taobao Live, and life research institute[§]. For Taobao live streaming alone, the single content channel generated a sales volume of RMB 100 billion in 2018, growing nearly 400% year-on-year^{**}. The key to achieve, sustain, and further facilitate such growth relies on the continuous output of high-quality contents generated by KOLs. Therefore, it is imperative for e-commerce content platforms to formulate effective mechanisms to ensure both the quantity and quality of content outputs by KOLs.

The rewards and punishments are two common mechanisms adopted by e-commerce content platforms in practice. E-commerce content platforms use monetary rewards to prize KOLs who generate high-quality content.

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† <https://technode.com/2019/05/14/content-emerges-as-new-driver-of-chinese-e-commerce/>

‡ We refer content platforms developed by e-commerce platforms as *e-commerce content platform* hereafter.

§ <https://www.parklu.com/tmall-taobao-influencer-marketing/>

** <https://technode.com/2019/04/01/taobao-live-ambitious-boost-plan/>

Meanwhile, they would also punish KOLs for not generating quality content in a given period. For instance, Alibaba content platform launches multiple monetary incentive policies to reward KOLs to continuously generate high-quality contents, such as dynamic commission rewards^{††}, and punishment policies to remove KOLs' identity for not generating quality content within a month. Nevertheless, the effectiveness remains less clear. While it is institutive that monetary rewards can improve the quality of contents generated by KOLs, such an increase may be pseudo. Because the criteria are partially based on customer engagement, such as the number of readings and likes by customers, some of the KOLs may buy likes from third parties in an attempt to obtain the desirable rewards. As such, monetary rewards can be counterproductive for engaging customers and driving product sales. Besides, the effects remain less certain for punishments. Although punishing KOLs for removing their identities and limiting their access to platform resources can potentially deter undesirable behaviors by KOLs, the punishment can also negatively impact KOLs' motivations and thus crowd out KOLs to competing platforms. Thus, getting clear about the effects of rewards and punishments on content generations by KOLs is consequential for e-commerce platforms to successfully grasp the trends of content transformation.

Platform governance literature mainly focuses on policies and mechanisms implemented by a platform owner to influence and coordinate the interaction between the two sides^[1] and has investigated how to leverage various policies or mechanisms (including pricing^[2-3], control^[4], and technical designs^{[1] [5-6]}) to foster complementor innovations and strengthen network effects. In particular, previous studies suggest that platform owners should apply a certain level of control without excessively intervening complementor autonomy^[7-8] so that the platform can appropriate the value of generativity^[9]. However, although prior literature has given some prescriptions in terms of how to balance the tension, such as standardized process and tools, graduated control regimes and self-selection of the desired level of control by complementors^[7-8], there is lack of study to quantify the effects of control mechanisms rather than qualitative descriptions. Moreover, the performance-based output control – a platform owner rewards or punishes complementors based on the quality of their outputs – which is a widely used control mechanism in content platforms – has been received limited attention in the platform governance literature.

The user-generated content (UGC) literature has started to examine how monetary incentives and non-monetary incentives (such as badges and social norms), as well as their combinations, affect the quantity and quality of UGC^[10-15]. While most studies have found that monetary incentives significantly increase the quantity of UGC^{[10][15]}, some studies have demonstrated that monetary incentives can crowd out content generators' intrinsic motivations and thus reduce the quality of their generated contents^[13]. Nevertheless, prior literature largely focuses on the quantity-based monetary rewards in the context of online product reviews. There is a dearth of research on the implications of performance-based monetary rewards for content generations by key opinion leaders (KOLs) in the context of e-commerce content platforms. Moreover, in contrast to retaining and incentivizing KOLs by monetary rewards, e-commerce content platforms also use punishment policies to remove the identity of KOL for not satisfying the quality criteria predefined by the platform. To our best knowledge, such punishments are understudied in the UGC literature.

Therefore, to address the above gaps, we are motivated to ask three research questions:

1. *How do monetary rewards affect the quantity and quality of content generated by KOLs in the context of e-commerce content platforms?*
2. *How do punishments affect the quantity and quality of content generated by KOLs in the context of e-commerce content platforms?*
3. *What is the relative effectiveness of monetary rewards and removing punishments on quantity and quality of contents generated by KOLs?*

^{††} <https://www.yuque.com/u229647/alczzpdrbbs/zt3l4w>

We next draw from the reinforcement theory as our overarching theoretical lens to define our core constructs and justify how and why monetary rewards and punishments affect the quantity and quality of contents generated by KOLs. We collected 128,614 contents generated by 465 KOLs from JD WeChat Shopping Circle, the largest e-commerce content platform embedded in WeChat, from January 1, 2017, to December 31, 2018. By leveraging the introduction of double commission subsidy and removing policy by JD WeChat Shopping Circle as quasi-experiment settings, we applied the difference-in-differences (DID) approach to empirically test our hypotheses. We found that while punishments significantly increase the quantity and quality of contents generated by KOLs, monetary rewards only have significantly positive effects on the quality of KOLs' generated content. Nevertheless, the magnitude regarding the effects of monetary rewards is larger compared with that of punishments. Theoretical and practical implications are also discussed.

2. THEORETICAL AND HYPOTHESIS DEVELOPMENT

2.1 Reinforcement theory

The reinforcement theory explains the strength of an individual's behavior as a function of its consequences^[16]. The theory assumes that individuals are learning agents that would adjust behaviors according to consequences of the behavior and the consequences are assumed as instrumental to the individual. Accordingly, behaviors followed by pleasurable consequences (rewards) are strengthened and tend to be repeated, while behaviors followed by unpleasant consequences (punishments) are weakened and are less likely to be repeated^[17-18]. Such effects diminish with the temporal distances between rewards or punishments to behavior^[17].

We apply the concepts of rewards and punishments, as well as the underlying theoretical arguments between rewards or punishments and individual behaviors from the reinforcement theory to develop our theoretical model. Rewards refer to adding a reward after the desired behavior is made and thus act as a positive reinforcer to increase the strength of the behavior. Punishments denote to adding a punishment or sanction after an undesired behavior is made and thus decrease the strength of the behavior^[16]. For e-commerce content platform owners, a desired behavior of KOLs is continuously generating high-quality content that improves consumer engagements and product sales^[19-20]. Undesired behavior is not generating high-quality content given a period. Accordingly, we conceptualize the behaviors of KOLs as the quantity and quality of contents. In reference to previous UGC literature, we define *content quantity* as the volume of contents generated by a KOL^{[10][13][15]} and *content quality* as the perceived informativeness of content by users and the platform^[21]. Besides, we conceptualize rewards as *monetary rewards* a platform owner gives to a KOL after the KOL generates high-quality or high-performing content^[13]. Meanwhile, we conceptualize *punishments* as removing the identity of a KOL and limiting a KOL's access to platform resources for not generating high-quality content in a given period.

2.2 Monetary rewards and content generations by KOLs

The monetary rewards are monetary prizes a platform owner gives to KOLs to recognize their efforts or excellence in generating high-quality content^[13] with a high level of consumer engagement and conversion rate. According to the reinforcement theory, the monetary reward would act as a positive reinforcer to increase the strength of the desired content-generating behavior^[16], increasing both quantity and quality of contents generated by KOLs.

Particularly in the e-commerce content platform context, monetary rewards are consequential in influencing KOLs' content-generating behaviors because KOLs rely on contents to obtain commissions and collaboration with brands. If consumers buy products through clicking the product link KOLs share in his or her content, the KOL will receive commissions of a certain percentage. Besides, another major source of KOLs'

income is a collaboration with brands. The collaboration depends on the historical performance of a KOL (including quantity and quality of generated contents). Under such circumstances, the introduction of monetary rewards by the platform means that KOLs can not only increase their amount of commissions and collaboration opportunities with brands through generating more high-quality content but also can enjoy the monetary subsidies provided by platforms in appreciating their high-quality content generation behavior. In other words, the intrinsic and extrinsic motivations of KOL are both strengthened by rewarding their high-quality content generation behaviors^{[13][15]}. As such, both the quantity and quality of contents generated by KOLs are expected to increase. Accordingly, we hypothesize the following:

Hypothesis 1a. *The introduction of monetary rewards increases content quantity by key opinion leaders.*

Hypothesis 1b. *The introduction of monetary rewards increases content quality by key opinion leaders.*

2.3 Punishments and content generations by KOLs

The punishments refer to the identity of a KOL being removed from a content platform for not generating high-quality content in a given period. It is worth noting that the removal does not mean the punished KOL can no longer generate contents in the platform but means that the identity or status of a KOL would be removed and the KOL would have limited access to the platform resources, such as online traffic support and collaborations with brands. Besides, the KOL cannot enjoy any monetary rewards.

Previous online review literature has demonstrated that reviewers' identity is important peripheral information cues for consumers to evaluate the helpfulness of a review and make following purchase decisions^[22-23]. KOL identity represents a content generator's rich product knowledge and professional skills in discovering and recommending quality products^[24], and thus are important means to influence consumers' following purchases of a KOL's recommended products. The number of following purchases further determines the number of commissions a KOL can earn. As such, the removal of KOL identity would have consequential effects on the income of a KOL. Thereby, the punishments act as an anxious stimulus to reduce the strength of the undesired content-generating behavior^[16]. In other words, after the introduction of the punishments, KOLs would increase the quantity and quality of their generated content to avoid the unpleasant consequences of being punished. Therefore, we hypothesize that:

Hypothesis 2a. *The introduction of punishments increases content quantity by key opinion leaders.*

Hypothesis 2b. *The introduction of punishments increases content quality by key opinion leaders.*

3. METHODOLOGY

3.1 Research context

We chose JD WeChat Shopping Circle as our research context. JD WeChat Shopping Circle is an online shopping content sharing platform introduced by a Chinese e-commerce giant JD.com with WeChat^{††} in May 2015 and has been growing as the largest content communities for product sharing and recommendation on WeChat^{§§}. In the JD WeChat Shopping Circle, WeChat users and key opinion leaders (KOLs) can post reviews on products, recommend products available from JD.com, and share shopping experiences in any of twenty-five interest groups or circles, such as beauty, photography, books and maternal and child product circles^{***}. The generated content by users and KOLs can be attached with a link that directs consumers to JD WeChat Shopping, a shopping function of WeChat that allows users to buy products from JD.com without leaving WeChat, to complete purchasing seamlessly. If consumers buy products through the link a user or KOL shares, the user or the KOL can have a commission of a certain percentage. Moreover, after years of development, the Shopping

^{††} WeChat is a Chinese multi-purpose messaging, social media, and mobile payment app developed by Tencent.

^{§§} <https://www.marketingtochina.com/jd-wechat-store-one-year-anniversary-a-touch-of-circles-marketing/>

^{***} <https://www.chinadaily.com.cn/a/201903/27/WS5c9b16e8a3104842260b2de0.html>

Circle has attracted and retained a large number of users, as well as desirable converted purchases. As of May 2018, JD WeChat Shopping Circle has accumulated more than 10 million users and more than 50 million user-generated content. Meanwhile, the monthly gross merchandise volume (GMV) achieved through generated content in Shopping Circle is over 100 million RMB.

JD WeChat Shopping Circle is a suitable empirical setting for several reasons. First, in contrast to user-generated content platforms that largely relies on users voluntarily generate contents, the Shopping Circle, as a typical online shopping content sharing platform introduced by traditional e-commerce firms, plays an active role in managing KOLs in terms of their generated contents. The generated contents by KOLs are vital in stimulating consumers' purchases^{†††} and thus are important means to boost and sustain the revenue growth of JD WeChat Shopping. Thereby, the Shopping Circle has taken various mechanisms to regulate KOLs' content-generating behavior in an attempt to increase the quantity and quality of generated contents, as well as prompting more following buys. This objective is aligned with our theoretical consideration of output control mechanisms in the e-commerce content platform context.

Second, the double commission subsidy policy and the removing policy carried out by JD WeChat Shopping Circle provide a rare opportunity to investigate and compare the effects of monetary rewards and punishments on KOLs' content-generating behaviors in a single setting. The double commission subsidy was introduced by the JD fashion division to incentivize KOLs specialized in fashion to generate more high-quality content related to fashion products, such as clothes, shoes, jewelry, and luxury on August 8, 2018. The reward policy is a performance-based reward that gives KOLs a double commission based on the number of following buys through their generated contents. The policy is effective during the period between August 8 to December 31, 2018. JD WeChat Shopping Circle also introduced a removing policy to regulate KOLs' content-generating behaviors on July 27, 2017. KOLs were required to have at least one content recognized by the platform as high quality in three months. Otherwise, a KOL would be removed from JD WeChat Shopping Circle, meaning that the level of a KOL would be reduced and could no longer enjoy the privileges as a KOL including the financial and traffic support, and cooperation opportunities with brands. These privileges are directly linked to the number of commissions a KOL can earn from a content platform. Besides, the two policies are largely exogenous to KOLs, and therefore minimizes endogeneity concerns. Moreover, the periods of the two policies do not overlap, thus eliminating the confounding effects between different policies.

We collected data from JD WeChat Shopping Circle from January 1, 2017, to December 31, 2018. The dataset consists of 128,614 contents generated in all of the twenty-four interest groups by 465 KOLs. The data covers the demography of content generators (including the nickname, ID, gender, and level) and content details (including the date, belonged interest groups, contents, number of likes, and whether being recognized by the platform).

3.2 Research design

We exploit the introduction of a double commission subsidy policy and removing policy by JD WeChat Shopping Circle as an exogenous shock for the quasi-experiment. Recall that the double commission subsidy policy aimed at KOLs specialized in the fashion category. Thus, the introduction of the reward policy allows us to compared the quantity and quality of generated contents by KOLs affected by the reward policy (that is KOLs that are specialized in the fashion category) with the quantity and quality of generated contents by KOLs not affected by the reward policy (that is KOLs that are not specialized in the fashion category). Meanwhile, the removing policy was for KOLs who had not generated qualified content within the last three months. Accordingly, the introduction of the punishment policy allows us to compare the quantity and quality of generated contents by KOLs affected by the punishment policy (that is KOLs who had not qualified content in

^{†††} <https://jingdaily.com/nielsen-china-impulsive-shopping-comes-from-social-commerce/>

last three months) and quantity and quality of generated contents by general users not affected by the punishment policy. The quasi-experiment needs to identify the treatment group and control group to estimate the treatment effects on which we next elaborate.

For the reward policy, we identified treatment groups as KOLs who were specialized in fashion product categories and had not generated content in other product types. We label the treatment group as a *RewardAffected* group. There were five interest groups related to fashion products – the circle of cloth matches, sporting goods, shoes and bags, accessories, and child clothes. KOLs who had not generated content in the five interest groups before and after the reward policy was viewed as not affected by the policy and thus were identified as the control group which is labeled as *RewardNotAffected* group. Consistent with the period of JD WeChat Shopping Circle in assessing KOLs' content-generating behavior, we define a six-month period – three months before the reward policy, May 8, 2018, as the pre-policy period and three months after the reward policy, November 8, 2018, as the post-policy period. Our final sample for the reward policy includes 35 KOLs in the treatment group and 137 KOLs in the control group, each observed over a six-month period. Our unit of analysis is the KOL-quarter combination.

For the punishment policy, we identified the treatment group as KOLs who were affected by the removing policy – that is KOLs who had not generated qualified content recognized by the Shopping Circle in the last three months before the policy. The treatment group was matched with the control group of comparable general users. The comparable general users refer to content generators who had not applied for KOLs but were qualified candidates – having more than 1000 followers and at least 30 generated content. Accordingly, we identified 162 KOLs in the treatment group and 64 general users in the control group. Each of them was observed over six months – three months before the punishment policy, April 27, 2017, and three months after the punishment policy, October 27, 2017. The treatment group and control group for the punishment policy are labeled as *PunishmentAffected* group and *PunishmentNotAffected* group.

3.3 Variables and measurement

Our dependent variables are the quantity and quality of generated content by content generators (including KOLs and general users). The *content quantity* (ContentQuantity) is measured by the number of generated contents by content generator i in quarter t . Following previous literature on user-generated content that uses the number of likes or helpfulness votes provided by other users as a proxy for the quality of product reviews^[13], we first measure *content quality* by the number of likes content generator i received in quarter t (NumLikes). Our second measure of content quality is the ratio of qualified content selected by the platform (RatioSelected) which is operationalized by the number of qualified contents divided by the total number of generated contents of content generator i in quarter t . JD WeChat Shopping Circle has a predefined standard for high-quality content and would accordingly select and tag qualified content daily. The standards are specified in terms of different types of contents, including product lists, product recommendations, product reviews, videos, cloth matches, and general information. Take product recommendation for an example, the criteria are a length of more than 300 words, clear product pictures, products from diversified brands, product links to JD.com, and a well-designed layout. Thus, if a content is selected by the platform, we can assume the content meets the standard and is of high quality. We then log-transformed the values of ContentQuantity, NumLikes, and RatioSelected to address the skew in distributions.

The effects of monetary rewards and removing punishments are examined using dummies in difference-in-difference settings. For the monetary reward, a dummy *PostReward* takes a value of 0 for the quarter before the reward policy and a value of 1 for the quarter after the reward policy. A dummy *RewardAffected* takes a value of 1 for KOLs affected by the reward policy, and a value of 0 for KOLs not affected by the reward policy. Similarly, for removing punishment, a dummy *PostPunishment* takes a value of 0 for the quarter before the

punishment policy and a value of 1 for the quarter after the punishment policy. A dummy *PunishmentAffected* takes a value of 1 for KOLs affected by the punishment policy, and a value of 0 for general users not affected by the punishment policy. Details about constructing these groups are provided in section 4.2.

We also controlled for the gender and level of content generators to include their effects on the quantity and quality of generated content^[25]. A dummy *Gender* takes a value of 1 for female, and a value of 0 for male. A dummy *Level* takes a value of 1 for high levels (levels above six), and a value of 0 for low levels (levels below five). Table 1 and Table 2 summarize the descriptive statistics and correlations of reward and punishment sample correspondingly.

Table 1. Descriptive statistics and correlations for reward sample

Variables	Mean	S.D.	Min.	Max.	1	2	3	4	5	6
1.RewardAffected	0.10	0.30	0	1	1.00					
2.Gender	0.65	0.48	0	1	0.17 [*]	1.00				
3.Level	0.90	0.31	1	1	-0.07	-0.09	1.00			
4.ContentQuantity	0.88	1.37	0	6.02	0.25 [*]	0.10	0.01	1.00		
5.NumLikes	1.56	2.39	0	9.26	0.16 [*]	0.13 [*]	-0.05	0.82 [*]	1.00	
6.RatioSelected	0.15	0.36	0	1	0.02	0.08	0.01	0.57 [*]	0.73 [*]	1.00

Note: The number of observations is 344; * denotes significance at the 5% level.

Table 2. Descriptive statistics and correlations for punishment sample

Variables	Mean	SD	Min	Max	1	2	3	4	5	6
1.PunishmentAffected	0.36	0.48	0	1	1.00					
2.Gender	0.66	0.47	0	1	-0.01	1.00				
3.Level	0.81	0.39	0	1	0.25 [*]	0.05	1.00			
4.ContentQuantity	3.54	1.38	0	5.87	0.17 [*]	0.05	-0.04	1.00		
5.NumLikes	7.59	2.79	0	11.53	0.24 [*]	0.09 [*]	0.09	0.80 [*]	1.00	
6.RatioSelected	0.84	0.37	0	1	0.25 [*]	0.05	0.07	0.59 [*]	0.68 [*]	1.00

Note: The number of observations is 452; * denotes significance at the 5% level.

3.4 Difference-in-differences model specifications

We estimate the differences between the pre-reward period and the post-reward period for the *RewardAffected* and *RewardNotAffected* groups, as well as the differences between the pre-punishment period and post-punishment period for the *PunishmentAffected* and *PunishmentNotAffected* groups using a DID approach. By comparing the relative difference between the group affected by policy and the comparison group not affected by a policy, both before and after the exogenous shock of a policy change, we can infer the average treatment effects of a policy. We specify the following models:

$$Y_{it} = \beta_0 + \beta_1 PostReward_t \times RewardAffected_i + \beta_2 Gender_i + \beta_3 Level_{i,t} + u_i + T_t + \varepsilon_{i,t}, \quad (1)$$

$$Y_{it} = \beta_0 + \beta_1 PostPunishment_t \times PunishmentAffected_i + \beta_2 Gender_i + \beta_3 Level_{i,t} + u_i + T_t + \varepsilon_{i,t}, \quad (2)$$

where i is the content generator index and t is the quarter index, Y_{it} denotes to our outcome of interests including ContentQuantity, NumLikes, and RatioSelected for content generator i on quarter t , *RewardAffected* and *PunishmentAffected* are dummy indicators with a value of 0 for the control groups, and a value of 1 for the treatment groups, u_i are content generator fixed effects, and T_t is time fixed effects. Because the fixed effects of the content generator and time are collinear with the main effects of *PostReward*, *RewardAffected*, *PostPunishment*, and *PunishmentAffected*, we exclude them from our equations. The coefficient of the interaction, β_1 , is the coefficient of interest, which can be interpreted as the relative changes of the treatment group caused by the treatment in comparison with the control group.

4. RESULTS

4.1 Effects of monetary rewards

Table 3 shows the effects of monetary rewards on the quantity and quality of generated content by KOLs. The coefficients of the interaction between *RewardAffected* and *PostReward* in the models for the number of likes and ratios of selected content by the platform are positive and significant, whereas the coefficient of the interaction term in the model for content quantity is positive but not significant. The results show that the introduction of monetary reward resulted in about 155% greater increases in the number of likes received by users and about 36.4% greater increase in the ratio of qualified content selected by the platform. However, there were no significant increases in the quantity of contents generated by KOLs. Therefore, H1a is not supported and H1b is supported.

Table 3. Results of the effects of monetary reward

Variables	Model 1	Model 2	Model 3
	ContentQuantity	NumLikes	RatioSelected
PostReward X RewardAffected	0.405 (0.85)	1.551** (2.18)	0.364*** (3.26)
Gender	-0.027 (-0.19)	0.164 (0.69)	0.005 (0.13)
Level	0.263 (1.23)	0.008 (0.02)	0.052 (0.97)
Content generator fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Number of observations	344	344	344
R-squared	0.225	0.203	0.169

Note: * p<0.10; ** p<0.05; *** p<0.01; standard errors reported in parentheses.

4.2 Effects of removing punishments

Table 4 shows the effects of removing punishment on the quantity and quality of generated content by KOLs. The coefficients of the interaction between *PunishmentAffected* and *PostPunishment* in all the models are positive and significant. In particular, the introduction of removing punishment resulted in about 54.6% greater increases in quantity of content generated by KOLs, about 122% greater increases in number of likes received by users, and about 16% greater increases in the ratio of qualified content selected by the platform, indicating that the removing punishment increases both quantity and quality of contents generated by KOLs. Therefore, H2a and H2b are supported.

Table 4. Results of the effects of removing punishments

Variables	Model 4	Model 5	Model 6
	ContentQuantity	NumLikes	RatioSelected
PostPunishment X PunishmentAffected	0.546* (1.82)	1.218** (2.03)	0.160** (2.03)
Gender	0.173 (1.25)	0.540** (2.03)	0.036 (1.00)
Level	-0.359* (-1.77)	0.439 (1.04)	0.057 (0.98)
Content generator fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Number of observations	452	452	452
R-squared	0.041	0.072	0.076

Note: * p<0.10; ** p<0.05; *** p<0.01; standard errors reported in parentheses.

4.3 Comparison of effects of monetary rewards and removing punishments

Table 5 summarizes the effects of monetary rewards and removing punishments. As indicated by the table, monetary reward and removing punishment can increase the quality of content generated by KOLs in terms of the number of likes received by users and the ratio of qualified contents selected by the platform, wherein the magnitude is greater for monetary reward. Moreover, removing punishments significantly increases the quantity of content generated by KOLs whereas the effects of monetary rewards on content quantity are not evident.

Table 5. Summary of effects of monetary rewards and removing punishment

Variables	ContentQuantity	NumLikes	RatioSelected
RewardAffected	0.405 (0.84)	1.551** (2.18)	0.364*** (3.26)
PunishmentAffected	0.546* (1.83)	1.218** (2.03)	0.160** (2.03)

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; standard errors reported in parentheses.

5. DISCUSSIONS

This study investigates the effects of monetary rewards and punishments on quantity and quality of contents generated by key opinion leaders in the context of e-commerce content platforms. We found that the introduction of monetary rewards significantly increases the content quality by KOLs reflected as about 155% greater increases in the number of likes received by users and about 36.4% greater increase in the ratio of qualified content selected by the platform. But the effect is not evident on content quantity by KOLs. In contrast, the introduction of punishments results in about 54.6% greater increases in the content quantity by KOLs, as well as greater increases in KOLs' content quality (about 122% greater increases in number of likes received by users, and about 16% greater increases in the ratio of qualified content selected by the platform). Although monetary rewards cannot significantly increase content quantity, the magnitude of its effects on content quality is higher in comparison with punishments. We next reflect on how these findings contribute to theory and practice.

First, we contribute to the platform governance literature by incorporating the performance-based output control as an important but understudied form of the control mechanism and justifying how it affects complementors' innovation behaviors. Previous platform governance literature has investigated the tension between control and autonomy^[7-8] and yielded qualitative prescriptions to tackle the tension. Nevertheless, although various control mechanisms have been discussed in prior literature^[1], such as input control and process control, there is a dearth of research on the performance-based output control (that is, a platform owner rewards or punishes complementors based on the quality of their outputs), as well as its subsequent effects on complementors' behaviors. In particular, we investigate the effects of rewards and punishments on KOLs' content-generating behavior in the context of e-commerce content platform. Our findings on how rewards and punishments affect the quantity and quality of contents generated by KOLs greatly supplement existing platform governance literature.

Second, we contribute to the UGC literature by exploring the effects of performance-based monetary rewards and punishments on the quantity and quality of content generations by KOLs. Previous UGC literature mainly focuses on the quantity-based monetary rewards in the context of online product reviews and largely ignores punishments as an alternative mechanism to regulate content generators' behavior^[10-15]. In contrast, we focus on the performance-based monetary rewards and punishments for content generations by key opinion leaders (KOLs) in the context of e-commerce content platforms. While the literature has demonstrated that quantity-based monetary rewards increase content quantity, we found that performance-based monetary rewards

increase content quality. Moreover, punishments increase both the quantity and quality of contents generated by KOLs. These findings help clarify the effects of different approaches of monetary rewards and add punishments to discussions of motivating content generations.

Our findings also have several practical implications. First, e-commerce content platforms should use different approaches to monetary rewards to encourage KOLs' content contribution according to strategic purposes. Quantity-based monetary rewards increase content quantity, whereas performance-based monetary rewards increase content quality. Second, punishments are alternative mechanisms in regulating KOLs' content generations. After attracting a certain number of KOLs, e-commerce content platforms can use punishment mechanisms, such as removing KOL identity, to ensure the quantity and quality of content generations, thereby engaging consumers and increasing product sales.

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Understanding Consumers' Avoidance of Personalized Advertising in Social Commerce: The Leveraging Effect of Information Transparency and Information Dissemination Scenes

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Abstract: With the growing proliferation of personalized advertising during the process of browsing information in social commerce platform, consumers' advertising avoidance has made a potential challenge to the advertising push of platform managers. However, the research currently lacks an understanding of how advertising avoidance can be related to consumer perception and information dissemination. Based on rational choice theory (RCT), this study investigates the mediating role of perceived advertising relevance and perceived vulnerability for advertising avoidance, especially adding the variables of information transparency and information dissemination scene to explore the interacting effect between information dissemination and advertising matching. An online experiment was conducted to empirically test the conceptual model and the result indicated the positive effect of perceived vulnerability and the negative effect of perceived advertising relevance on advertising avoidance. Besides, higher information transparency will lead to more consumer's perceived relevance to advertising, and when the same advertisement is displayed on social web pages, the perceived vulnerability will turn higher. This study provides theoretical implications and practical guidance for online advertising research and practices, especially on leveraging and managing information dissemination of personalized advertising on social commerce platform.

Keywords: Personalized advertising, Avoidance, Social commerce, Consumer perception, Information dissemination

With the growing influence of personalized advertising on social commerce platforms, personalized advertising has become an emerging and increasingly important way of information dissemination in the era of mobile social commerce. Personalized advertising, defined as "customized promotional information that is delivered to each consumer via paid media based on personal information (such as consumer name, past purchase history, demographics, psychological, location, and lifestyle interests)" ^[1]. The fundamental difference between personalized advertising and traditional online advertising is that the push of personalized advertising is completely dependent on users' private information and behavioral data. This leads to the "personalization-privacy paradox". It is assumed that when people see personalized advertising that is too close to their real personal information, they may think that personalized advertising violates their privacy, and thus react with emotional aversion and behavioral avoidance to personalized advertising. "All actions by media users that differentially reduce their exposure to advertising content" is called advertising avoidance, which make advertising in the consumer exposure frequency is reduced, resulting in a decline in the effect of the advertising message to consumers. Therefore, consumers' advertising avoidance behavior poses a potential challenge to platform managers' advertising push.

In this context, academic research on advertising avoidance is also developing. The past many empirical studies about online advertising from the perspective of advertising design consider advertising features ^[2], think advertising feature is the main factor of advertising avoidance. There is also psychological literature that

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shows that consumer perception is a potential factor for personalized advertising avoidance. However, nowadays in the context of mobile social commerce, the communication content and the communication scene of personalized advertising are more diversified, presenting a hybrid feature different from that of traditional online advertising. On the one hand, consumers and regulators have a higher demand for the integrity of information disclosure; On the other hand, in order to meet the different needs of consumers, mobile social commerce platform has built a variety of different information dissemination scenarios in one platform. Therefore, previous research on the role of advertising features is insufficient to explain the new phenomenon in mobile social commerce. Personalized advertising information relevance and how consumers perceive these two factors trigger personalized advertising to evade, mobile social commerce context brings new factor how to carry on the combination and interaction in information transmission, so as to affect the consumer perception of personalized advertising, has become a problem to be solved in the academic field and the advertising industry.

Based on the rational choice theory, this paper aims to explore the paradox of individuation from two aspects: the process of information transmission and consumer perception. The rational choice theory emphasizes the balance between risk perception interests and activities in the case of rational behavior^[3]. In the context of personalization, the paradox of personalization is often understood as a trade-off between benefits and risk factors. In this study, 239 participants were recruited to conduct a 2(personalized matching: low versus high) x 2(information transparency: pop-up versus no pop-up) x 2(information dissemination scene: shopping page versus social page) online experiment using a customized social mobile platform website, by investigating the personalized matching, information transparency, and information dissemination scene on consumer perception of the interaction of personalized advertising avoidance, the experimental results show that perceived advertising relevance is negatively correlated with the advertising avoidance, perceived vulnerability advertising is positively correlated with the advertising avoidance. The matching degree of personalized advertising has a significant influence on the relevance and perceived vulnerability of consumers' perception of advertising. In addition, the website with high information transparency will make consumers aware that their information is used to customize personalized advertising, so as to generate higher advertising perceived relevance; When advertising containing the same personal information appear in the social scene, consumers will have a higher perceived vulnerability.

The innovations of this research mainly include as follows: (1) In theory, based on the rational choice theory, this paper introduces consumer perception variables and successfully explores the reasons why consumers choose to avoid and respond to personalized advertising; (2) in practice, although the advertising push scenario, in theory, has been proved to be a potential predictor of communication effect^[4], there is little empirical evidence for the complex information transmission scenarios on emerging social commerce platforms. This study tries to incorporate the information transmission scenario into the model by the empirical method, which broadens the research boundary of the information transmission process.

The conclusion of this paper is helpful to improve the performance of the platform manager in the social commerce platform, help the manager to find the best balance between consumers' personalized advertising avoidance and the communication effect of advertising, improve the personalized advertising effect of the social scene, and minimize the possibility of users to avoid personalized advertising.

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Study of Influencing Factors on Users' Knowledge Contribution

Behaviors in Social Q & A Communities

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Abstract: Social Q&A communities are important platforms for knowledge sharing among online users nowadays. Therefore, it is of theoretical and practical significance to understand the motivations behind users' knowledge contribution behaviors in social Q&A communities. Drawing on a dataset from Stack Overflow, one of the largest Q&A sites worldwide, this paper aims to explore the factors that may influence users' knowledge contribution behaviors. In particular, we examined factors related to three aspects: social interactivity, social capital and questions readability. Based on related theories we proposed several hypothesis and then tested these hypothesis using an econometric model. Our research results established the relationship between user's knowledge contribution behaviors and factors related to social interactivity, social capital and questions readability. This paper contributes to literature related to studies on Social Q&A communities.

Keywords: social Q&A communities; knowledge contribution behaviors; social capital

1. INTRODUCTION

The increasing size of Internet users and the rapid development of Internet technology, especially the Web 2.0 technology, have transformed the network information sharing model from a traditional one-way transfer model to a user-centric communication model that emphasizes collaboration and sharing. Social Q & A communities are booming as a result ^[1]. The social question and answer communities, or Q&A communities for short, are social media platforms where users seek information and share knowledge ^[2]. In particular, social Q&A communities provide platforms and tools for users to ask questions on various topics. Other users may provide answers to these questions and therefore knowledge sharing is completed among these users ^[3]. Social Q&A communities usually design various mechanisms to improve the efficiency of knowledge sharing ^[4]. For example, users' questions and answers can be rated by others to motivate them to provide high quality content. Users can make friends and interact with each other on social Q&A communities and thus social interactivity is an important feature of social Q&A communities. Reputation systems is another commonly used mechanism. Users can earn high reputation scores or medals by posting questions and answers.

Social Q&A communities have rapidly grown into popular knowledge sharing platforms with large number of active users worldwide ^[5]. For example, Stack Overflow was founded in 2008 and has become the world's largest English IT question and answer community. It has more than 11 million users worldwide and an average daily traffic of more than 10 million. As of October 2019, more than 16.5 million questions were answered on Stack Overflow ^[6]. Furthermore, Stack Overflow has well-designed systems to motivate users to contribute high quality questions and answers. That includes questions and answers rating systems, social interaction design and reputation systems mentioned above. Due to its significant influences and well-designed features, this research draws data from Stack Overflow to conduct research on motivations behind users' knowledge contribution behaviors in social Q&A communities.

One major motivation for most users in Q&A communities is to receive answers to their posted questions. Therefore, number of answers that one users' question receives can largely influence his satisfaction with the

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platform. To identify factors that may influence number of answers one question receives is thus an important task and has become a popular research topic in literature. For example, in one previous research on the answerability of questions in Stack Overflow, it was found that the level of detail, specificity, and clarity of questions, as well as the popularity and participation of questioners, have an impact on whether questions are answered ^[7].

However, due to the fast innovations of social Q&A communities, many new features have not been studied, leaving rooms for further studies. To fill the gap in literature, this paper studies factors from three aspects: social interactivity, social capital and questions readability. Through an econometric model, we established the relationship between these factors and number of answers users' questions received. This paper has significant theoretical contribution to literature related to studies on social Q&A communities. Some findings are quite new. For example, we find that social interaction between questioners and responders (i.e., the number of responses from the questioner to the responder) positively increases the number of questions received. We related these new findings to theories and contribute to the understanding of the motivation behind users' knowledge contribution behaviors in social Q&A communities.

2. LITERATURE REVIEW

As a new type of knowledge sharing platform, social Q&A communities has achieved great success in helping users solve their information needs. However, to increase the response rate of questions still poses a huge challenge to social Q&A communities. It is therefore a popular research topic to identify factors that influence number of answers that a question receives. Previous studies are conducted from different perspectives. Some scholars examined factors that related to users. That is, to identify factors that influence one user to provide or receive answers. For example, Zhe Liu and Bernard J. Jansen's research on question recommendation from the perspective of users' willingness to answer reveals different roles of knowledge sharers and consumers in the Q&A community ^[8]. Based on this finding, scholars first identified knowledge sharers from non-sharers in order to improve the response probability of respondents.

Some scholars have pointed out that compared to social media such as Twitter and Facebook, the online social Q&A community focuses on knowledge contribution and dissemination, rather than information, news or commentary on an individual's current mood^[9]. A study by Zhang, Ackerman, and Adamic (2007) found that more than half of users on Yahoo! Answers usually only ask questions without answering them^[10]. This shows that in the Q&A community, users' willingness to contribute knowledge needs to be strengthened. Therefore, many scholars have also carried out rich researches on the influencing factors of users' knowledge contribution behavior in the community. For example, Liu Zhe and Bernard J. Jansen predicted the probability of answering a question on Sina Weibo, from the perspective of question-related features and questioner-related features. In particular, they selected question-related features including the length of the question, the uniqueness of the question, the urgency of the question, and the issue time of the question, and related features of the questioner. Using machine learning methods, the probability of receiving a response to a question posted on Weibo is predicted. They found that the probability of answering the question was more related to who the questioner was (user activity, posting style, and historical interaction), but less related to the characteristics of the question (amount of information, attractiveness, urgency, courtesy, and posting time) And subject) ^[11]. Another research found that the questioner's popularity, participation, and questioning time have important effects on the response to questions ^[11]. On the question side, the level of detail, uniqueness, and clarity of the question will also affect the response.

Mechanisms design such as reputation system and social interaction design are important features of social Q&A communities. Therefore, it is also crucial to study their influences on users' knowledge contribution behaviors. Such research is yet rarely seen in literature. Some scholars have studied several related topics. For example, Zhe Liu and Bernard J. Jansen found that factors such as user participation, interest, and relevance

have a significant impact on users' willingness to answer in a social Q&A community^[11]. Studies by Jiahua Jin et al. also found that user self-presentation, peer recognition, and social learning have a positive impact on their knowledge contribution behaviors and willingness to answer^[9].

In summary, to identify factors that influence knowledge contribution behavior of users in social Q&A communities is an important research topic. However, the influence of factors that related to mechanisms design such as reputation system and social interaction design are yet to be examined. Our paper contributes to the literature by exploring the effects of these newly designed mechanisms along with question-related factors.

3. RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

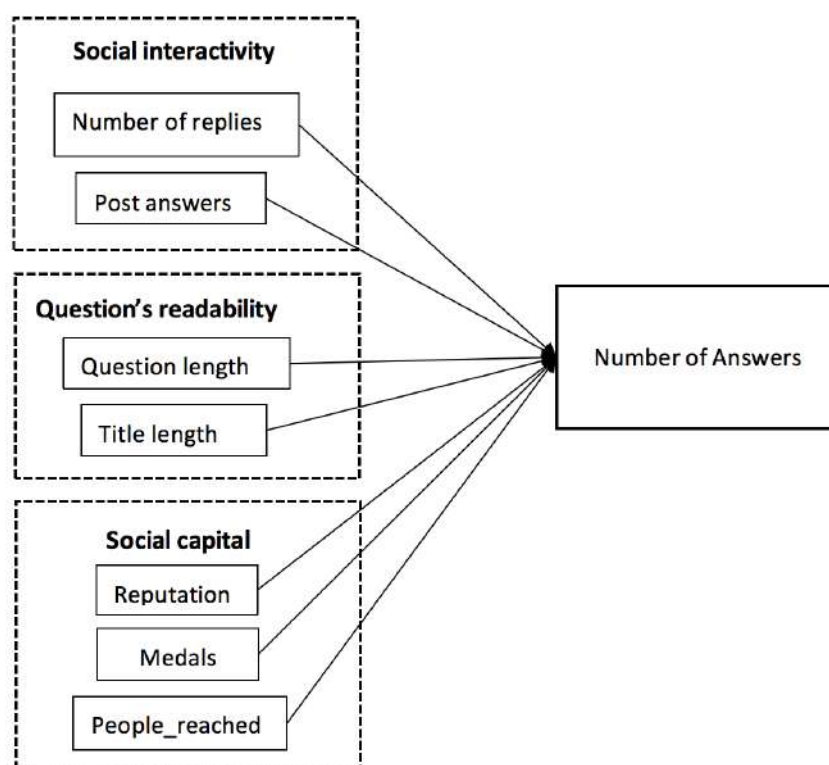


Figure 1. Research model

(1) Social interactivity

As a platform to facilitate information sharing between users, social interaction between users are important for Q&A communities^[12]. The most common type of users' interaction in Q&A communities is users' questioning and answering activities. These questioning and answering activities are also the foundation of the development of the Q&A communities. In this paper, we use the number of answers one users posted in Stack Overflow as a measurement of how active the user is in knowledge sharing on Stack Overflow. In addition, the social value and exchange benefits generated by interaction can make users experience positive emotional changes and promote their instant information sharing behavior^[13]. Studies also have shown that historical interaction can affect the social influence of questioners, and in the Q&A community, the social influence of questioners may affect the willingness of other users to answer^[8]. Further, according to the principle of reciprocity^[14], when users solve more problems for other users in the same community, their questions are more likely to receive answers by others. Therefore, we conjecture that the number of answers posted by users in the Q&A community is positively related to the number of answers received by their questions.

In addition to users' questioning and answering activities, there are other types of social interactions between users in Q&A communities. For example, the questioner may reply to some responders under his

question. Further, the responders may reply to the questioners' last round reply. That is, there may exist such "dialogue" type of interactions between users. Such interaction can bring more direct feedback to the respondent and can make the responder more active. Such "dialogue" type of interactions may generate high quality content and illicit other users' enthusiasm to reply. This important interactive behavior is often ignored by previous researches, which will be studied in our paper.

Therefore, we measure the level of social interactivity of users from the following two aspects: (1) the number of times the questioner responded to the respondent under his question (2) the number of answers the questioner has posted. The following hypotheses are made:

H1a: The number of responses from the questioner to the responder has a positive effect on the number of responses received.

H1b: The number of answers posted by the questioner in the community has a positive impact on the number of answers received by the questioner.

(2) Social capital

Bourdieu (1985) presented his own views on the definition of social capital. He proposed that social capital is related to the network of relationships it recognizes, and to the identity of members of a group^[15]. Social capital theory has been widely used to explain various social behaviors in Q&A communities, including information sharing and social achievements^[16].

In stack overflow, one user's identity in the community is reflected by his reputation and the number of medals earned. Based on their analysis on Stack Overflow, Chua et al. (2015) found that highly prestigious respondents generally perform better in providing detailed and high-quality answers, while novices perform better in terms of readability of answers. At the same time, they also found that novices answer questions such as facts, lists, and definitions more quickly. These results show the impact of user reputation on answering behaviors^[17]. Similarly, Zhang (2013) found in social media, compared with members of socially marginalized groups such as migrant workers, often people with higher social prestige have the right to speak^[18]. We thus test how users' reputation and number medals earned relates to the number of answers he received.

As for the relationship network in the community, one measurement of it in Stack Overflow is the visits of user's home page. When a user's homepage is visited more than others, it shows that he receives more attention in the community, which in turn indicates that his degree of recognition in the community network is high. Thus, we include the visits of user's home page as variable to measure the social capital of one user in Stack Overflow.

Therefore, to test how social capital of one user influence number of answers he receives, this article makes the following hypotheses:

H2a: The questioner's reputation has a positive effect on the number of answers he receives.

H2b: The number of medals a questioner has a positive effect on the number of answers they receive.

H2c: The number of visitors to the questioner's homepage has a positive impact on the number of answers to their questions.

(3) Questions' readability

Obviously, the characteristics of questions will influence the number of answers it receives. One important aspect of questions is the readability of questions. Questions' readability indicates how much efforts other users take to read the questions^[11]. In Q&A communities, questions' readability can be measured by the length of the questions and the length of the titles.

Apparently, it requires more time and efforts for users to provide answers to a question with low readability. According to the least-effort principle, people always try to minimize the average work that can be done. People's various social activities are governed by this principle^[19]. Since they are economically rational, they always try to make judgments and decisions as quickly as possible. Moreover, a huge number of questions are

posted every day on Stack Overflow and users bear a large amount of cognitive costs when answering questions. Thus a question with low readability might be passed at the first impression. According to the principle of least-effort principle, we therefore conjecture that users prefer questions with higher readability. That is, questions with shorter content and title. Accordingly, we make the following hypotheses:

H3a: The length of the question has a negative effect on the number of answers received for the question.

H3b: The length of the question title has a negative effect on the number of responses received for the question.

4. RESEARCH METHODOLOGY

We collected data from Stack Overflow, one of the largest Q&A communities worldwide. Everyday, more than 10 million users will visit Stack Overflow to ask, answer or view questions. It includes huge amount of information. More than 16.5 million questions were already received answers by October 2019 on Stack Overflow. Due to the huge amount of data, we limit our data collection time window as from January 2017 to January 2018. That is, only questions (and their answers received) posted during this time window are collected. We used a web crawler to collect data, including number of answers received and related features from three aspects including social interactivity, social capital and questions readability. After data cleaning, we obtained in total 13,897 observations.

To test Hypothesis H1-H3, we test the following regression model:

$$\text{Number of answers} = \beta_0 + \beta_1 \text{reply_num} + \beta_2 \text{post_answers} + \beta_3 \text{post_questions} + \beta_4 \text{reputation} + \beta_5 \text{medals} + \beta_6 \log p_r + \beta_7 \text{questionlength} + \beta_8 \text{titlelength} + \epsilon \quad (1)$$

Previous studies employed the number of answers to represent the level of user knowledge contribution^[9]. We therefore employ the number of answers as the dependent variable. *Number of answers* measures the number of answers. *reply_num* measures how many times the questioner reply to respondents under a specific question. The larger this variable is, the higher degree of “dialogue” type of social interaction between users exist. *post_answers* indicates how many answers the questioner has provided to other users’ questions. Similarly, *post_questions* measures the number of questions the questioner has asked within the same Q&A community. These three variables represent social interactivities between users. The variable *reputation* is given by Stack Overflow to measure one user’s “reputation” score in the community. Stack Overflow has a mechanism to calculate each user’s “reputation” score based on his past performances. The basic idea is, users with higher “reputation” scores are more recognized within the community. Another mechanism design is the “medal” system. Users can earn medals by answering questions, posting answers or providing ratings for questions. When users completed certain amount of tasks, they will be granted a medal. Thus, the variable *medal* measures a user’s past contribution to the community. *logp_r* measures how many visits the questioners profile page has attracted. Higher visits indicate stronger network connects. These three variables can measure questioner’s social capital. Lastly, Variables *questionlength* and *titlelength* measures the length of questions and titles respectively. As discussed above, these two variables can be used to measure the readability of posted questions.

5. RESULTS AND DISCUSSION

5.1 Descriptive statistics

Table 1. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
answers	1.013816	0.9221007	0	10
reply_num	0.5690127	0.9981565	0	10
post_answers	28.15457	202.8747	0	12687

Variable	Mean	Std. Dev.	Min	Max
post_questions	38.69144	106.3235	1	2407
reputation	1156.124	8648.17	1	513000
medals	4.827733	7.383647	0	263
logp_r	8.569213	2.785468	1.609438	18.61543
questionlength	1467.703	2024.676	35	28076
titlelength	55.57081	20.79852	15	161

According to the descriptive statistics of the data, it can be seen that the average number of answers received for each question is about one. the average number of questions posted by users is about 39, while the average number of posted answers is about 28. Such statistics shows that users usually tend to ask questions rather than answer questions. This further proves the importance of the research to explore factors that influence the number of answers received. Further, the average number of responses from users and responders was only 0.569. This shows that the social interaction between the questioner and the respondent exists but not very strong. Another statistic worth noticing is that the ranges of reputation is from 1 to 513000, indicating that users' reputation on Stack Overflow is distributed widely.

5.2 Regression analysis results

Table 2. Collinear Results

Variable	VIF	1/VIF
reputation	8.54	0.117103
post_answers	7.60	0.131549
medals	1.53	0.655487
log of people_reached	1.16	0.863011
questionlength	1.01	0.993776
titlelength	1.01	0.994906
reply_num	1.00	0.996282
Mean VIF	3.12	

Before performing regression analysis, we first performed a collinearity test on the research data. The results of the collinearity test showed that $VIF < 10$, which indicates that there is no multicollinearity in our experimental data.

Table 3. Testing The Hypotheses in The Research Model

Hypothesis	Relationship	Coef.	Std. Err.	P-values	Decision
H1a	reply_num->answers	0.2834891	0.0074462	0.000	Supported
H1b	post_answers->answers	0.0001875	0.0001009	0.063	Supported
H2a	reputation->answers	-6.91e-06	2.51e-06	0.006	Not supported
H2b	medals->answers	0.0024547	0.0015529	0.114	Supported
H2c	logp_r->answers	0.0198884	0.0031293	0.000	Supported
H3a	questionlength->answers	-0.0000188	3.68e-06	0.000	Supported
H3b	titlelength->answers	-0.0008798	0.0003576	0.014	Supported

As shown by Table 2, the final analysis results support the hypotheses H1a, H1b, H2b, H2c, H3a, H3b. Firstly, results show that the number of responses from the questioner, the number of answers posted, the number of medals users earned, and the number of visits to the questioner's homepage have a significant positive impact on number of answers. Therefore, as we have conjectured, results show that social interactivity and social capital have a significant positive impact on the answers to questions.

Secondly, results show the length of question and its title have a negative impact, indicating readability is a significant factor that influences users' willingness to answer as we have hypothesized.

However, H2a is not supported. That is, users' reputation score does not positively affect number of answers that their questions received. Rather, it significantly reduces the number of questions received. A close observation reveals that its magnitude is very small ($-6.91\text{e-}06$), although it is significant ($p=0.006$). This can be explained as follows. Users on Stack Overflow usually are senior users who has a long history with this platform. Stack Overflow focuses on technical questions and answers, such as programming techniques. These senior users usually have more in-depth knowledge with these techniques. As a result, their posted questions also will be more difficult for common users to provide answers. Therefore, their posted questions usually receive low number of answers. In contrast, novice users usually ask some questions that easy to answer and such that receive more answers.

6. CONCLUSIONS

Social Q&A communities are now important knowledge sharing platforms with large amount of users to ask and answer questions on various topics. However, users are more tend to ask questions rather than provide answers. Thus, to increase the number of received answers poses a challenge for these Q&A communities.

Drawing a dataset from Stack Overflow, one of the largest Q&A communities worldwide, this paper explores the factors that may influence users' activities to provide answers on Q&A communities. We specifically examined factors from three aspects including questioner's social capital, social interactivity between users and questions' readability. Our paper establishes their relationship with the number of received answers using a econometric model. For example, we find that the number of responses from the questioner, the number of answers posted, the number of medals users earned, and the number of visits to the questioner's homepage have a significant positive impact on number of answers; the length of question and its title have a negative impact. One interesting finding is that users' reputation score would reduce number of received answers, rather than increase. This might because users with high reputation usually are senior users with more technical knowledge and their posted questions are difficult for common users to answer.

This research contributes to the literature by establishing a framework to analyze influencing factors from three aspects. Some variables are first discussed in this paper. For example, we find that questioner's response to responder's answers will significantly increase the number of answers received. This proves the significance of social interaction. In addition, positive effect of the number of visits to the questioner's homepage provides the significant of social capital. This paper thus provides great practical and theoretical implications.

There are several limitations within this study. First of all, this research is conducted based on a cross-sectional dataset and some dynamics might not be captured. Future research may collect a panel dataset and conduct further study. Secondly, this paper only considers variables from three aspects. More variables might be related the number of answers one question receives, such as emotions of questions, usage of emoticon, when the question is posted. Thus, future research may take these variables into consideration. Lastly, the conclusion of this paper is solely drawn based on dataset from Stack Overflow. Future research may conduct analysis on other Q&A communities, such as CSDN, to test the robustness of our research.

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Avoidance Behavior toward Social Network Advertising: Dimensions and Measurement

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Abstract: While social network advertising is pervasive, research focused on avoidance behavior toward it is relatively rare. This study provides the development of a three-dimension scale to measure avoidance behavior toward social network advertising. Based on the survey of 195 social network users, evidence is provided for the reliability, factor structure and validity. Meanwhile, T-tests are used to examine the effects of gender, sample source and purchasing experience on the three-dimension avoidance behavior (i.e., skimming, ignoring and blocking). The results show males on social network are more likely to block social network advertising than females while users without purchasing experience on social network are more likely to skimming through advertisements on social network.

Keywords: avoidance behavior, social network, measurement, blocking

1. INTRODUCTION

Social network advertising is pervasive and takes a dominant role in companies' marketing commutations^[1]. Considering around 3.46 billion active users on social networks all over the world, spend an average of 136 minutes every day, companies regard the social network as a promising platform to launch advertising^[2]. For example, digital advertising on Facebook increased by 43% in 2016^[3]. A report from eMarketer in 2018 forecasts that advertisers in the US will spend nearly \$34 billion on social networks by 2021. Tencent Annual Report revealed that advertising revenue from WeChat and QQ increased by 55% to 39.8 billion RMB in 2018. Meanwhile, some individual sellers (i.e., individual vendors operated on WeChat) are also active on social networks. A report revealed that WeChat captured more than 15 million Youshoppers, and the total sales had reached 328.8 billion RMB in 2016^[4]. Social network advertising is becoming a new trend^[5].

Defined as all actions adopted to reduce their exposure to advertising contents, customer avoidance behavior would weaken the effectiveness of advertisements (ads) on social networks^[6,7]. Individuals or companies post much advertising information on a social network to diffuse activities, create brand and product awareness, or just sell something. Nevertheless, users are not always open to this kind of information and often chose avoidance strategies. User avoidance behavior toward social network advertising is nothing new, along with the pervasiveness of social networks. Through focus groups and in-depth interviews, Kelly et al.^[8] found advertising medium skepticism, advertising relevance, advertising skepticism and expectations of a negative experience drive teenagers to avoid ads on social networking sites. Then, Van den Broeck et al.^[9] revealed ad avoidance toward sidebar ads and message stream ads on Facebook. However, research focused on avoidance behavior is relatively rare. Simultaneously, several limited studies do not reach a consensus on the content of avoidance behavior toward social network advertising, which has largely hindered the theoretical advancement. Therefore, this study is to construct a scale to measure avoidance behavior toward social network advertising.

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Following the basic procedures for developing measures of some marketing constructs, this research will report the development process. Some properties and implications of the scale are also addressed.

2. LITERATURE REVIEW

2.1 Advertising avoidance

Advertising avoidance has been recognized for several decades but formally defined by Speck and Elliott^[10]. They saw advertising avoidance as behavioral responses, including all actions individuals take to "differentially reduce their exposure to unwelcomed contents". Then, advertising avoidance is examined across different media. For instance, Wilbur^[11] examined zap response toward television advertising. Through surveys, Shin and Lin^[12], Okazaki et al.^[13] investigated mobile consumers' avoidance of location-based advertising including ignoring, deleting, and stopping read ads. Baek and Morimoto^[14] identified the potential avoidance toward personalized advertising including ignoring, discarding and blacklisting. Surveying across six countries and five media, van der Goot et al.^[15] examined generational differences in media use and advertising avoidance (e.g., ignoring or closing ads).

While previous research enhanced our understanding of advertising avoidance, how to measure this construct has not reached a consensus. While some research saw advertising avoidance as a one-dimension construct and arbitrarily adapted some items to measure it (e.g., Okazaki et al.^[13], van der Goot et al.^[15]), Cho^[16] developed a three-dimension measurement with affective, cognitive and behavioral avoidance. Although the latter measurement is accepted by many studies, it does not emphasize the behavioral responses and violates the definition proposed by Speck and Elliott^[10]. More seriously, there is no research to measure avoidance behavior for the context of social network advertising, while some related research just described it by some words (e.g., Kelly et al.^[8]). Therefore, we defined *avoidance behavior toward social network advertising as all actions users adopt to reduce their unwelcome information*, and filled the gap that a new measurement for it is also calling for development.

2.2 Three dimensions of avoidance behavior

Following Speck and Elliott^[10], we view the avoidance patterns as the (possible) profiles of the action strategies that are employed by users who are motivated to reduce exposures. Considering social network advertising combines *individual physical effort, attention and information system*, we identify three patterns of avoidance behavior to contextualize physical avoidance, cognitive avoidance and mechanical avoidance^[10,17].

2.2.1 Skimming

Physical avoidance entails a variety of physical efforts aiming at not exposing the ads^[17]. It means behavioral avoidance in a narrow sense. For example, while Rojas-Mendez et al.^[18] regarded talking to others as behavioral avoidance, Speck and Elliott^[10] classified it into physical avoidance. It can be concluded that physical avoidance places emphasis on individuals' physical effort to shun unlike contents, and is a physically involved behavioral pattern. In traditional media like magazines, newspapers, flipping past or skipping over ads is seen as typical behavior of physical avoidance^[19,10]. When advertising comes into screens such as Internet and mobile devices, scrolling down Web pages to avoid banner ads, purging pop-up ads, clicking away from the ad are classified into physical avoidance by Cho^[16]. As social network advertising is also presented on an interactive screen, popping up on the screen is identified as physical avoidance^[8]. Standing in line with them, we propose skimming to represent physical avoidance, which entails a variety of skipping strategies without much thinking to avoid ads on the social network.

Skimming is pervasively adopted by users on social networks. During users browsing friends' status updates, many ads are scrolled down the screen^[8]. It generally takes only a little time to determine whether the content needs to process. It can be seen as a subconscious or habitual response toward uninterested content.

When skimming functions, individuals look like disabled people without seeing or hearing other content ^[20].

2.2.2 Ignoring

According to cognitive dissonance theory, individuals would tend to avoid media contents which contradict their own beliefs. Consistent with the notion of cognition, cognitive avoidance engages in the distribution and switch of attentions associated with exposures ^[16]. It occurs as a result of cognitive process in some forms of selective exposure or avoidance ^[21,22]. When individuals encounter advertising with high strength or extremity, selective exposure or switching attentions seem effective for them.

This study chooses ignoring to represent cognitive avoidance. Ignoring is frequently referred in previous research in the domain of advertising avoidance. Speck and Elliott ^[10] used it to describe individuals pay attention to other things even though they are exposed to some ads in traditional media. Cho ^[16] adopted it to represent an intentional avoidance response to unfavorable contents on the website. Previous studies also found individuals ignore location-based mobile ads and personalized ads, and do not look social media ads ^[12,14,8]. Moving to the context of social network advertising, users actually cannot escape the exposure of ads, and only choose selective exposure or attention ^[17]. In other word, users have to distribute their attentions on consonant ads and withdraw attention from contents which violate their beliefs. Thus, ignoring is used to describe what extent individuals distribute or switch their attentions.

2.2.3 Blocking

Mechanical avoidance involves the use of technology to reduce their exposure ^[10]. In the 1990s or before, mechanical avoidance is just used to describe zapping, zipping, or muting the television or radio when encountering ads. These behaviors are seen as the main avoidance pattern in those days. While technologies available to people today have far surpassed the small remote control in the past, the concept has not been proposed to describe the pattern associated with avoidance behavior in this circumstance. We see mechanical avoidance as an avoidance pattern in which individuals reduce exposure to advertisements with the assistance of technologies and propose blocking to represent it in the context of social networks.

Blocking refers to actions users adopt technology to keep unwelcomed information away from them. People sometimes block several commercials or channels, filter email, or subscribe to ‘do not connect’ ^[23]. Deletion and blacklist are also identified as an avoidance response ^[13,14]. Moving to social network advertising, some technologies are available to users to avoid unlike contents, such as blacklist, deletion, or unsubscribe. Therefore, we use blocking to represent mechanical avoidance.

3. METHOD

3.1 Conceptualization of avoidance behavior scale

The construct of avoidance behavior toward social network advertising addresses the actions of users adopted to reduce exposure of advertising information. Several previous relevant studies had served as the groundwork in our conceptualization stage. Speck and Elliott ^[10] proposed eliminating, ignoring and flipping past ads as the main behavior of advertisement avoidance. Cho ^[16] reported a three-dimension measurement for advertisement avoidance (i.e., cognitive, affective and behavioral avoidance). We think affective avoidance is the affective response rather than a kind of behavior; thus removing the affective dimension. Some items in other research (e.g., Huh et al. ^[19], Shin and Lin ^[12], van der Goot et al. ^[15]) also are adopted to form the initial pool. Following a conceptualization process, we construct the three dimensions based on subsequent scale development efforts on them, namely, *skimming*, *ignoring* and *blocking*.

3.2 Generation and purification of scale items

From previous studies and exploratory research, we generated the initial pool of 44 items for the three facets. After removing the same words, we got 22 items (see item keywords in Table 1). The focus group

comprising 13 participants was conducted to purify the items. First, the participants, including seven bachelor students, three master students, and three Ph.D. candidates (six males and seven females) were asked to recall and describe how they respond to some advertising information on their Wechat Moment, QQ Shuoshuo or MicroBlog. Then three researchers made an interpretation for the focus group transcripts using the items from the initial pool. After researchers and participants together compared, deleted, replenished, and modified those items, the 13-item scale was yielded. Lastly, one marketing professor and two Ph.D. candidates rechecked the items and prepared two versions (in English and Chinese) for the following survey through a blind translation-back translation ^[24].

Table 1. Item keywords for the initial pool

Skimming (5)	Ignoring (7)	Blocking (10)
eliminating, flipping past, skip over, throw away, popping up on the screen,	ignoring ads, cognitive avoidance, not reading, stop reading, hang up, closing ads, not look ads	rip out, discard, turning out, switching to other things, talking to someone, zap, block zip, delete ads, deletion, blacklist

Table 2. Scale factor structure and reliability

Items	Blocking	Ignoring	Skimming
<i>X5: I glance through ads on my social network.</i>	-0.026	0.100	0.797
<i>X6: I scroll down the screen to avoid ads on my social network.</i>	0.185	0.189	0.875
<i>X7: I skip over ads on my social network.</i>	0.217	0.301	0.833
<i>X8: I fast-forward ads on my social network.</i>	0.301	0.217	0.793
<i>X9: I intentionally don't pay attention to ads on my social network.</i>	0.235	0.827	0.273
<i>X10: I intentionally ignore ads on my social network.</i>	0.288	0.825	0.270
<i>X11: I intentionally don't put my eyes on my social network.</i>	0.291	0.876	0.168
<i>X12: I don't read any ads on my social network, even if some draw my attention</i>	0.263	0.843	0.165
<i>X13: I would do something rather than browse ads on my social network.</i>	0.771	0.240	0.217
<i>X14: I would log out my social network account to avoid any ads.</i>	0.865	0.168	0.068
<i>X15: I want to delete the ad on my social network if possible.</i>	0.876	0.239	0.167
<i>X16: I block the advertising on my social network if possible.</i>	0.833	0.217	0.213
<i>X17: I want to blacklist the one who sends me ads if possible.</i>	0.701	0.352	0.066
The eigenvalue	6.776	1.973	1.407
Cronbach's alpha value	0.889	0.932	0.911

Notes: a. The rotation converges after five iterations; b. Orthogonal rotation method with Kaiser standardization.

3.3 Sample procedure

To test the measurement on the basis of its psychometric properties, an online survey was conducted through Sojump (<http://www.sojump.com>). Through a small gamble game, respondents were encouraged to actively participate in the investigation. We collected data from February 9 to February 23 in 2018 and obtained 207 completed responses. After eliminating those who did not identify the screen item, 195 valid responses are applied to the analysis. Specifically, 44.6 percent of the respondents were men and 55.4 percent were women. In terms of age, 7.2 percent were below 20 years, 75.9 percent were 20-29 years, 20.5 percent were 30-40 years, and 3.6 percent were older than 40 years. Among them, 69.7 were students seeking bachelor, master, or Ph.D. degree. As to their experience of social commerce, 62.1 percent had not ever purchased products from social networks. In addition, we added *attention* as the control variable to check the validity of the measurement model,

because the variable is vital to advertising on social networks. Attention was measured by four items (i.e., As to the ad on my social network, I paid close attention to it (x1), I was able to concentrate on it (x2), it held my attention (x3), and I was absorbed by it (x4).), which were adapted from Davis^[25].

4. RESULTS

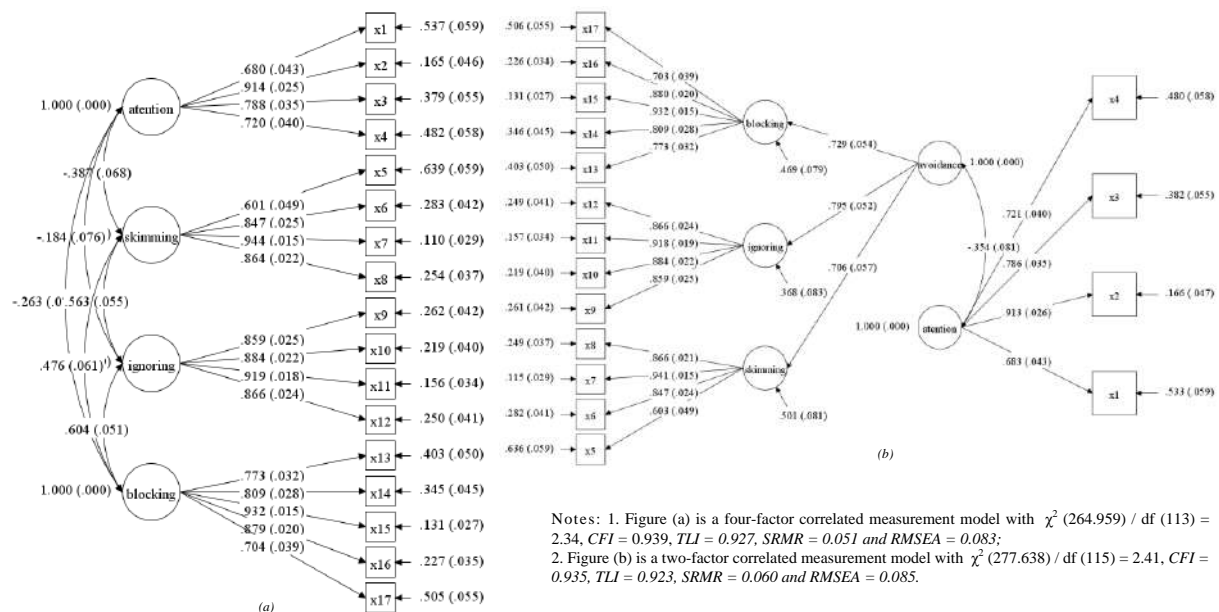
4.1 Scale factor structure and reliability

First, we made item-to-total correlation and item-to-item correlation examinations for each set of the three dimensions. The results show that all item-to-total correlations are above 0.6 and each item-to-item correlation is above 0.4 at the 0.001 level. Then, we run the Kaiser–Meyer–Olkin (0.882) and the Bartlett’s test of sphericity tests ($\chi^2 = 2091.67$, $p < .001$) and found the data supports a factor analysis. Last, we performed a principal factor analysis with max variance rotation to evaluate the factor structure. Through several iterative processes, we got factor loading with the eigenvalues, which are greater than 1. As Table 2 shows, the factor analysis results in three factors, which explain 78.121 percent of the total variance. The three-factor measures achieved Cronbach’s alpha values with 0.889 (skimming), 0.932 (ignoring), and 0.911 (blocking), all exceeding the 0.70 cut-off value recommended.

Table 3. Reliability and Discriminant Validity

Dimension	Construct	CR	AVE	1	2	3	4
Three-dimension model	Attention	0.860	0.609	0.780			
	Skimming	0.892	0.679	-0.387	0.824		
	Ignoring	0.934	0.779	-0.184	0.563	0.883	
	Blocking	0.912	0.679	-0.263	0.476	0.604	0.824
One-dimension model	Attention	0.860	0.609	0.780			
	Avoidance behavior	0.788	0.554	-0.354	0.744		

Notes: a. AVE = average variance extracted, CR = Composite reliability; b. The figures below the diagonal are correlation coefficients (all $p < 0.05$), and the bold figures in the diagonal represent the square root of the AVE.



Notes: 1. Figure (a) is a four-factor correlated measurement model with $\chi^2 (264.959) / df (113) = 2.34$, $CFI = 0.939$, $TLI = 0.927$, $SRMR = 0.051$ and $RMSEA = 0.083$;
2. Figure (b) is a two-factor correlated measurement model with $\chi^2 (277.638) / df (115) = 2.41$, $CFI = 0.935$, $TLI = 0.923$, $SRMR = 0.060$ and $RMSEA = 0.085$.

Figure 1. Results of confirmatory factor analysis**4.2 Confirmatory factor analysis with three dimensions vs. one dimension**

By introducing attention, we first test the validity of the scale with confirmatory factor analysis using MPLUS 17.0. The four-factor correlated measurement model got an acceptable fit with the data (see Figure 1). The four variables have enough reliability, convergent validity, and discriminant validity with criteria of composite reliability (> 0.7), average variance extracted (> 0.5) and the results the square roots of AVE of the individual factors are bigger than the correlations between factors (see Table 3).

Next, we tested whether measures of skimming, ignoring and blocking can be organized hierarchically in a second-order CFA model, given that they are so highly correlated yet are distinct. A two-factor measurement model with second-order measure was run by MPLUS 7.0. Results also show it is an acceptable fit with the data (see Figure 1), and the two variables obtained a good reliability, convergent validity, and discriminant validity (see Table 3). Even so, there is no significant improvement with the model in item level or factor level (see Figure 1). We can conclude that the one-dimension model may be an alternative to measure avoidance behavior.

4.3 T-tests for demographic variables

We checked whether gender, purchasing experience and sample source (i.e., students sample or not) have influences on the three-dimension avoidance behavior. To simplify it, we just made the T-test between the two groups for gender, sample source and purchasing experience. As Table 4 shows, male users are more likely to block social networking advertising than female users ($t = 2.598, p < 0.05$), and users without purchasing experience on social networks are more likely to skim through social networking advertising than those who have ever purchased products on social network ($t = 2.598, p < 0.01$). Meanwhile, there is no significance for gender in skimming and ignoring, for sample source in skimming, ignoring and blocking and for social purchasing experience in ignoring and blocking (all $ps > 0.05$).

Table 4. Results of the T-tests

Demographic variable	Dimension	Classification	N	Mean	SD	T-value	Sig.
Gender	Skimming	Male	87	5.037	1.290	1.234	0.219
		Female	108	4.822	1.147		
	Ignoring	Male	87	4.302	1.435	1.516	0.131
		Female	108	4.019	1.173		
	Blocking	Male	87	4.386	1.380	2.598	0.010
		Female	108	3.906	1.202		
Sample source	Skimming	Student	136	4.998	1.150	1.404	0.162
		Not student	59	4.733	1.342		
	Ignoring	Student	136	4.261	1.214	1.906	0.058
		Not student	59	3.877	1.458		
	Blocking	Student	136	4.141	1.226	0.344	0.731
		Not student	59	4.071	1.475		
Purchasing experience	Skimming	Zero time	121	5.122	1.150	3.063	0.003
		One or more time	74	4.585	1.250		
	Ignoring	Zero time	121	4.198	1.295	0.733	0.464
		One or more time	74	4.057	1.313		
	Blocking	Zero time	121	4.195	1.297	1.028	0.305
		One or more time	74	3.997	1.312		

5. CONCLUSION

This study developed a three-dimension instrument with good reliability and validity that advertisers on social networks can use to understand users' responses toward social networking advertising. First, the scale provides a new tool to recognize customer avoidance behavior on social networks, which fulfills the gap of understanding of avoidance behavior thoroughly. We proposed the scale and examined the difference between one-dimension and three-dimension models, which would enrich and progress the domain of avoidance behavior toward advertising.

Then we made a t-test on the three dimensions (skimming, ignoring and blocking) between male and female and found there is different influence only for blocking. The founding provides new evidence of the effects of gender on avoidance behavior, which are still inconsistent in previous studies. For example, Rojas-Mendez et al.^[18] found that gender has different effects on avoidance behavior across cultures, while van der Goot et al.^[15] found that gender has no significant influence on advertisement avoidance. Our findings may give an alternative explanation of the inconsistent effects. Because avoidance behavior may have three dimensions, the globe avoidance behavior in their studies may cover up some effects. The results of T-tests also reveal that users without purchasing experience on social networks are more likely to choose skimming behavior. The findings indicated that an effective measure to conquer avoidance behavior is to make users have a try to purchase on social networks.

Despite many valuable implications, this study has several limitations. First, the proposed scale is just examined by one survey sample. Another survey in future is needed to verify its reliability and validity. Second, the quantities of the two groups used for T-tests are not equal, which may lead to findings that are not robust. Third, more theoretical and practical discussions are needed in future research on one-dimension or three-dimension model for avoidance behavior toward social network advertising.

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I Watch But I Intend Not To Buy:

Viewers' Persuasion Knowledge About Live-streaming Shopping

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Abstract: Live-streaming shopping is a new shopping pattern integrating real-time commerce communication and real-time social interaction by streaming videos. The intense attempts taken by marketers trying to persuade viewers to buy products have stimulated the purchase intention of some viewers, however, generated reactance of some other viewers at the same time, such as the behavior of “watching without buying anything.” Based on the Persuasion Knowledge Model, we investigated what persuasion knowledge viewers beheld. Thematic analysis of semi-structured interviews and online comments of viewers of live-streaming shopping revealed four themes (recognition of tactics, awareness about psychological mediators, censors on tactics, clearness of coping goals) and ten sub-themes (coupon tactic, hunger marketing tactic, social influence, flow, effectiveness, manipulateness, legitimacy, upgrading persuasion knowledge, managing self-image, and managing costs and benefits) of viewers' persuasion knowledge about live-streaming shopping. We argued that the persuasion of live-streaming shopping might backfire since viewers' persuasion knowledge motivated them to take responses strategically. Discussions and implications were provided, based on which researchers in live-streaming shopping can better involve prominent factors of persuasion knowledge in their analytical framework, and marketers can improve management on their persuasion tactics.

Keywords: live-streaming shopping, persuasion knowledge, persuasion tactics, reactance

1. INTRODUCTION

As the competitions among marketers become fierce, many marketers are attempting to employ live-streaming shopping to engage consumers and stimulate their purchase intention. Live-streaming shopping, the newly emerging way of online shopping since 2015, can be defined as a type of shopping merging real-time social interaction^[1] with real-time marketing information transferring to assist online viewers in making purchase decisions^[2].

Live-streaming shopping is becoming popular all over the world. Some e-commerce or online shopping platforms have introduced live-streaming shopping modules^[3], such as Taobao, Mogujie in China, and Livby, Popshop Live in American. At the same time, some streaming media platforms are beginning their commerce business^[3], such as Tik Tok and YY streaming. Besides, some professional live-streaming shopping platforms are emerging, such as Shopshops, Red bean angle. Amazon has launched its platform of live-streaming shopping, Amazon Live^[4]. Furthermore, there is news that Facebook has bought a video-commerce company named Packagd, aiming to explore the business in live-streaming shopping^[5].

Live-streaming shopping has exploded in China from a \$1.8 billion industry in 2015 to an expected \$15.9 billion in 2020^[6]. By broadcasting a live streaming show, Alibaba achieved a total sales of \$ 17.7 billion in the year 2019, 32% more than the last year^[7]. Many brands, including P&G, Burberry, Adidas, and Sony, attempt to

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sell their products through live-streaming shopping. Moreover, sellers are becoming experts at applying to kinds of persuasion tactics, such as celebrity endorsement, sensation cooperation, and a series of exclusive consumer discounts^[8]. Moreover, they are keeping exploring the persuasion strategies which can work best.

On the other side, the persuasion attempts in live-streaming shopping face much reactance from consumers. On one hand, there are still lots of people who find it hard to accept live-streaming shopping as a shopping ritual, on the other hand, there is an interesting phenomenon that some consumers do not avoid watching live-streaming shopping videos but develop some alternative strategies to react to purchasing while watching the videos. In short, they “watch without buying anything.” This kind of behavior has been noticed by some scholars, as [3] mentioned, some of the motivations of viewers were not significant with shopping behaviors, only significant with watching behavior, or shopping through other channels. However, since live-streaming shopping is newly entering the field of academic interest, there has been sparse research on this topic^{[3], [8]}, and there has been barely research directly focus on people’s reactance behavior to live-streaming shopping, to our knowledge. Under this circumstance, this study tried to figure out the reason people do this through the lens of the Persuasion Knowledge Model. Specifically, how will viewers develop coping and controlling strategies during participating in live-streaming shopping? What are the “good” and “successful” persuasion tactics when considering viewers’ persuasion knowledge and their consequent responses? This study collected data from 42 semi-structured interviews and 200 online comments to identify the prominent themes from the content of viewers’ persuasion knowledge influencing their responses to live-streaming shopping.

2. LITERATURE REVIEW

2.1 What is live-streaming shopping

A few scholars have defined live-streaming shopping mainly by a focus on the merging of interaction technology and e-commerce. For instance, [2] defined “IT-mediated service content of e-commerce live streaming” as the functions of transmitting marketing information to assist online viewers in making purchase decisions. Moreover, this function of transmitting marketing information has its own features, namely real-time social interaction^[3], including business-to-consumer and business-to-business interactions^[8], and interactions among consumers as well. Thus we define live-streaming shopping as a shopping pattern integrating real-time commerce communication and real-time social interaction by streaming videos.

2.2 The advantages and tricky sides of live-streaming shopping

The existing studies (which are very rare till now) mainly focus on the benefits of live-streaming shopping. It has been found that live-streaming shopping can enhance both consumers’ utility and hedonic value^[1]; based on prior research on general live streaming, the gratifications of convenience, informativeness, pleasure, sensational satisfaction of consumers have been distinguished^{[1], [9]-[11]}.

As for its marketing effects, live-streaming shopping has many advantages comparing to traditional online shopping. First, because of the rich media and multi-sensory technology it employs, it increases the authenticity of the products^[12]. Some scholars also argue that its media richness can improve people’s immersion and presence^[8], both of which have positive effects on their purchase intention^[13]. Some researchers suggest that the more pre-purchase information consumers have about a product, the lower are their perceived uncertainty and psychological distance^[14], and the more likely they intend to purchase^[15]. Second, it advances prior video media in its feature of synonymy^[16], which means that while watching the live streaming video, viewers can have real-time social interaction with streamers and other viewers as well. Communication visibility increases social presence, which can also have a positive effect on viewers’ purchase intention^[2].

However, everything has two sides. Due to the features of multi-sensory, real-time, and sociality of live-streaming shopping, many marketers employ profoundly influencing tactics into their persuasion attempts,

such as celebrity endorsements, peer-to-peer influencing, time-orientation tactics such as hunger marketing and time pressuring, limited-time discount. These persuasion tactics help to persuade viewers into purchasing, but many times the way they are perceived may negatively influence viewers' purchase intention.

2.3 The reactance to live-streaming shopping: based on the Persuasion Knowledge Model

The Persuasion Knowledge Model has built up a framework of how people's responses to persuasion attempts are influenced by their persuasion knowledge^[17]. It points out that people's reactance behavior is not a simple rejection, but is a procedure maintaining control over the expected outcomes under their specific goals, in other words, some coping behavior^[18]. People's persuasion knowledge to persuasion attempts from other people or agencies mainly contained several causal-explanatory beliefs about the psychological states and interacting processes during the persuasion^[17]. It can be divided into several facets, being: beliefs about the identity, the purpose, and the features of marketers' tactics (such as weather recognizing marketers' certain behavior as a tactic trying to persuade, the perceived effectiveness, the appropriateness of their behaviors, and marketers' persuasion goals), beliefs about the psychological mediators which affects one's response to the stimulation generated from marketer's behaviors, beliefs about one's own coping (including the coping goals and the coping tactics)^{[17], [18]}.

In the context of live-streaming shopping, both the marketers' persuasion and the viewers' responses are tense. What is more, both the marketers' persuasion tactics and consumers' persuasion knowledge is upgrading at a fast speed. We find that employing the Persuasion Knowledge Model as an analytical framework in live-streaming shopping has two advantages: 1) It helps us to identify some prominent topics related to people's persuasion knowledge which may hinder the viewer from transforming into a buyer; 2) It also helps to investigate the reason why viewers watched but not purchase, and thus help to explain some of the primary responses of viewers to the persuasion attempts in live-streaming shopping.

3. DATA COLLECTION

The data mainly contains two types: the first type is data collected from semi-structured interviews; the second type is data collected from Microblog, the famous social media network website in China.

3.1 Semi-structured interviews

Two of the co-authors carried out all the semi-structured interviews. Both of them were female Ph.D. candidates majoring in commercial management, of expertise at interviewing, which allowed them to develop a strong rapport with interviewees.

The interviewees were recruited through social media networks. We posted a recruiting advertisement through the Wechat moment news, in several online communities, on the Q&A platform Zhihu, and through some volunteers' personal social networks. Finally, 42 interviewees (refer to Table 1 for demographic details) agreed to join in this study. We organized in-depth interviews with them, and each of them was reimbursed with 20 RMB for their devotion of time.

Interviews were carried out face to face, or through video chats provided by some telecommunication applications (Tencent QQ, or Wechat). All of the interviews were conducted under a guideline covered three main aspects: their experiences of live-streaming shopping, their opinions about live-streaming shopping, and the related experiences such as online shopping, live streaming. Each interview lasted for about 20 minutes to 30 minutes. During the interviews, the researchers listened carefully and allowed the interviewees plenty of time to answer the questions. All the interviews were audio-recorded.

The interviews were immediately transcribed into electronic texts to ensure consistency. Interviewees were assigned pseudonyms, and the transcripts were imported into MAXQDA 2020, a computer-assisted data analysis package, which facilitated reading and re-reading to identify themes.

Table 1. Demography statistics

<i>Gender</i>	<i>number</i>	<i>percentage</i>
Female	30	71.43%
Male	12	28.57%
<i>Age</i>	<i>number</i>	<i>percentage</i>
16-20 years	22	52.38%
21-25 years	8	19.05%
26-30 years	6	14.29%
Above 31 years	6	14.29%
<i>Education</i>	<i>number</i>	<i>percentage</i>
High school/ Vocational education or below	6	14.29%
Bachelor's degree	28	66.67%
Master's degree	3	7.14%
Ph.D.'s degree or above	5	11.90%
<i>Income per month (after tax)</i>	<i>number</i>	<i>percentage</i>
Below 2000 RMB	25	59.52%
2000-4000 RMB	10	23.81%
4000-6000 RMB	4	9.52%
6000-8000 RMB	2	4.76%
Above 8000 RMB	1	2.38%
<i>Occupation</i>	<i>number</i>	<i>percentage</i>
Student	30	71.43%
Employed for wages	4	9.52%
Professional/Technical (exemplified by teachers, doctors)	7	16.67%
Self-employed	1	2.38%

3.2 Data collected from Microblog

The other source of data was collected from one of China's biggest social network sites, Microblog, on 12th Nov 2019, right a few hours after the Singles Day, China's biggest sales day. On that day, Alibaba was broadcasting a "See now, buy now" fashion show, including over 80 brands, and China's famous streamer Austin Li has given a streaming show of a whole evening, which has generated many discussions. We searched netizens' comments posted on Microblog and tagged with "live-streaming shopping" or "Austin Li," and collected the newest 207 comments. After deleting seven posts which are not relative with live-streaming shopping, we imported the valid 200 comments into MAXQDA 2020 for analysis.

4. DATA ANALYSIS AND FINDINGS

The analysis process brought to light some interesting features of the experience of live-streaming shopping and other related experiences of the interviewees (refer to Table 2). It was shown that 11 of them had viewed live-streaming shopping but never conducted a purchase. Comparing to their purchases on traditional online shopping platforms, their purchases through live-streaming shopping are still limited. Besides, the most mentioned products viewers focus on are clothing, cosmetics, and food. Taobao, the online shopping platform merged with live streaming, is the most often referred platform, while none of the participants talked about

experiences on any of the professional live streaming platforms.

Table 2. Live-streaming shopping experiences and related experiences

<i>Live-streaming shopping experiences:</i>		
<i>Watching experience</i>	<i>number</i>	<i>percentage</i>
Have viewed	33	78.57%
Have never viewed	9	21.43%
<i>Frequency of watching</i>	<i>number</i>	<i>percentage</i>
Below one hour per week	31	73.81%
2-10 hours per week	9	21.43%
Above ten hours per week	2	4.76%
<i>Purchasing experience</i>	<i>number</i>	<i>percentage</i>
Have bought things through it	22	52.38%
Have never bought things through it	20	47.62%
<i>Frequency of purchasing</i>	<i>number</i>	<i>percentage</i>
Once or below once per month	30	71.43%
2-10 times per month	10	23.81%
Above ten times per month	2	2.38%
<i>Platforms</i>	<i>number</i>	<i>percentage</i>
Online shopping platforms	19	57.58%
Streaming platforms	14	42.42%
<i>Products</i>	<i>number</i>	<i>percentage</i>
Clothing	17	77.27%
Cosmetics	11	50%
Food	6	27.27%
Daily use articles	5	22.73%
Electronic products and toys	1	4.55%
Toys	1	4.55%
<i>Related experiences:</i>		
<i>Frequency of traditional online purchasing</i>	<i>number</i>	<i>percentage</i>
Once or below once per month	8	19.0%
2-10 times per month	26	62.0%
Above ten times per month	8	19.0%
<i>Frequency of watching other live streaming</i>	<i>number</i>	<i>percentage</i>
Below one hour per week	7	16.6%
2-10 hours per week	23	54.8%
Above ten hours per week	12	28.6%

Each interview was analyzed simultaneously using a three-step thematic analysis procedure, as proposed by [19]. The inductive thematic analysis approach was used to generate codes, which were then collated into themes. Themes were then checked against the initial codes for consistency before being defined explicitly with specific accounts chosen to illustrate each theme. Two researchers coded the transcripts independently (the first and second authors) and then reviewed interpretations in discussion with a third researcher (the third author) who was not involved in the analysis [20]. We found that the themes reflected in the data collected through

interviews were almost the same as themes reflected by online comments.

Four themes and ten sub-themes were summarized. We named and made definitions of them, which are shown in Table 3. The four themes depicted the most prominently discovered types of viewers' persuasion knowledge on live-streaming shopping, which could be understood by two orientations: the persuasion knowledge on the persuasion tactics employed in live-streaming shopping, and the persuasion knowledge on viewers' own coping goals. More vividly, the former could be divided into three facets, focusing on the observable feature/pattern, the underneath psychological activities and procedures, and the overall appraisals of persuasion tactics, namely, recognition of tactics, awareness about psychological mediators, and censors on tactics. Besides, there was actually an intimate association between viewers' persuasion knowledge on the persuasion tactics and the persuasion knowledge on their own coping goals.

Table 3. Definition of the themes

Themes	Definitions	Sub-themes	Definitions
Recognition of tactics	Viewers' recognition of the observable feature/pattern of the persuasion attempts in live-streaming shopping	Coupon tactic	The tactical pricing from marketers in live-streaming shopping, e.g., a time-limited coupon
		Hunger marketing tactic	The promotion way that was strategically making viewers have strong desires to purchase by driving up the scarcity of the product
Awareness about psychological mediators	Viewers' beliefs about the psychological activities and procedures that marketers are trying to influence them	Social influence	Influences coming from others during live-streaming shopping, including streamers and other viewers
		Flow	The mental state of being fully immersed in live-streaming shopping
Censors on tactics	Viewers' beliefs about the essential features and overall appraisals of the causal relation between marketers' tactics, psychological mediators and the behavioral outcomes	Effectiveness	Evaluations on whether the persuasion can have a significant effect on viewers
		Manipulativeness	Evaluations on whether the persuasion aims to manipulate viewers, e.g., inducing them consuming compulsively
		Legitimacy	Evaluations on whether the persuasion is admitted by ethics, norms, and judgment
Clearness of coping goals	Viewers' establishment and self-awareness of the possible goals they can pursue in their coping activity	Managing self-image	Viewers' aims of maintaining or changing (usually maintaining) their opinions about themselves
		Managing costs and benefits	Viewers' aims of minimizing the relative costs and maximizing the relative benefits (including utility and hedonism benefits)
		Upgrading persuasion knowledge	Viewers' aims of gaining further understanding of live-streaming shopping, including the tactics, psychological mediators, and the overall natures

4.1 Recognition of tactics

Viewers were aware of some of the persuasion tactics employed in live-streaming shopping, such as some price-related tactics and time-related tactics.

4.1.1 Coupon tactic

The price tactic was highly recognized. Coupons were usually provided during live streaming. However, viewers like [I6] noticed that the coupons could only be used when purchasing from some unreliable or

unfamiliar sellers; she will give up the coupons. Selectively using the coupons provided by certain sellers that are trusted by viewers dismissed the persuasion effect of the price promotion. See:

*[I6]*²(be asked about whether the coupon had influence) because the coupons were usually provided by the official flagship online stores, they had impacts on me. However, if the coupons were offered by other kinds of stores, I would refuse to use them.*

Another thinking related to price tactics is viewers' thorough view of price, see:

[I3] I usually searched for the live streaming video about the products I needed to buy. Considering the time cost and the risk, I found live-streaming shopping was relatively low in value.

And also:

[N15] The so-called economic efficiency was achieved at the cost of wasting time. The key point was, it (refers to live-streaming shopping) was not necessarily economy.

Both the viewers subjectively evaluated the total price instead of only the monetary price of buying a product through live-streaming shopping. By containing the time into the total cost, they get a more rational assessment of the products, which would also dismiss the persuasion effect of the low price tactics often being uses in live-streaming shopping.

4.1.2 Hunger marketing tactic

Hunger marketing was a commonly-used tactic. Viewers realized time orientation played a crucial role in this real-time video shopping, so they sometimes realized that the declaration of “almost sold out” was a persuasion tactic from the marketers. This recognition would somewhat dismiss the stimulation power of applying hunger marketing in live-streaming shopping. See:

[I4] And they created an atmosphere that everybody thought the product was good, and everybody bought it. So this kind of product was sold out in no less than a second, for the broadcasting room which had a steady flow of the viewers.

4.2 Awareness about psychological mediators

Besides the persuasion tactics, viewers could also somewhat realize the psychological procedure involving in the persuasion of live-streaming shopping, especially the social influencing procedure, and the effect of flow.

4.2.1 Social influence

[N23] Live-streaming shopping was actually letting a person get into such kind of a situation: someone in the broadcasting room was selling, the streamer was asking you to buy, others were buying, and then you found yourself was buying too!

This viewer realized that live-streaming shopping attempted to impose the social influence on him/her by making all the related communication visible, and he/she realized that the influence might come from not only the streamer, but also the groups of other viewers.

4.2.2 Flow

In no matter the interviews or the online comments, many viewers described their feeling about involved by the flow. Generally, viewing live-streaming shopping without a clear purpose of selecting information would be more influenced by the procedure of flow, as [I2] said:

[I2] For example, shopping in physical stores and shopping on Taobao were purposeful, because I only bought what I needed. Live-streaming shopping was different; sometimes, one bought what one saw or even what one did not need. Live-streaming shopping could induce me to buy things I did not need, what is important, I did not feel like it was inducing me when I bought them, and then I found out that the products were actually of little use to me right after I bought them.

* We distributed each case a serial number. “I” means this text was transcribed from interviews; “N” means this was netizens’ comment. The following are the same.

Moreover, [N166] vividly described the co-influence from the social influence of an expertise streamer and the flow procedure.

[N166] Austin Li was really “toxic,” there was still all the echoes of his voice in the live streaming show in my head now: “all the girls, all the girls,.....” And then I kept adding items to the shopping cart.

4.3 Censors on tactics

Most importantly, viewers would also form the overall evaluation of not precisely one live-streaming shopping experience but the way of doing shopping through live streaming. Once this evaluation had formed, it would directly and generally influence people’s adoption of live-streaming shopping. The evaluation relied on three indexes, namely, effectiveness, manipulativeness, and legitimacy.

4.3.1 Effectiveness

An occupy of consumers admitted the effectiveness of live-streaming shopping. Interestingly, they mentioned their concern on its “addictive” feature and called the expertise streamer as “toxic” teasingly, which hinted their admittance of the negative outcomes of live-streaming shopping based on the effectiveness of the persuasion tactics. See:

[I4] There were disadvantages of live-streaming shopping. Watching the shows was an addictive behavior, just like playing games on the mobile phone.

And also see:

[N97] Austin Li’s live streaming shows were really “toxic.” My mother, a middle-aged woman who was addicted to watching them, sent me screenshots every time she saw something she wanted to buy.

4.3.2 Manipulativeness

Inductivity, or manipulativeness of live-streaming shopping is among the most mentioned concerns of consumers. Both [I1] and [N155] showed their intense reactance once they realized the seller’s intention of manipulating them to buy.

[I1] I realized it would tempt me to “cut off my hand,” so I repelled.

[N155] I might be disgusted by all behaviors that make too much noise and stir up too much emotion. In addition, the time they choose live-streaming shopping was usually at night when both people’s judgment and self-control were feeble. This kind of thing made me think it was a very tricky act, taking advantage of the weakness of human nature.

4.3.3 Legitimacy

Interestingly, many netizens with a negative view on live-streaming shopping showed their strong doubts about the legitimacy of this shopping pattern. They might hold strong beliefs in the analogy with live-streaming shopping and the nearly disappeared TV shopping. See:

[N58] I am really very puzzling, TV shopping has long been believed by no one, how comes that people believe in live-streaming shopping? Is there any difference between the two? The latter one is just a rougher form of the former one.

Most people like [N58] acclaimed that they found live-streaming shopping and TV shopping were essential and acclaimed their confusion that live-streaming shopping was accumulatively popular while TV shopping had been proved to be an out of time and lack-in-legitimacy shopping pattern. Most of the people behold of this view would vehemently refuse to give a try on live-streaming shopping, not to mention forming a purchase intention through live-streaming shopping.

4.4 Clearness of coping goals

Viewers formed their own beliefs about the goals of their coping behavior when viewing the live-streaming shopping video, which could be reflected by three main aspects: the goal of managing their benefits, the goal of managing their self-image, and the goal of upgrading their understanding of persuasion tactics.

4.4.1 Managing self-image

Another theme that repeatedly appeared was the effort of self-managing the images of viewers. It was found that how to respond to live-streaming shopping attached to one's self-image, and viewers might maintain or change their knowledge of self-image after coping with live-streaming shopping. When a viewer had a strong motivation to maintain his/her original self-image, the purchase intention through live-streaming shopping was usually negatively influenced. See:

*[I1] Since I am a rational consumer, I will instinctively stay away from the thing which tempts me to “cut off my hands”^{*3}.*

Although repeatedly mentioned herself a person with reason who would never buy things without a need, this viewer talked about the experiences that he/she was at the edge of buying things, and then realized the purchasing behavior might go against her perceived image of a rational consumer, that he/she stopped the purchase just before it would become real. Also, see:

[I7] I entirely believe in my own ideas. For example, if this dress was suddenly ordered by a lot of people, it would not have an impact on me (since I would doubt if it was a tactic of the seller).

This viewer thought she was not that easy to be influenced by others, so a specific persuasion tactic emerged, she interpreted it in a way that she could be less socially influenced. A similar theme appeared in some of the online comments. See:

[N45] My brother asked me if I wanted something that he could send to my address. But I really did not want to buy anything. I was so sorry that I opened Austin Li's video for the first time to find a little shopping desire, but still no.

This viewer believed he/she was an individual with a low desire for consumption and commodity. Interestingly, he/she chose to watch the live-streaming shopping video and was confirmed of this self-perception after he/she found himself/herself not influenced by it.

4.4.2 Managing costs and benefits

Viewers could both negotiate and have some control over the benefits they achieved during watching the live streaming video, including either utility or hedonism/experiential benefits, which goes along with [3]. The benefits included but not limited to:

Convenience, see:

[I5] I do not have to go too far for live streaming (shopping). What is more, the number of offline shopping stores nearby is not too many, so I guess I cannot visit many within a day. But if I watch live-streaming shopping videos, I can visit a lot more “shops” within a short time. For instance, once I watched the live video, I saw the streamer tried on over seventy clothes in only one hour.

Entertainment, see:

[I1] It (refers to live-streaming shopping) is interesting. I will watch it if I really want to kill time.

[N92] I think the live shows of Austin Li looked very entertaining. The feeling of them was not like pure live-shopping shows. Anyway, I watched them with relish, like watching entertainment programs. Even if I did not want to buy anything, I still watched his live shows from time to time, which were very good anyway.

[I1] expressed that time pressure was among the main factors influencing his/her watching live-streaming shopping video, and if he/she were not under time pressure, he/she would choose to watch it since it had high entertainment. The online comment [N92] also realized the enjoyment of the live streaming video. It seemed that the pleasure of this entertaining content could be achieved by just watching the streaming video, not necessarily purchasing the products, so [N92] told his/her coping strategy of watching the streaming video and avoiding purchase intention.

* “Cut off my hands” is a Chinese slang meaning conducting impulse buying while neglecting the budget.

Even the meaning of consumption, see:

[N21] There is something that you long to buy times ago, you just need someone to convince you. That is why you enter the broadcasting room of live-streaming shopping.

[N117] To be straight, when you buy from the live-streaming shopping show, what you buy is not the commodity, it is a compulsive pleasure of shopping. And Austin Li just can “bless” the merchandise that kind of pleasure, that is the reason why he goes popular.

Some viewers realized the meaning of participating in live-streaming shopping, and they seem to legitimate the happiness achieved by purchasing and consumption, which could be confirmed by live-streaming shopping and the soothing persuasion of online celebrities.

4.4.3 Upgrading persuasion knowledge

Consumers also realized that facing in all the persuasion attempts could gain their understanding of live streaming marketing, and gain their coping performance. See:

[I4] After watching live-streaming shopping for such a long time, I even had an impulse to be a streamer myself. [When being asked why developed this idea] It seemed that doing this kind of streaming was easy, did not need much unique technology. Still, when coming to practical operation, it was not that kind of thing, e.g., the management of product supply...but I just felt this way of selling things was good.

From this narrative, [I4] was conducting consumer learning when experiencing and coping live-streaming shopping, and it even stimulated his/her motivation to change his/her role from a viewer to a streamer and seller. This motivation was generated by the confidence he/she got from learning through live-streaming shopping.

[N33] It is, at the same time, an excellent way to cultivate my rationality.

This viewer's strategy was somewhat unexpected yet very typical. Instead of passively receiving the exposure and influence of live-streaming shopping, he chose to encounter it consciously. He aimed to gain more knowledge about the persuasion tactics by intentionally watching but avoiding buying anything.

5. DISCUSSIONS AND IMPLICATIONS

5.1 Theoretical findings

This study distinguished the content of viewers' persuasion knowledge influencing their responses to live-streaming shopping by developing four themes, namely, recognition of tactics, awareness about psychological mediators, censors on tactics, and clearness of coping goals. These themes served as the reasons depicting why people watch live-streaming shopping but give up purchasing on purpose. Viewers recognized well of some of the tactics employed by live streaming marketers, which are the coupon tactic, and the hunger marketing tactic; they also had an awareness of the psychological mediators such as the social influence and the flow; based on these features, patterns, and effecting paths, they built up an overall evaluation of live streaming persuasions, where some persuasion attempts failed at their censors for being manipulative, or lack in legitimacy, although they might be admitted to be effective at persuasion. However, people did not merely avoid them but developed some coping tactics under specific goals, such as managing their self-image, managing the costs and benefits, or even gain their persuasion knowledge by watching live-streaming videos.

This study is the first (to our knowledge) to adopt the perspective of the Persuasion Knowledge Model to analyze people's perception and behavioral intention in the domain of live-streaming shopping. We found different content of persuasion knowledge play an essential role in people's different responses, which implies that persuasion knowledge might serve as an important mediator when studying the influences on live-streaming shopping on viewers. Moreover, we underlined not only the facets but also the most prominent factors within these facets influencing the persuasiveness of live-streaming shopping, which might shed light on a further research agenda on how different factors (such as hungry marketing tactic, social influence, flow, perceived

Manipulativeness) influence the persuasiveness of live-streaming shopping.

5.2 Practical implications

5.2.1 Persuasion tactics in live-streaming shopping backfire

The finding tells that, viewers do not merely accept or refuse the persuasion in live-streaming shopping but select to accept and reject specific elements of live-streaming shopping. Based on the accumulatively increasing knowledge on live-streaming shopping and their beliefs on the values they achieved through live-streaming shopping, they will make decisions on either watching the live-streaming shopping video or purchasing through this channel. Admitting that consumers have their own recognition and understanding of persuasion tactics used and even the psychological procedures effect in live-streaming shopping, the persuasion tactics which are too induced or makes consumers feel being manipulated may not work well. Moreover, we can also find that both marketers and consumers are gaining their persuasion knowledge, so some more refined and implicit persuasion tactics are expected to appear.

5.2.2 Spillovers through different purchasing channel due to various coping strategies

Since consumers are motivated to embrace various benefits, they may develop different coping strategies. For instance, viewers who only intended to consume the entertaining content will watch the live-streaming shopping video without explicit purchase purpose, and be vigilance of being induced into buying something; viewers who want to seek for information about products will refer to the vivid presentation in the live streaming video, but they will choose another channel (a more trusting online shop or a physical shop) to buy. The circumstances hint that live-streaming shopping may have effects on brand equity, and might contribute spillovers from one shop to another.

5.2.3 Consumers are empowered by their persuasion knowledge

Consumers today may selectively accept and refuse specific elements of live-streaming shopping in order to fulfill their goals, including managing costs and benefits, managing their self-image, and upgrading their knowledge of live-streaming shopping. Interestingly, some consumers are curious about the effectiveness and manipulateness of live-streaming shopping. Thus they intentionally try to watch live-streaming shopping for the first time to satisfy their curiosity. Some consumers choose to face the persuasion procedure instead of avoiding it in order to gain their persuasion knowledge, to increase their recognition ability, and even to achieve an “immunocompetence” of the “bad” persuasion. It gives marketers some insight that the propaganda of live-streaming shopping through media, including social media, might stimulate people to try it, and word of mouth seems necessary for persuading more people to try it.

5.2.4 Incorrect perceptual of live-streaming shopping will hinder

From the online comment, there is a trend that people will emphasize the similarity between live-streaming shopping and TV shopping in that both ways are employing some highly induced persuasion tactics, and the differences between these two (also the advantages of live-streaming shopping), e.g., the real-time commerce communication, the authenticity of the presentation of products and other consumers’ opinions, are often neglected. It gives marketers some insight that educates people on the main features of live-streaming shopping and makes them form a more objective understanding of live-streaming shopping will play a critical role in persuasion people to adopt this shopping channel.

6. CONCLUSIONS

In this study, we employed a thematic analysis to understand the prominent factors in people’s persuasion knowledge that influence their responses to live-streaming shopping. We identified four themes named recognition of tactics, awareness about psychological mediators, censors on tactics, and clearness of coping goals. By recognizing ten sub-themes (namely, coupon tactic, hunger marketing tactic, social influence, flow,

effectiveness, manipulateness, legitimacy, upgrading persuasion knowledge, managing self-image, and managing costs and benefits), we provided some discussions on how to deal with the persuasion knowledge of viewers from the perspective of marketers. We felt that this study is limited to the content of viewers' persuasion knowledge, which left the interacting procedure of both viewers' and marketers' persuasion knowledge a vast space to explore.

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Understanding the Technology Extra-role Behavior in Smoking Cessation

Online Health Communities: A Social Support Perspective

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Abstract: Technology extra-role behavior (TERB) is critical for the success of online communities (OCs). However, the factors that determine individual TERB vary in different contexts. In addition, less attention has been paid to smoking cessation online health communities (OHCs). This study aims to explore what motivates users' TERB in smoking cessation OHCs from a social support perspective. In this study social support (including informational, emotional, and esteem support) motivates individuals' knowledge contribution and recommendation behavior, which are studied as two different TERB in smoking cessation OHCs. We tested the research model by analyzing 173 valid answers of an online survey from two smoking cessation OHCs. The results show that emotional support positively affects knowledge contribution, and esteem support has a positive impact on recommendation. Informational support exerts influences on emotional and esteem support. The findings extend our understanding on the determinants of TERB in the context of smoking cessation OHCs, and offer practical implications for the administration of smoking cessation OHCs.

Keywords: Social support, Extra-role Behavior, Online Health Community, Smoking Cessation.

1. INTRODUCTION

Individuals cope with smoking cessation by seeking social support (e.g., physicians' advice on quitting and encouragement) to enhance their confidence or skills in stopping tobacco use in a long run ^[1]. However, acquisition of face-to-face support may be difficult because of limitations in time and space as well as social stigma due to anti-smoking social pressure ^[2, 3]. Consequently, smokers who want to quit their smoking habit increasingly turn to online settings, such as smoking cessation online health communities (OHCs), to complement social support from offline settings ^[2, 4, 5]. Smoking cessation OHCs are collectives of individuals who communicate with each other on smoking cessation online ^[6]. Such OHCs provide smokers with an easy-to-access channel to expand their social network of people who are facing similar situations and support each other via sharing advice, success stories, and personal feelings. In addition, smoking cessation OHCs allow users to communicate anonymously without social stigma. Using smoking cessation OHCs have been suggested to lead to positive smoking cessation outcomes, such as short-term abstinence ^[5] and reducing relapse ^[7].

In the Information Systems (IS) literature, there is a growing discussion on the technology extra-role behavior (TERB). According to Zou, Fang, Sun and Lim ^[8], TERB refers to users' voluntary contributions, and can be defined as "user behavior that benefits the IT service and/or is intended to benefit the IT service, which is not necessary to receive the IT service" ^[8, p.4], such as knowledge contribution and recommendation. TERB offers an appropriate perspective in investigating various types of user voluntary contributions in smoking cessation OHCs. For smoking cessation OHCs, users' knowledge contribution is a fundamental issue since the long-term success of OCs depends on the willingness of users to contribute to the OHCs voluntarily ^[9]. In addition, their recommendation of smoking cessation OHCs to outsiders could attract new users and extend the

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reach of OHC service^[8, 10]. Thus, there is a need to investigate the factors that motivate users' voluntary knowledge contribution and recommendation behaviors in smoking cessation OHCs, and to identify the motivator difference for the two different TERB: knowledge contribution and recommendation.

Previous research has argued that social support is a key driver of TERB within OHCs. For instance, Yan, Wang, Chen and Zhang^[11] found that social support is an important determinant of sharing both general and specific knowledge in general OHCs. Since social support may increase strong motivations for users to contribute voluntarily to OHCs, disentangling the components of social support may extend our understating of TERB in smoking cessation OHCs. Drawing on social support theory^[12, 13], this paper aims to investigate *how the three components of social support (including informational support, emotional support and esteem support) affects the two TERB (knowledge contribution and recommendation) in the smoking cessation OHCs?* Specifically, this study proposes a research model to explore the relationships between the components of social support and the two TERB in the context of smoking cessation OHCs. Three components are considered as motivators of TERB in smoking cessation OHCs, including informational, emotional, and esteem support. Two different TERB are explored, i.e., knowledge contribution and recommendation. The proposed research model was tested empirically with 173 valid online survey answers from users of smoking cessation OHCs in both China and Finland. In doing so, this study clarifies the impacts of three components of social support on two different TERB in the particular context of smoking cessation OHCs, and identifies the different roles of the three components of social support in explaining the two different TERB.

We structure the rest of this article as follows: Section 2 reviews prior literature on TERB and social support theory. Then Section 3 presents the research model and hypotheses. Section 4 introduces the research method. Finally, Section 5 discusses the research findings and limitations.

2. THEORETICAL BACKGROUND

2.1 Technology Extra-role Behavior

Due to the ever-changing online environment, users of OCs provide their voluntary contributions in more ways that are different. Users not only contribute knowledge to OCs, but also offer feedback or governance to improve the services of OCs, or refer OCs to outsiders for user expansion^[8]. Previous literature focuses on knowledge sharing in OCs^[11, 14], but pays less attention to other different user voluntary contributions OHCs. Zou et al.^[8] theorize various user voluntary contributions as TERB and classify it into four dimensions: (1) service provision, i.e., delivering services to other users, such as knowledge contribution and helping users; (2) service improvement, i.e., improving services, such as offering feedback and governance; (3) service advocate, i.e., promoting user expansion, such as recommendation and justification; and (4) service financing, i.e., contributing monetary terms. Following this typology of TERB offered by Zou et al.^[8], this study selects two key different TERB from two dimensions, i.e., knowledge contribution from service provision, and recommendation from service improvement, and attempts to investigate their determinants and compare the difference of determinants. Other two dimensions of TERB (i.e., service financing and service improvement) have not been studied in this research because tangible resources, service feedback or governance are not widely existed in smoking cessation OHCs^[15, 16].

2.2 Social support theory

Social support is defined as information and actions that make people believe that they are “cared for and loved, esteemed and valued, as well as belongs to a network of communication and mutual obligation”^[17, p. 300]. Social support has been viewed as an uncertainty-reduction or stress-management mechanism to buffer the negative effects of stressful events and protect people from stressors^[2, 12]. Previous studies have reported that social support from both offline settings and online settings is effective in promoting smoking abstinence^[1, 5].

Thus, in this study we applied social support as the theoretical framework to investigate the TERB in smoking cessation OHCs. Cutrona and Suhr^[13] classified social support into five different categories: (1) informational support, i.e., sharing information on problem-solving; (2) emotional support, i.e., sharing warmth and caring to reduce emotional distress; (3) esteem support, sharing compliments in others' abilities; (4) network support, i.e., sharing companionship; and (5) tangible support, i.e., sharing goods or services. Among the five types of social support, informational and emotional support are the two most frequent types of social support, and esteem and network support are also found commonly exchanged in OHCs, but tangible is rare in OHCs^[2, 16]. Following the typology of social support proposed by Cutrona and Suhr^[13], this study considers three types of social support as motivators of TERB in smoking cessation OHCs, i.e., informational, emotional, and esteem support. Tangible support is excluded due to its rarity in OHCs^[2, 16]. We also remove network support because it is similar to companionship, which has been highlighted as a different activity from social support in OHCs^[4].

3. RESEARCH MODEL AND HYPOTHESES

3.1 Research model

Following the literature on social support and TERB, we argue that three components of social support, i.e., informational, emotional, and esteem support, are key drivers of two TERB (knowledge contribution and recommendation) in smoking cessation OHCs. In addition, informational support is assumed to affect emotional and esteem support. Figure 1 presents the proposed research model, and the definitions of construct included in the research model are shown in Table 1.

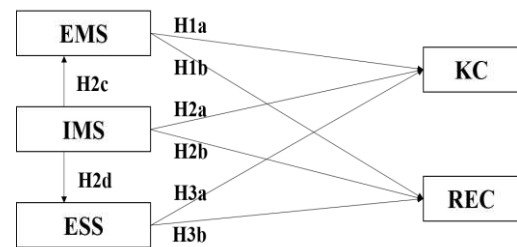


Fig. 1. The proposed model

Table 1. List of constructs in the research model

Construct	Definition
Emotional support (EMS)	Sharing encouragement, empathy, or caring in a smoking cessation OHC ^[13]
Informational support (IMS)	Sharing information on smoking cessation, such as suggestions, success stories, and medicine information, in a smoking cessation OHC ^[13]
Esteem support (ESS)	Sharing relief of blame or compliments regarding quitting smoking in a smoking cessation OHC ^[13]
Knowledge contribution (KC)	The behavior to contribute information, experience, and skill regarding smoking cessation in a smoking cessation OHC ^[14]
Recommendation (REC)	The behavior to recommend the smoking cessation OHC to others ^[10]

3.2 Hypotheses

Smokers who attempt to quit smoking often face stressful issues (e.g., unpleasant withdrawal symptoms), and have an urgent need of emotional support to buffer deleterious effects of such stressors (e.g., distress, anxiety, and self-doubt)^[2, 12]. In smoking cessation OHCs, most of users are ex-smokers or current smokers who truly understand the struggles in smoking cessation process, and they can empathize with others and offer adequate emotional support (e.g., sympathy and empathy). Such emotional support from OHCs may help users to decrease their emotional distress and restore their emotional stability^[2]. The reciprocal motivation brought out via emotional support might drive users to contribute to the OHCs in return^[18]. Emotional support has been reported to affect TERB regarding service provision, such as users' willingness to offer support in OHCs for pregnant women^[19]. Hence, we assume that emotional support has a positive impact on knowledge contribution within smoking cessation OHCs, and we state the following hypothesis:

H1a: Emotional support is positively correlated with knowledge contribution in a smoking cessation OHC.

IS scholars have suggested that the fulfilment of users' various needs in OCs could motivate users' other

contribution behavior indirectly, such as through attachment and satisfaction^[20, 21]. Also, marketing research has shown that perceived value has a direct impact on customers' WOM^[22]. The users who perceive that they could obtain high value tend to be more committed to the organization and recommend it to others. Based on these findings, we argue that when users perceive that emotional support from smoking cessation OHCs could provide them with emotional value and satisfy their emotional needs, they are more likely to feel obligated to refer the OHCs to outsiders for attracting new users. Thus, we propose the following hypothesis:

H1b: Emotional support is positively correlated with recommendation in a smoking cessation OHC.

Smokers who intend to stop using tobacco products often need guidance on how to quit or prevent relapse^[23]. In smoking cessation OHCs, informational support often includes advice on quit plan making, personal tips, and success stories^[15]. Such informational support usually comes from real-life experience and expressed in the form of layman's terms. This could better meet users' personalized informational needs, and assist users to make better decisions on smoking cessation. As similar to emotional support, the reciprocal obligation may encourage users who received information support to return favors to the OHCs. Previous studies have found that informational support positively affects the willingness to help other users in OHCs^[19]. Therefore, we suppose that informational support exerts a positive influence on knowledge contribution in the smoking cessation OHCs, and the following hypothesis is suggested:

H2a: Informational support is positively associated with knowledge contribution in a smoking cessation OHC.

Similar to emotional value and emotional needs fulfilment, informational support in smoking cessation OHCs also could provide users with informational value, and allow users to fulfill the need to master the knowledge on smoking cessation. Previous research has shown that information support is one main social value in OHCs^[16]. Also, informational support has been found to affect recommendation through satisfaction in online brand communities^[24]. Therefore, we assume that in smoking cessation OHCs, when users gain informational value to fulfill their information needs, they tend to be satisfied with the OHCs and offer positive recommendations to others. Thus, we suggest the following hypothesis:

H2b: Informational support is positively associated with recommendation in a smoking cessation OHC.

In addition, informational support from smoking cessation OHCs is helpful to solve problems related to smoking cessation and reduce uncertainty^[2, 12]. This might trigger users' emotional recovery, for instance, from negative emotions (e.g., blame and self-doubt) to positive emotions (e.g., confidence and self-control) about smoking cessation. As a result, the exchange of emotional support and esteem support might be facilitated by sharing informational support. Thus, we propose following hypotheses:

H2c: Informational support is positively related to emotional support in a smoking cessation OHC.

H2d: Informational support is positively related to esteem support in a smoking cessation OHC.

In smoking cessation OHCs, esteem support is often in the form of expressing confidence and compliment in others' ability to deal with smoking cessation^[12, 13]. In smoking cessation OHCs, esteem support usually includes congratulations and positive feedback about others' achievements, as well as relief of blame for relapse^[15]. Such esteem support could help users to strengthen their beliefs and confidence in quitting, and relieve their self-blame regarding repeating smoking. Similar to informational and emotional support, the reciprocity might motivate users to contribute back to the OHCs voluntarily. Thus, we suggest the following hypothesis:

H3a: Esteem support is positively associated with knowledge contribution in a smoking cessation OHC.

Like emotional support, esteem support also could fulfill users' need to seek positive evaluations from others and feel confident about themselves^[12, 13]. Users who benefit from the esteem support in smoking cessation OHCs might establish a strong psychological bond with the OHCs, and perceive that they have rights and responsibility to recommend the OHCs to other smokers. Accordingly, we presume following hypothesis:

H3b: Esteem support is positively associated with recommendation in a smoking cessation OHC.

4. RESEARCH METHOD

4.1 Measurement Development

All constructs were measured by adopting multiple items taken from previous literature. The five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree, was used to measure each item. The measurements for informational and emotional support were adopted from [25]. The items for esteem support came from [26]. Knowledge contribution was measured with items taken from [14]. The items for recommendation were adapted from [10]. All items were reworded for fitting smoking cessation OHCs context.

4.2 Data Collection

We selected two smoking cessation OHCs in this study: one is Stumppi.fi in Finland; the other is the online Smoking Cessation Bar in China. We recruited users from these two OHCs to participate in our online survey via releasing the online questionnaire link to the OHCs. Before collecting data, we received an ethics permit approved by the Ethics Committee of the home University of the first author. Each respondent received a gift for their participation. We launched the official online survey on 13th November 2018 in China and 17th December 2018 in Finland. By 30 April 2019, 235 users completed the online survey (187 in China, and 48 in Finland). We excluded replies due to disagreement on participation (48 in China, 2 in Finland), and untrustworthy answers like the same answer choices for all items (12 in China). Finally, 173 responses were used as valid research sample base in this study. Table 2 presents the background information of the respondents.

4.3 Data Analysis

This study employed Partial Least Squares (PLS) [27] to evaluate both the measurement and structural model.

Table 2. Respondents' background information

Measure	Items	Frequency	Percentage (%)
Country	China	127	73.4
	Finland	46	26.6
Age	15-24	17	9.8
	25-44	117	67.6
	45-65	35	20.2
	> 65	4	2.3
Gender	Male	103	59.5
	Female	64	37.0
	Unknown	6	3.5

Table 4. Correlation matrix and discriminant validity

	EMS	ESS	IMS	KC	REC
EMS	0.852				
ESS	0.751	0.859			
IMS	0.78	0.772	0.843		
KC	0.607	0.566	0.585	0.915	
REC	0.557	0.611	0.556	0.415	0.802

Table 3. Confirmatory factor analysis results

Constr	Item	Factor loading	Cronbach's α	CR	AVE
EMS	EMS1	0.856	0.874	0.913	0.725
	EMS2	0.841			
	EMS3	0.846			
	EMS4	0.863			
ESS	ESS1	0.82	0.822	0.894	0.738
	ESS2	0.86			
	ESS3	0.895			
IMS	IMS1	0.859	0.796	0.881	0.711
	IMS2	0.809			
	IMS3	0.861			
KC	KC1	0.925	0.935	0.954	0.838
	KC2	0.899			
	KC3	0.925			
	KC4	0.912			
REC	REC1	0.839	0.812	0.877	0.643
	REC2	0.804			
	REC3	0.85			
	REC4	0.706			

The measurement model test includes a convergent and discriminant validity test [27]. The factor loadings for each item, composite reliability (CR) and average variance extracted (AVE) of each construct were used to test the convergent validity. As shown in Table 3, the factor loadings for all the items exceed 0.7, and values of

CR and AVE meet the recommended threshold of 0.8 and 0.5, respectively. All Cronbach's alpha values also satisfy the threshold of 0.7, confirming adequate convergent validity^[27, 28].

We further evaluated the discriminant validity by calculating the square root of AVE for all the constructs. As presented in Table 4, the value of the square root of AVE for each construct is higher than its correlations with other constructs, supporting the discriminant validity^[27, 28].

We then tested structural model by using the bootstrap resampling procedure in PLS to test the significance and effect of the proposed hypotheses. As shown in Figure 2, the proposed research model explains 41% of the variation of knowledge contribution, 40% of recommendation, 60.8% of emotional support, and 59.7% of esteem support. As postulated, emotional support exerts significant impacts on knowledge contribution ($\beta=0.322$, $p<0.01$), and esteem support has a significant influence on recommendation ($\beta=0.387$, $p<0.001$), supporting H1a and H3b. Informational support significantly affects emotional support ($\beta=0.780$, $p<0.001$) and esteem support ($\beta=0.772$, $p<0.001$), thereby supporting H2c and H2d. Surprisingly, information has no significant impact on knowledge contribution and recommendation; emotional support exerts no impact on recommendation, and esteem support no impact on knowledge contribution either. Thus, H1b, H3a, H2a and H2b are not supported. In addition, through a mediation analysis, we found indirect effects from informational support on knowledge contribution via emotional support ($\beta=0.251$, $p<0.01$), and from informational support on recommendation via esteem support ($\beta=0.299$, $p<0.001$).

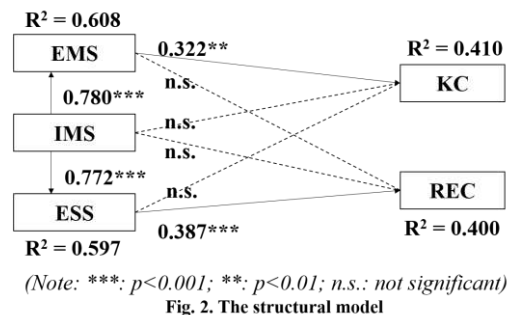


Fig. 2. The structural model

5. DISCUSSION AND CONCLUSION

5.1 Discussion

This study raises several interesting findings. Emotional support was found to affect knowledge contribution positively. This finding is consistent with research findings by Lin et al.^[19], who found that emotional support has a positive impact on users' willingness to offer support for other users in pregnant women OHCs. Nevertheless, emotional support has been found to have no influence on recommendation. A possible explanation is that recommendation and knowledge contribution are two different TERB motivated by different determinants^[8]. When users obtain emotional support from the OHCs, they are likely to contribute their knowledge to the OHCs for returning favors to OHCs, but may have no strong intention stimulated to recommend the OHCs to people beyond the communities. Emotional support might affect recommendation indirectly, such as through satisfaction or attachment^[20], only those users who satisfied with emotional support tend to be more committed to the OHCs, and eventually recommend the OHCs to outsiders.

Esteem support was found to have a positive effect on recommendation, but no influence on knowledge contribution. This might be because smokers who want to quit have a great amount of burden related to avoiding relapse, they require positive evaluations from others to make them feel confident about themselves. Esteem support in smoking cessation OHCs might lead to higher self-esteem and self-efficacy, which in turn facilitate cessation outcomes. Consequently, users who benefit from esteem support in OHCs are more likely to introduce such effective smoking cessation OHCs to other smokers beyond communities.

Surprisingly, informational support was found to exert no impacts on both knowledge contribution and recommendation. These finding contradicts prior research regarding OHCs for pregnant women^[19], informational support is found to be an important determinant of helping users. The possible reason is that informational support exerts indirect influences on TERB, as we found that informational support indirectly affects knowledge contribution via emotional support ($\beta=0.251$, $p<0.01$), and recommendation via esteem

support ($\beta=0.299$, $p<0.001$). Thus, informational support from the OHCs maybe not enough to activate TERB directly, but such informational support may motivate TERB via emotional support and esteem support.

5.2 Conclusion

This study offers some theoretical implications. First, the findings on emotional support as a determinant of knowledge contribution, and esteem support as a motivator of recommendation in smoking cessation OHCs, indicate that TERB could be explained from the social support theory, which is highly related to the context of smoking cessation OHCs. This brings new insights into TERB by disentangling the various components of social support and investigating their impacts on determining TERB in smoking cessation OHCs.

Second, emotional support has been found to affect knowledge contribution but not recommendation, while esteem support has been discovered to determine recommendation but not knowledge contribution. The different roles of each component of social support on different TERB suggest that extra-role behaviors are different and determined by different determinants in smoking cessation OHCs. This offers new implications to TERB by distinguishing the antecedents of different TERB in the context of smoking cessation OHCs.

Third, the findings on the significant influence of informational support on emotional and esteem support imply that informational support is a precondition of sharing emotional and esteem support in smoking cessation OHCs. Even though informational support cannot determine users' TERB directly, it is still important in such OHCs as it promotes emotional and esteem support. This provides new insights into social support by investigating the relationships between different components of social support in smoking cessation OHCs.

This study also offers some practical implications for administrations of smoking cessation OHCs. Specifically, emotional support and esteem support have been found to affect knowledge contribution and recommendation respectively, indicating that managers of smoking cessation OHCs should emphasize on emotional and esteem support when developing service improvement plans to motivate users' voluntary contributions. In addition, even though informational support has been found to exert no direct influence on TERB, it should be strengthened as it could promote emotional and esteem support in such OHCs.

This study has several limitations. First, this study only investigates knowledge contribution and recommendation in smoking cessation OHCs. Other types of TERB, such as feedback and governance have not been considered in this study. Further research should also explore other TERB in OHCs. Second, our data were limited to two OHCs in China and Finland, we should be cautious to generalize our findings to other contexts or culture. Future research should expand our research model to other contexts to validate our findings empirically.

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The Research of Users' Continuance Intention in Relationship-Based Virtual Communities from the Perspective of Quality

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Abstract: With the increasing number of virtual communities, it was challenging to retain existing users and encourage their continued participation in recent years. A research framework to investigate virtual community users' continuance intention was proposed from the perspective of quality. Based on the empirical study, it was found that information and system quality directly affected functional benefits and social benefits, which ultimately determined users' continuance intention to get and to provide information. Furthermore, by modeling information quality and system quality as multifaceted constructs, the results revealed key quality concerns in relationship-based virtual communities. The conclusions had a certain significance on theoretical research and management practice.

Keywords: Virtual Community; Continuance Intention; Information Quality; System Quality

1. INTRODUCTION

Virtual community is a social aggregate that appear on the Internet whose members have emotional communication and form a interpersonal relationships network^[1]. At present, in our country, virtual communities that meet people's various needs become rapidly emerging and increasingly important. According to Hagel and Armstrong^[2], virtual communities are divided into four types in the light of the needs of members: interest-based virtual community, relationship-based virtual community, fantasy virtual community and transactional virtual community. Compared with other types, relationship-based virtual community emphasizes the social relationships among members, which is based on mutual understanding. Therefore, relationship-based virtual community is a network community based on social relations in the real world, which realizes information sharing and interactive communication by community members on the Internet platform.

For a relationship-based virtual community, users voluntarily decide whether or not they participate in the community based on their individual needs and experience. If a virtual community is unable to meet individual needs, he may stop using it or switching to other similar virtual communities. Therefore, it is critical to retain existing users in the long term construction and development of virtual communities. In addition, if the virtual community can maintain the existing user base, it will attract more new users according to the theory of network externality^[3]. Compared with smaller one, people are more willing to participate in virtual communities with large user groups^[4]. The theory of network externality also points out that virtual communities operate and grow effectively by using Economies of scale, and it can bring greater benefits to users as well^[5]. Ma and Agarwal^[6] believe that not all virtual communities can successfully retain users and drive them to continue to use. Therefore, it is particularly important to conduct a research on users' continuance intention in relationship-based virtual community.

This study mainly discusses continuance intention of virtual community users from the perspective of quality. Butler^[7] believed that the amount of information in essence could not retain users, unless the information could be converted into personal interests of users, which could lead to the intention of continuous use. Gu et al^[4] found that the value of virtual community is that high-quality postings help users achieve personal benefits. High-quality information enhances the reputation and user loyalty of the virtual community,

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and it is also a tool for attracting and retaining users. In addition, an excessive increase in the amount of information will lead to information overload due to people's limited information processing capabilities. It also hinders the active participation of users, and ultimately leads to user loss^[8]. Virtual community also require good information filtering or organization mechanisms, which can minimize the process. In summary, this study considers that information quality and system quality of virtual community is very important for retaining existing users. Previous studies suggest that the quality of information systems has multifaceted concepts^[9]. However, these quality dimensions are widely used in enterprise information systems, and they are not well defined in the context of virtual communities. So, what is the difference between the information quality and system quality of virtual community and other types of information systems? What mechanism will affect the users' continuance intention in the information quality and system quality of the virtual community? The purpose of this study is to enrich research findings in this area, and to provide research credentials for user retention and ongoing participation in virtual communities from a quality perspective.

2. THEORETICAL BACKGROUND

2.1. Social exchange theory

According to the theory of social exchange, people's participation in social activities is expected to be rewarded. Social exchange is universal and a completely voluntary act. Social exchange theory assumes that people try to maximize the ratio of social exchange pay and return in social relationships, so the extent to which people perceive a relationship depends on the benefits they receive. Therefore, the reason why users voluntarily participate in relationship-based virtual communities because they want to benefit from it.

2.2. Information quality and system quality of virtual community

The information quality is the evaluation of the information performance of the user after using the information provided by the virtual community^{[10][11]}. In the virtual community, most of the information content is published by users, so it is difficult to control who, when, and what will be released. Therefore, the information quality of virtual community is different from traditional enterprise information systems. In the virtual community, most of the information comes from strangers, so it is the key for users whether the information is reliable and dependent. On the contrary, the reliability of information is guaranteed when employees use information systems. Because it is screened and managed when the information enters the system. In addition, the objectivity of the content in the virtual community is also different. When users are free to express their opinions in the virtual community, their views are subjective and lack guidance. However, the traditional enterprise information system reflects the information of products and personnel, so it is more objective and authentic.

The system quality is the users' evaluation of system performance based on his experience of using the virtual community^{[10][11]}. It is also different from the enterprise information system. In a large virtual community, a large amount of information is released every day, so information overload often occurs. Therefore, users need to use efficient retrieval work to query information and minimize the cost of information processing. In addition, many users in the virtual community do not know in the real world, and can not communicate face to face with each other, they may be more concerned about whether their personal information is exposed. Therefore, it is very important to let users feel safe and comfortable when communicating with others in the virtual community. Comparatively, personal privacy issues can be easily guaranteed and handled when only internal employees can use this information system in the traditional enterprise information system. Another notable feature of the virtual community is interactivity. It depends on the extent to which the virtual community can provide interactive communication to users. In contrast, traditional enterprise information system users have less interaction with others, who simply obtain information from the enterprise's information system.

2.3. Users' participation

There are mainly two types of the behavior of users participating in virtual communities : the behavior on getting information and the behavior on providing information^[12]. First, the behavior on getting information. Many users in the community have a kind of “diving” participation behavior, that is, community members only obtain information as bystanders. Second, the behavior on providing information. It is also called the information contribution behavior, which is expressed as the user posting valuable information or forwarding or evaluating the posting of others in the community. As a consequence, this paper divides users' continuance intention of relationship-based virtual community into two dimensions: continuance intention to get and to provide. The former indicates that the users of the virtual community are willing to continuously browse and find information. The latter indicates that they are willing to continuously contribute various types of information, including information release, information evaluation, and information forwarding.

2.4. Perceived benefits

Users' participation in virtual communities is a voluntary behavior. According to the theory of social exchange^[13], users' participation in social interaction hopes to get a return. It can be seen that users' participation in virtual community activities requires gains. Referring to Dholakia et al^[14], the perceived benefits in virtual communities include both functional benefits and social benefits, which reflect the benefits that users can participate in virtual communities from both rational and emotional perspectives. Among them, functional benefits refer to direct, information-based support that can help users solve problems and achieve real benefits. Social benefits refer to the social and emotional benefits that users bring to their members in the interaction of the communities.

3. THEORETICAL MODELS AND RESEARCH HYPOTHESES

3.1. Information quality & system quality and perceived benefits

Gu et al.^[4]pointed out that low-quality information can distract people because it increases the cost of querying information. In fact, users can benefit from the virtual community only when it provide valuable information to them^[7]. This hypothesis is thus raised:

H1: The information quality of the virtual community positively affects users' functional benefits.

High-quality postings and discussions can help users better understand a topic, and make better decisions^[15]. High-quality information helps users get the important information directly, and it also facilitates the discussion, communication and interaction of the information between users. Therefore, the hypothesis is offered:

H2: The information quality of the virtual community positively affects users' social benefits.

Markus^[16]believes that the technical nature of virtual community online communication is important, which is the key to the success of virtual communities. Indeed, virtual communities are designed to enable users to effectively access information and participate in communication discussions. To reduce information overload, virtual communities need to provide clear navigation and search tools to find and locate information easily^[4]. Therefore, this paper informs this hypothesis:

H3: The system quality of the virtual community positively affects the users' functional benefits.

Virtual community can also establish reward system to increase user enthusiasm, stimulate them to communicate more, and contribute more valuable information^[8]. Users feel that they are maximizing the benefits of the community's functionality and socialization when they participate in community activities easily. Therefore, this paper informs this hypothesis:

H4: The system quality of the virtual community positively affects the users' social benefits .

3.2. Continuance intention of virtual community

Whether users get functional benefits or social benefits from the virtual community, their community sense will be enhanced, which will greatly stimulate them to continue to use it to get more benefits. In addition, according to the theory of social exchange^[14], information exchange in virtual community is a process of reciprocity. When users get valuable information and help from other community members' interactions, they are more willing to provide resources to other in return. H5 and H6 hypotheses are raised:

H5: Functional benefits positively affect users' continuance intention to get.

H6: Functional benefits positively affect users' continuance intention to provide.

On the other hand, users who provide valuable information also expect better resources and help from other. Thus, this study proposes the following hypothesis:

H7: Social benefits positively affect users' continuance intention to get.

H8: Social benefits positively affect users' continuance intention to provide.

The theoretical model of this study is shown in Figure 1.

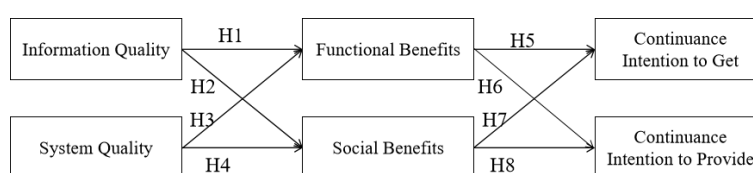


Figure 1. Theoretical model of the study

4. RESEARCH DESIGN

4.1. Data collection

This paper takes WeChat and Weibo of the relationship-based virtual communities as the research object which both have a wide user group in China. The data collection method is questionnaire survey. The survey was conducted by users who had used WeChat or Weibo. In order to ensure the universality and effectiveness, the sample of the trial is from students and staff from all walks of life. There were two ways to distribute questionnaires: online questionnaires and paper questionnaires. In total, 326 questionnaires were collected in two ways, and 292 valid questionnaires, with an effective rate of 89.6%.

4.2. Measurement of variables

The measurement scale for this study used a Likert scale 7-scale scale with options ranging from very non-compliant to very consistent. The variables were measured by the maturity scale of domestic and foreign literature.

Information quality and system quality are multifaceted constructs^[17]. Information quality mainly includes dimensions: richness, value-added, reliability, timeliness, and objectivity. Four dimensions of system quality are navigation and positioning, ease of use, security, and interactivity. Both information quality and system quality include 7 items. Both functional benefits and social benefits include four items. Continuance intention to get and to provide measurement scales include 3 items.

5. DATA ANALYSIS AND RESULTS

5.1. Reliability and validity test

In order to ensure the credibility of the questionnaire, this study used SPSS 19.0 to test the reliability and validity, before the statistical analysis.

5.1.1. Reliability test

The reliability of the scale was tested using Cronbach's α coefficient. In 292 valid questionnaires, the

reliability coefficients of each variable dimension were above 0.7, indicating that the scale of this study has good internal consistency.

5.1.2. Validity test

The study mainly tests the validity of the scale from three aspects: content validity, convergence validity and differential validity. First, in terms of content validity, it adopted in-depth research and interviews and expert consultation in the process of preparation. And the questionnaire has been pre-study after preparation and revised according to the feedback, so its content validity can be guaranteed; secondly, in the convergence validity aspect, this study was performed using standardized factor loading, mean variance extraction (AVE), and compositional reliability (CR). As shown in Table 3, the normalized factor load index of each item on the corresponding variable exceeds the requirement of 0.5, and the AVE of each variable also exceeds the acceptable level of 0.5, and the composition reliability CR is greater than 0.7. Therefore, it has been verified that the research scale has good convergence validity; finally, in terms of differential validity. The test data showed that the square root of the AVE value of all variables is greater than the correlation coefficient between it and other variables, indicating that the scale has good discriminant validity.

Table 1. Reliability and validity test results

Variable	Cronbach's α coefficient	CR	AVE
Information Quality	0.90	0.92	0.62
System Quality	0.87	0.90	0.58
Functional Benefits	0.82	0.86	0.61
Social Benefits	0.85	0.87	0.62
Continuance Intention to Get	0.86	0.87	0.69
Continuance Intention to Provide	0.81	0.80	0.58

5.2. Validation of the research model

This study uses structural equation model to test the previous research hypotheses through Amos 19.0. The path diagram of the model is shown in Figure 2, and the fitting index of the model is shown in Table 4.

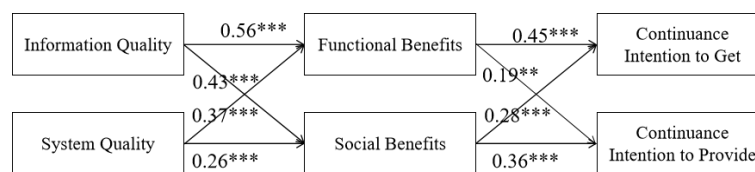


Figure 2. Structural equation model analysis results

Table 2. Each variable confirmatory factor analysis model fitting index table

Fitting index	χ^2	df	χ^2/df	NFI	TLI	CFI	IFI	GFI	RMSEA
Result value	459.68	278	1.65	0.91	0.95	0.98	0.98	0.92	0.06

In the verification of research hypotheses, the 8 research hypotheses are supported. Information quality has a significant impact on functional benefits and social benefits, that is, H1 and H2 are verified; system quality has a significant impact on functional benefits and social benefits, that is, H3 and H4 are verified; Functional benefits have a significant impact on continuance intention to get and to provide, that is, H5 and H6 are verified; social benefits have a significant impact on the continuance intention to get and to provide, that is, H7 and H8 are verified.

6. DISCUSSION

6.1. Research conclusions

6.1.1. Users' continuance intention in the virtual community

This paper believes that users' continuance intention in the virtual community is aimed at information to get and provide. The study found that these two continuance intentions are directly affected by user benefits. As users gain functional benefits and social benefits, their dependence on the virtual community increases, which encourages them to continue to participate in virtual community activities, and users are more willing to continue browsing and finding the information from the community. Besides, the research results show that when users get revenue from the community, they are more willing to share and provide information in return. Therefore, the functional benefits and social benefits can promote users' continuance intention to get and to provide information in the virtual community.

6.1.2. The importance of information quality and system quality

The study also found that high-quality information can help users access high-quality information resources and facilitate information exchange. It can help users to obtain multiple benefits by enhancing the richness, value-added, reliability, timeliness and objectivity of information. The results show that a high level of system quality can enhance the perceived benefits and satisfaction of users in the virtual community. Improving system quality can be carried out in four dimensions. In short, the information quality and system quality of the virtual community are two complementary qualities that affect the users' continuance intention. The results show that compared with system quality, information quality has more influence. The contribution of information quality to users' continuance intention is more obvious.

6.2. Theoretical contributions

First, this article pays special attention to the quality of virtual communities. The research distinguishes the information quality and system quality of virtual communities from the traditional information systems, and redefines the dimensions and connotations of virtual community information quality and system quality. It is found that the high level of information quality and system quality is conducive to the transformation of virtual community resources into user perceived personal benefits.

Secondly, based on the previous studies, this paper defines and expounds the two types of benefits of the relationship-based virtual community: functional benefits and social benefits. In order to show the difference between the relationship-based virtual community and the traditional information system, this paper expands the perceived personal benefits construct and subdivides it to better understand the benefits of the virtual community. At the same time, the introduction of functional benefits and social benefits explains how the quality factors can achieve the users' continuance intention.

6.3. Managerial implications

The research results of this paper provide the following practical guidance for the construction and management of virtual communities:

First, virtual communities need to strengthen quality control mechanisms to ensure information quality. Managers often need to monitor, filter, and delete posts that are unreliable and have a strong personal bias. It can also highlight the most valuable posts through user reviews in the virtual communities, which help other users better understand and have a discussion.

Second, virtual communities need to provide effective navigation tools for information query to help users quickly get the information they need. In addition, the virtual community needs to understand the users' past browsing behavior, so that it can better recommend hot topics and engage users to discuss in the community effectively.

Third, virtual communities can adopt reward system to highlight the contributions of active users and encourage them to participate in virtual community activities actively and continuously. For example, based on their contribution, it can award a medal to an active user (for example, a gold user), or give a certain gift reward.

7. LIMITATIONS AND FUTURE RESEARCH

It can select more virtual similar communities to verify this theoretical model in the future, which make the research results universal. In addition, in the questionnaire survey, the subjects were mainly students (63.2%), and the samples had certain limitations. Future research can consider selecting more people from other industries for more accurate research results.

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No Fun no Use? The Impact of Gamification on User's Continuous Usage Intention toward E-Business App

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Abstract: Gamification as an internal incentive method has been widely adopted in practice. Compared with the traditional external rewards, internal rewards can stimulate the enthusiasm of users. This paper, therefore, explores and constructs a model on how gamification (herein composed of three dimensions: sense of achievement, social influence and sense of ownership) affects user's continuance intention from the perspective of intrinsic motivation (herein composed of three dimensions: self-presentation, entertainment and self-efficacy). Through the multiple regression analysis of 456 e-shoppers sample data by using the software of SMARTPLS 3.0, we draw the following five conclusions: gamification was positively correlated with self-presentation, entertainment and self-efficacy; sense of achievement, social influence and sense of ownership, significantly positively affected self-presentation, entertainment and self-efficacy; there is no correlation between self-presentation and users' continuance intention; entertainment and self-efficacy are positively correlated with users' continuance intention; and entertainment and self-efficacy play a mediation role between gamification and users' continuance intention.

Keywords: gamification; self-presentation; entertainment; self-efficacy; users' continuance intention

1. LITERATURE REVIEW AND THEORETICAL CONSTRUCTION

With the rapid development of information technology and the drop of information-collecting cost, e-shoppers switch frequently among various e-business apps and reduce greatly their loyalty toward the APP. How to enhance the users' stickiness to the app and loyalty to the enterprise has been a major challenge faced by different enterprises.

Literature has shown that gamification can be used in customer relationship management. The research on gamification, at present, mainly focuses on its impact on customer's engagement and purchase intention, and on how to increase customer's participation rate and evaluation quality (Kavaliova et al., 2016). Few studies focus on its impact on customer's continuance intention and the major research methods are case studies. Based on these, this paper chooses the empirical method to study its influence on users' continuance intention from the perspective of gamification.

1.1 Gamification

Gamification originated from games. Bunchall (2010) defines it as the process of integrating the dynamics and mechanics of a game into a website, service, content or activity. Zuckerman and Gal-OZ (2014) define it as the application of game design elements to the persuasion system to encourage users to participate in activities personally. Penenberg (2015) defined it as an addiction system that uses game elements to influence non-game behaviors, which is composed of a complete set of institutions, mechanisms and rules to ensure the good operation of incentives. The above definitions of gamification were mainly studied from the perspective of system design. Zichermann and Linder (2013), whereas, defined it as the process of integrating games and

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strategies into business from the perspective of user experience. They believe that gamification can create experiences that provide intrinsic meaning and improve employee and customer motivation. Robson et al. (2014) defined it as applying the experience in the game field to non-game environments to make the traditional organizational process more fun and bring the game experience to stakeholders. Huotari and Hamari (2017) defined it as providing better interactive services through motivational affordances, bringing game-like experience to users and realizing value creation of users.

In this paper, gamification is viewed as an incentive mode, its definition mainly refer to the Penenberg's (2015) as an addiction system that uses game elements to influence non-gaming behaviors, which is composed of a complete set of systems, mechanisms and rules to ensure the good operation of incentives.

1.1.1 The measurement of gamification

Chou (2015) devised a game framework, Octalysis Framework, basing on an octagon with eight gamification drivers without corresponding measurement scale development (e.g. Epic Meaning & Calling, Development and Accomplishment, Empowerment of Creativity, Ownership and Possession, Social Influence, Scarcity & Impatience, Unpredictability & Curiosity, Loss & Avoidance). Brito et al. (2018) developed a new gamification scale based on the research of Chou (2015), and divided it into six dimensions: achievement, avoidance, uncertainty, social influence, sense of ownership and sense of mission. Taking Alipay as an example, this paper developed the scale with reference to Chou (2015), submitted the scale to three experts in related fields for discussion, and finally chose the measurement from three aspects: development and achievement, social influence and sense of ownership. Brito et al. (2018) gave the following definitions about these three measurements:

“Development and Accomplishment is related to the sensation of progress, development of skills and achieving complex goals followed by a reward or feeling of great accomplishment.”

“Social Influence is related to activities inspired by what people think, do or say to each other, and includes all the social elements that motivate them: acceptance, competition, envy, the need not to feel excluded and companionship.”

“Ownership is associated with motivating people who are directly related to so-called “virtual goods” or “virtual currency”, the use or trade of which has become extremely popular and an important model of recipes for online services, social networks or massively multiplayer online games.”

1.1.2 Research on gamification

At present, the research on gamification in marketing mainly focuses on advertising management (Bittner and Schipper, 2014), customer management (Kavaliova et al., 2016), brand management (Harwood and Garry, 2015) and product creativity (Zimmerling et al., 2018).

In terms of advertising management, scholars mainly focus on the antecedents of in-game advertising effects, such as the matching degree between advertising types and game types (Huang and Yang, 2012), and the interaction between audiences and characters in games (Hang and Auty, 2011). In terms of customer management, scholars mainly focus on the impact of gamification on customer participation and purchase intention, which is embodied in the improvement of customer participation rate and evaluation quality by gamification (Jang et al., 2018). In terms of brand management, scholars mainly focus on the relationship between gamification and brand fit, which is embodied in the influence of gamification on consumers' brand cognition (Hsu et al., 2018) and the influence of gamification on brand fit (Gatautis et al., 2016b). In terms of product creativity, scholars have found that game elements can improve quantization performance, but not the quality of participants' motivation or ideas (Zimmerling et al., 2018).

To sum up, the research on gamification mainly focuses on advertising, customer, brand management and product creativity in the marketing field. The research methods are mainly case studies and statements, with few

empirical studies. The theories adopted are mainly self-determination theory and flow theory, with a lack of research on Continuous Usage intention.

1.2 Research on continuous participation behavior

In the field of continuous participation behavioral research, the expectancy confirmation theory (ECT) proposed by Oliver (1980) is the most typical theory to explore consumer behavior. Bhattacharjee (2001) proposed a post-acceptance model of IS Continuance based on the expectancy confirmation theory and argued that users' willingness to continuous participation in information systems was similar to consumers' willingness to make repeated purchases and was influenced by the initial use or purchase experience. According to the characteristics of information system, this model modifies the original expectation confirmation model to make it better explain the intention of continuous usage of information system.

Scholars Basak et al. (2015) took Facebook as the research object and showed that users' attitude and satisfaction had a significant impact on individuals' willingness to continuous usage. Hu et al. (2017) took online live video programs as the research object, and found that broadcaster identification and group identification had an impact on audiences' willingness to continue watching. Wu et al. (2018) took social network game apps as an example, and found that perceived curiosity and perceived pleasure had a significant impact on users' willingness to continuous participation. Yang et al. (2018), taking Ant Forest (a Chinese e-business app) users as examples, found that perceived persuasiveness, achievement and perceived entertainment have significant effects on users' willingness to continuous participation.

To sum up, scholars based on expectation-confirmation theory to study the continuous participation mostly from the relational perspective like the user's attitudes, satisfaction, sense of identity and so on, less from the motivation perspective to treat gamification as an incentive to study its effects on user's continuous participation behavior.

1.3 Gamification and users' intention to continuous usage

Huang et al. (2019) studied the non-continuous use of gamified apps, they found that the value of gamified apps would affect user satisfaction, and the satisfaction would affect the users' willingness to non-continuous usage. Hassan et al. (2019) studied how motivational feedback increased user's benefit and continuous usage, they found that gamification would affect continuous usage through affective feedback, social feedback and information feedback. Thongmak(2017) studied the influence of gamification on students' learning of programming courses, they found that gamification could affect the satisfaction of continuous interaction intention. Feng et al. (2018), in their studying of the effects of gamification on users' participation in crowdsourcing, found that reward points and feedback had positive effects on users' participation.

1.4 Motivational affordances

Zhang (2008) first proposed the concept of motivational affordances with regard to the positive design of information and communication technology (ICT) in human-computer interaction, and constructed a theoretical model of psychological, cognitive, social and emotional motivational affordances, and proposed corresponding design principles on this basis.

Blohm and Leimeister (2013) carried out an exploratory analysis on gamification elements with motivational affordances, and related gamification mechanisms to corresponding user motivations, including achievement, thirst for knowledge, social recognition, cognitive stimulation and self-determination. Hamari et al. (2014) provided the theoretical framework of “affordances -- psychological outcome -- behavioral outcome” based on the background of gamification. Koivisto (2017) believes that although this conceptualized theory (affordances -- psychological outcome -- behavioral outcome) is still at a relatively preliminary level, it is the most appropriate understanding of the mechanism of gamification in the academic world at an abstract level.

Based on the theory of “affordances--- psychological outcome -- behavioral outcome”, this paper studies the influence of gamification on the persistent intention of mobile business users and divides motivation into three types (Self-presentation, entertainment and self-efficacy) according to the model proposed by Zhang (2008). Self-presentation refers to an individual's willingness and desire to express themselves to others regarding their identities (Baumeister & Hutton, 1987), Jung et al. (2007) indicates that competence/capability is an important predictor in explaining individual's self-presentation behaviors in online settings. Entertainment refers to the extent to which the execution of a certain behavior is perceived to be personally enjoyable and fun. Point rewarding mechanism is typically utilized by online platforms to motivate individual's intrinsic motivation to participate (Sjoklint, Constantiou, € & Trier, 2013). Self-efficacy refers to the belief in one's capabilities to organize and execute courses of actions required to manage prospective situations (Bandura, 1997). As individuals gain more experiences in a specific domain of tasks, their self-efficacy beliefs in completing the tasks are strengthened (Eastin & LaRose, 2000).

2. ASSUMPTIONS AND MODELS

2.1 Gamification and motivations

According to the theory of psychological needs, there are three main motivations for people to participate in activities: internal motivation, external motivation and internalized motivation (Ryan and Deci, 2000). Internal motivation is the innate driving behavior of human beings, which is caused by the fun and satisfaction that the activity itself can bring to individuals. And when people's inner needs are satisfied, it is possible to drive their internal motivation to participate in activities or to achieve the internalization of external motivation. Progress and a sense of accomplishment as an internal drive, will encourage players to continue to improve and acquire new skills. And this kind of progress will not only provide the players a chance of self-efficacy and self-presentation, but also to a certain extent bring the players the sense of pleasure. Based on this, this paper proposes:

H1a: Sense of achievement has a significant positive impact on self-presentation

H2a: Sense of achievement has a significant positive effect on entertainment

H3a: Sense of achievement significantly positively affects self-efficacy

Social Influence is related to activities inspired by what people think, do or say to each other, and includes all the social elements that motivate them: acceptance, competition, envy, the need not to feel excluded and companionship.

When users find that their friends possess something that they do not have or concern something that they do not know, they may, due to curiosity and jealousy, follow suit to pay attention to the behaviors, hoping to gain recognition from their friends through self-presentation, they may actively integrate into the circle of friends, further enhance friendship. Social interaction always unconsciously affect people's various behaviors, Paying attention to the Ant Forest score ranking, is conducive to show their ability. Participating in collecting the energy of the circle of friends is conducive to strengthening friendship. Based on this, this paper proposes:

H1b: Social Influence has a significant positive impact on self-presentation

H2b: Social Influence has a significant positive influence on entertainment

H3b: Social Influence has a significant positive impact on self-efficacy

Game design often gives users a sense of mission by creating a background story for the game. For example, "Ant Forest" in Alipay is such a kind of public welfare product that Public welfare organizations, environmental protection enterprises and other Ant ecological partners can buy the user's "tree" and plant a real tree in a real area. The product can make users more willing to use Alipay as a means of payment and Taobao as an online shopping platform. According to self-determination theory, people can analyze individual behavior

from three aspects: needs for competence, connection, and autonomy. Autonomy refers to the choice and execution of specific activities by individuals according to their self-consciousness. The stronger the sense of autonomy is, the higher satisfaction individual will be and the more fully they will be self-presented. Connection refers to a sense of belonging and attachment to other people, as well as the need to be recognized by organizations and groups through a spiritual identity and pleasure. Competency is the ability of an individual to match their position. It is a subjective judgment of a person's level and ability to perform a particular action or achieve a particular outcome in the future. Based on this, this paper proposes:

H1c: sense of ownership has a significant positive effect on self-presentation

H2c: sense of ownership significantly positively affects entertainment

H3c: sense of ownership significantly positively affects self-efficacy

2.2 Self-presentation and intention to continuous usage

Ma et al. (2007) showed that in the online community environment, self-presentation has an impact on user participation. Feng et al. (2018) studied the crowdsourcing platform, and found that self-presentation had an impact on the receivers participating in the crowdsourcing platform. In addition, Deng et al. (2016) also studied the Amazon crowdsourcing platform Mechanical Turk and found that one of the main motivations for the contractor to participate in Mechanical Turk is to better demonstrate his ability and create his own influence. Similarly, users continue to participate in the use of mobile apps in order to obtain more points, higher rankings, in order to better demonstrate their abilities. Based on this, this paper proposes the following assumptions:

H4: Self-presentation significantly positively affects users' intention to continuous usage

2.3 Entertainment and users' intention to continuous usage

Bilgihan et al. (2015) found that people's behavior in the network is to achieve both practical and enjoyable needs. Lee et al. (2013) using crowdsourcing as an example, found that the contractor participated in crowdsourcing in order to experience the entertainment brought by the entire crowdsourcing process. Ye et al. (2017) found that under the crowdsourcing platform, entertainment will positively affect the willingness of the contractors to participate. Motivation theory believes that work efficiency and labor efficiency are directly related to employees' work attitudes, while work attitude depends on the degree of satisfaction and motivation factors. Users participate in the use of mobile apps in order to get more points, higher rankings, in order to get a sense of enjoyment and accomplishment from the game elements, in order to better entertain themselves. This kind of entertainment is conducive to further increasing the frequency of users and increasing intention to continuous usage. Based on this, this paper proposes the following assumptions:

H5: Entertainment is significantly positively affecting users' intention to continuous usage

2.4 Self-efficacy and users' intention to continuous usage

Self-efficacy is a belief in people's ability to accomplish and characterize their goals, and is a subjective judgment of a person's level and ability to perform a particular behavior or to achieve a particular outcome in the future. Sun et al. (2015) found that in the context of crowdsourcing platforms, when the contractor develops a high level of self-efficacy for crowdsourcing, they will believe that they have the ability to complete the task and are more willing to participate in crowdsourcing. Similarly, users continue to use of mobile apps in order to obtain more points, higher rankings, in order to better demonstrate their ability to complete tasks, and thus more willing to continue to use. Based on this, this paper proposes the following assumptions:

H6: Self-efficacy significantly positively affects users' intention to continuous usage

According to the above analysis, the mechanism model of this paper is established, as shown in Figure 1.

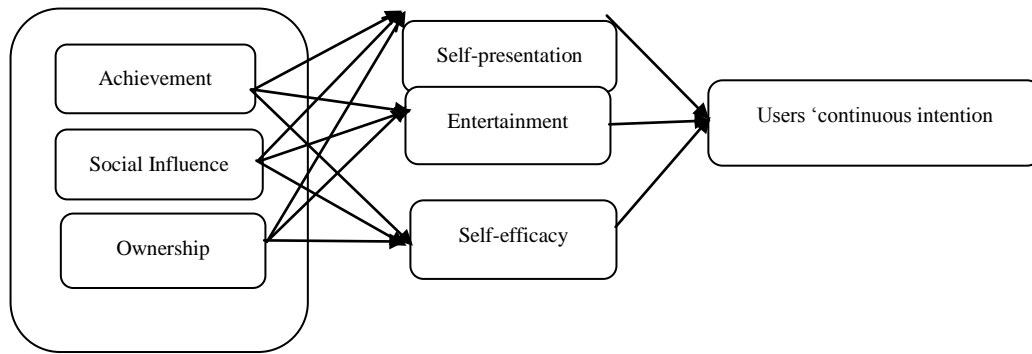


Fig. 1. The research model

3. RESEARCH METHODOLOGY

3.1 Measurement

Due to lack of mature scales, this paper develops new gamification measurement based on Chou's (2015) octagonal analysis and Brito's et al. (2018) scale. Alipay is taken as an example in the process of scale development and is submitted to experts in three related fields for discussion. Finally, the gamification is measured from three aspects: sense of accomplishment, social influence and ownership. The sense of accomplishment is tested by three items (e.g. when Alipay Ant Forest can provide me with energy points, I will actively participate in it). Social influence is formed by four items (e.g. When I use Alipay Ant Forest, I can make many friends). Ownership is composed of three items

The scales for self-expression are adapted from four items of online self-expression by Kim et al. (2012) (e.g. I want to confirm a preferred image in Alipay Ant Forest). The scales for entertainment are adapted from three items used by Wakefield et al. (2011) (e.g. Alipay Ant Forest aroused my curiosity), Self-efficacy is mainly measured with three items adapted from Feng et al. (2018) (e.g. I have full confidence in my ability to complete the tasks in the ant forest), The user's intention to continuous usage is measured by three items adapted from Wu et al. (2010) (e.g. I will actively use Alipay)

3.2 Sample and data collection

Data for this study was collected mainly from China's professional online research institutions (www.wjx.cn). The whole questionnaire takes Alipay Ant Forest as the research object and a preliminary 23 items were constructed. After the pre-test of 100 students, we add one more question "Please recall whether you have ever participated in the Alipay Ant Forest game?" in order to improve the authenticity and effectiveness of the questionnaire. A total of 500 questionnaires were collected in this questionnaire. After the removal of those incorrect data, the wrong answers, and the unanswered questionnaires, there were 456 valid ones, and the effective rate was 91.2%. Of this, 41.9% of the respondents were male and 58.1% were female; 82.2% were between the age of 18 and 34; 76.3% had at least college degree; 63.8% had monthly salary between 3000-10000 Chinese yuan; The occupation involved the students, the technical personnel, the professional, the sales personnel and so on.

4. DATA ANALYSIS AND RESULTS

4.1 The reliability test

Wu (2009) considered that $0.5 \leq \text{Cronbach's } \alpha < 0.6$ is acceptable; when $0.7 \leq \text{Cronbach's } \alpha < 0.8$, it is perfect. Except for the sense of ownership, The Cronbach value of all variables is between 0.701 and 0.8, indicating that internal consistency is acceptable (See Table 1).

Table 1. measurement and reliability

variables	items	Cronbach's α
sense of achievement	a1 when Alipay Ant Forest can provide me with energy points, I will actively participate in the Ant Forest a2 if I have a chance to grab a sapling in the virtual Forest, I will often use Alipay Ant Forest a3 when I win a complex challenge, Alipay Ant Forest will give me a Heshun reserve place(an environmental protection certificate) which offers me a sense of achievement	0.701
Social influence	b1 when I use Alipay Ant Forest, I will make many friends b2 when I use Alipay Ant Forest, it gives me a chance to show off or share my achievements b3 when I use Alipay Ant Forest, it is easier for me to talk to others and share ideas b4 when I use Alipay Ant Forest, it allows me to interact with others easily	0.784
sense of ownership	c 1 when I use Alipay Ant Forest, it helps me contribute to creating a better world c2 when I use Alipay Ant Forest, I feel particularly motivated because I can contribute to greater causes through it c3 when I use Alipay Ant Forest, I feel particularly motivated because it makes me feel as if I am the only one who has won the challenge	0.566
self-presentation	d1 I want to confirm a preferred image in Alipay Ant Forest d2 I want to show off my image in Alipay Ant Forest d3 I want to give others a preferred image in Alipay Ant Forest d4 I want to show an image of myself in Alipay Ant Forest	0.799
Entertainment	e1 Alipay Ant Forest aroused my curiosity e2 I feel attracted to Alipay Ant Forest e3 I am very happy to use Alipay Ant Forest	0.713
Self-efficacy	f1 I am confident to complete the tasks in the ant forest f2 I have professional skills to complete the tasks in the ant forest f3 I have the ability to complete the mission in the ant forest	0.749
user's intention to continuous usage	g1 I will actively use Alipay g2 I will continue to use Alipay in the future g3, I will often use Alipay in the future	0.776

4.2 Validity test

This paper carried out construction validity analysis through exploratory factor analysis, KMO=0.945, $p=0.000$, indicating that the data is suitable for factor analysis. The principal component method was adopted to maximize the variance by orthogonal rotation, and a total of seven factors were obtained, with a total explanation of 67.753%. From the results, the sense of achievement, social influence, sense of ownership, self-presentation, entertainment, sense of self-efficacy, and users' intention to continuous usage are all independent factors, indicating that the construction validity is good. In terms of convergence validity, Wu minglong (2017) [56] believed that when composite reliability (CR) is larger than 0.6 and average extraction

variance (AVE) is above 0.5, it would have a better convergence validity (as shown in table 2).

Table 2. Confirmatory factor analysis

factors	items	Standardized factor loading	Composite reliability (CR)	(AVE)
sense of achievement	a1	0.819	0.834	0.626
	a2	0.779		
	a3	0.774		
Social influence	b1	0.782	0.861	0.607
	b2	0.757		
	b3	0.794		
	b4	0.782		
sense of ownership	c1	0.720	0.775	0.535
	c2	0.753		
	c3	0.720		
self-presentation	d1	0.774	0.868	0.622
	d2	0.811		
	d3	0.792		
	d4	0.778		
Entertainment	e1	0.792	0.839	0.635
	e2	0.821		
	e3	0.777		
Self-efficacy	f1	0.837	0.856	0.665
	f2	0.770		
	f3	0.836		
user's intention to continuous usage	g1	0.808	0.870	0.691
	g2	0.847		
	g3	0.839		

In terms of discriminant validity, Wu (2017) believed that when the arithmetic square root of the mean extracted variance (AVE) of each factor was greater than the coefficient between it and other factors, the discriminant validity was better. (As shown in table 3)

Table 3. Discriminant validity test

	sense of achievement	Social influence	sense of ownership	self-presentation	Entertainment	Self-efficacy	intention to continuous usage
sense of achievement	0.791						
Social influence	0.418	0.779					
sense of ownership	0.623	0.676	0.731				
self-presentation	0.524	0.681	0.693	0.789			
Entertainment	0.639	0.554	0.671	0.600	0.797		

Self-efficacy	0.587	0.564	0.684	0.626	0.625	0.815	
intention to continuous usage	0.685	0.275	0.533	0.388	0.554	0.587	0.831

4.3 Common method biases

Concerning the common method bias testing, this paper, following Harman's single-factor test procedures, put all variables in one exploratory factor analysis and examined the unrotated factor solution to determine the number of factors that are necessary to account for the variance in the variables. The basic assumption of this technique is that if a substantial amount of common method variance is present, either (a) a single factor will emerge from the factor analysis or (b) one general factor will account for the majority of the covariance among the measures, we can determine the existence of serious common method biases. It was found that the explanatory power of the largest factor was 39.543 % (less than 40%), indicating that the common method bias in this model was weak.

4.4 Regression analysis

This paper mainly adopts smartpls3.0 for multiple regression analysis, and the results of hypothesis testing are shown in table 4

Table 4. Path coefficient and test results

assumption	coefficient	Standard deviation	T value	P value	Results
H1gamification—self-presentation	0.754	0.032	23.874	0.000	Supported
H1a sense of achievement - self-presentation	0.154	0.071	2.175	0.030	Supported
H1b Social influence - self-presentation	0.392	0.083	4.705	0.000	Supported
H1c sense of ownership - self-presentation	0.332	0.093	3.564	0.000	Supported
H2gamification—Entertainment	0.726	0.035	20.746	0.000	Supported
H2a sense of achievement - Entertainment	0.363	0.068	5.335	0.000	Supported
H2b Social influence - Entertainment	0.188	0.066	2.861	0.004	Supported
H2c sense of ownership - Entertainment	0.318	0.076	4.179	0.000	Supported
H3gamification—Self-efficacy	0.717	0.037	19.346	0.000	Supported
H3a sense of achievement - Self-efficacy	0.264	0.069	3.840	0.000	Supported
H3b Social influence - Self-efficacy	0.188	0.062	3.017	0.003	Supported
H3c sense of ownership - Self-efficacy	0.392	0.077	5.060	0.000	Supported
H4self-presentation - intention to continuous usage	-0.082	0.091	0.903	0.367	Not Supported
H5Entertainment—intention to continuous usage	0.336	0.088	3.802	0.000	Supported
H6Self-efficacy—intention to continuous usage	0.429	0.099	4.321	0.000	Supported

4.5 Mediation test

Referring to the mediation test procedure proposed by Zhao et al. (2010) [58], this paper first tested the coefficient a of the independent variable and the mediation variable, then the coefficient b of the mediation variable and the dependent variable. If $a*b$ was significant, there was a mediation effect, otherwise, there's no mediating effect. On this basis, the coefficient c of independent variable and dependent variable is tested. If c is significant, it is partially mediated, otherwise, it is a complete mediation. This paper mainly used smartpls3.0 for mediation testing, and the specific results are shown in table 5

Table 5. mediation test

Variable	coefficient (a*b)	Standard deviation	T Value	P Value
gamification—self-presentation—intention to continuous usage	-0.145	0.080	1.804	0.071
gamification—entertainment—intention to continuous usage	0.175	0.068	2.585	0.010
gamification—Self-efficacy—intention to continuous usage	0.250	0.075	3.333	0.001
Variable	coefficient c'	Standard deviation	T Value	P Value
gamification—intention to continuous usage	0.291	0.124	2.339	0.019

It can be concluded from Table 5 that self-presentation did not mediate between gamification and intention to continuous usage ($T = 1.804 < 1.96$, $P \text{ value} = 0.071 > 0.05$); entertainment partially mediated between gamification and intention to continuous usage ($T = 2.585 > 1.96$, $P = 0.010 < 0.05$); self-efficacy partially mediated between gamification and intention to continuous usage ($T \text{ value} = 3.333 > 1.96$, $P \text{ value} = 0.001 < 0.05$); gamification impacted intention to continuous usage ($T \text{ value} 2.393 > 1.96$, $P \text{ value} \text{ is } 0.019 < 0.05$),

5. CONCLUSION

5.1 Findings

5.1.1 Gamification and self-presentation

This study found that gamification and its three dimensions like sense of achievement, social influence and ownership were positively correlated with self-presentation. Gamification as an addictive system that uses game elements to influence non-game behavior consists of a complete set of institutions, mechanisms and rules to ensure that motivation works well. Users getting high scores and good rankings on the ant forest can display their strength and ability in front of others. The sense of achievement, social influence and ownership brought by scores and rankings will make it easier for them to present themselves to others or friends and better meet their needs.

5.1.2 Gamification and entertainment

The results indicate that gamification and its three dimensions as the sense of achievement, social influence and ownership are positively correlated with entertainment, and have significant positive effects on entertainment. Users who use Alipay Ant Forest hope to gain score, ranking, and to join in the environmental protection activities such as planting their own seedlings in Ala Shan area (a desert area in Inner Mongolia), for the purpose of meeting their own entertainment and enjoyment wants. This is consistent with the conclusion found by scholar Bilgihan et al. (2015) that the purpose of people's behavior in the network is to achieve both practical and hedonic needs.

5.1.3 Gamification and self-efficacy

Gamification and its three dimensions like sense of achievement, social influence and ownership are positively correlated with self-efficacy, and have significant positive effects on self-efficacy. Gamification provides people with opportunities to show their abilities, especially in non-game scenarios, through points and rankings. It can bring people a certain sense of achievement, social influence and ownership, which is conducive to improving people's sense of self-efficacy.

5.1.4 Intrinsic motivation and users' intention to continuous usage

Among the three intrinsic motivations, self-presentation is not correlated with users' intention to continuous usage, while entertainment and self-efficacy are. The reasons are that self-presentation does not guarantee that people are more willing to use mobile e-business apps; earning points and ranking in Alipay Ant Forest game can meet people's entertainment needs thus promote continuous usage intention; earning points and ranking in Alipay Ant Forest game are the proof of self-competency, the higher self-efficacy is, the stronger the intention to continuous usage.

5.1.5 Mediation effect of intrinsic motivation

The mediation effect of the three intrinsic motivators is different. Self-presentation does not mediate between gamification and the user's intention to continuous usage, while entertainment and self-efficacy do play a partial mediation effect. The purpose of users attending the Alipay Ant Forest activities are to present their image and ability, which does not guarantee their intention to continuous usage. Gaining points and ranking, to some extent, can fulfill people's entertainment and practical needs, thus partially mediate between gamification and user's intention to continuous usage

5.2 Managerial contribution

In reality, most of the stimuli come from external stimuli such as money, which can hardly give full play to users' creative and initiative. Therefore, gamification as an intrinsic motivation can improve users' participation frequency to some extent.

5.2.1 Focus on the selection of game elements

When carrying out marketing activities, enterprises should fully consider the design of game elements, combine and match different game elements, and make users better realize self-presentation through game elements such as points and ranking, so as to satisfy users' desire for entertainment and self-strength.

5.2.2 Focus on the user's internal needs

In the process of marketing, enterprises should fully consider the internal needs of customers, such as adding entertainment elements or challengeable programs, to stimulate users' interest and to enhance usage frequency and continuity.

5.2.3 Promote the practice of gamification marketing

Gamification (e.g. game elements) should be blended into marketing promotion activities, in order to enhance user's experience of game-like scenes, and improve their stickiness and continuous intention. Gamification marketing on the one hand can satisfy consumers' needs, on the other can reduce the cost of enterprises.

5.3 Limitations and future research

This paper mainly studies the influence of gamification on users' intention to continuous usage from the perspective of users' intrinsic motivation (self-presentation, entertainment and self-efficacy). User's game experience is not considered within the research process, and can be studied in the future

Last but not the least, the research object was limited to Alipay Ant Forest case which may not be so representative, future study may add more game-like activities into the research.

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How Emotional Attachment Effects Intention: The Case of Continuous Knowledge Sharing Intention in Virtual Community

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Abstract: Most existing researches explore continuous knowledge - sharing from the perspective of the rational cognition. This paper argues that the continuous intention and behaviors should be influenced by long-term emotional factors, and it can be explored from the perspective of emotional attachment to the influential factors of continuous knowledge sharing willingness of virtual communities. Based on the Expectation Confirmation Theory, this paper introduced the attachment and constructed a model of virtual community users' continuous knowledge sharing intention. Structural equation modeling method is used to analyze the data and verify the model. The results show that attachment not only has a direct positive effect on the long-term knowledge sharing intention of virtual community users, but also mediated the relationship between satisfaction, perceived usefulness and the intention of continuous knowledge sharing.

Keywords: continuous knowledge sharing, attachment, expectation confirmation theory, virtual community

1. INTRODUCTION

In the era of knowledge economy, virtual community has become an important platform for people to communicate and share information and knowledge. Virtual communities bring together users with common interests, hobbies and interpersonal relationships to create a good learning and exchange atmosphere for users and promote the flow of information and knowledge in the community as well as the creation of new technology, new ideas. The realization of the value of virtual community depends on the voluntary investment of time and energy by members of the community, as well as their own experience and knowledge, which contradicts the assumption of rational man in economics. Therefore, how to realize the sustainability of users' knowledge sharing behavior is an important problem for the long-term development of virtual communities.

Many scholars have conducted in-depth studies on persistent behavior^[1-3]. These studies mainly explain the continuous knowledge sharing behavior from the perspective of rational factors (such as cost, benefit, etc.). However, the emerging information system represented by the virtual community, which is mostly used by individuals, not purely pursuing economic benefits, so it is not suitable to adopt rational judgment mode to study^[4].

Continuous user behavior depends on satisfaction, which is a generalized state of mind that revolves around uncertain expectations and consumers' pre-adoption experiences^[5]. That is to say, people's continuous use behavior has a strong subjective emotional color. Attachment is the emotional connection and bond between people or people and the environment. As a psychological model of long-term interpersonal relationship dynamics, attachment has a low value intensity and a long duration, which is suitable for explaining long-term persistent behaviors. Therefore, this study attempts to construct the continuous knowledge sharing model of virtual community from the perspective of emotional attachment, and further explores the effect of attachment on users' long-term intention of knowledge sharing of different types in the virtual community.

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2. THEORETICAL BACKGROUND

2.1 Virtual communities and continuous knowledge sharing

Knowledge sharing behavior refers to the behavior that users with common interests, expectations and background voluntarily share knowledge through publishing, answering and discussing questions based on their common interests in the virtual community^[6]. When the user repeatedly participates in the knowledge sharing activity, the user's knowledge sharing behavior again will develop into the continuous knowledge sharing behavior^[7]. The continuous knowledge sharing behavior of users includes not only the continuous behavior process, but also the methods and means to manage and promote the continuous knowledge sharing^[8]. The continuous knowledge sharing behavior explored in this paper is defined as the behavior that virtual community voluntarily carries out different types of knowledge sharing activities for a long time.

2.2 Expectancy - confirmation theory

Expectation Confirmation Theory (ECT) is the basic Theory of studying consumer satisfaction proposed by Oliver^[9]. Bhattacharjee, A^[5] first introduced the expectation-confirmation theory into the information systems domain, suggesting that the information system user's continuous use decision is similar to the consumer's buyback decision, and is a continuation of the initial adoption decision, influenced by the initial use, and may lead to the termination of the initial adoption. As an information system that relies on user participation and interaction, the research on the continuous participation behavior of virtual community users should draw on the research results of the continuous use behavior of information system users. Further research believed that users' initial sharing behavior could help other members to achieve performance equal to or higher than expected (honor or excitement), which would result in confirmation or positive unconfirmed, and meanwhile increase users' satisfaction with knowledge sharing^[10]. This means that the ECT model has strong explanatory power for both first-time and reuse by users of the virtual community.

Although ECT theory is widely used to explain the willingness of information systems to persist after adoption, it does not explain the possibility that long-term persistent behavior may lead to irrational factors. Since there is no guarantee that every knowledge sharing can bring positive feedback to the knowledge provider, the ECT model of after-thought expectation and confirmation belongs to cognitive judgment, which does not go beyond the short-term perspective and has certain limitations.

Pleasant emotions have a stronger effect on the user's ongoing behavior than perceived usefulness^[11]. Further research refined the role of emotion into specific activities and pointed out that emotional experience value had a significant positive impact on the co-creation of participation value^[12]. Thus, the continuous creative sharing behavior of users may be affected by emotional attachment. The influence of emotional attachment on the long-term behavior of virtual community should be stronger than the previous cognitive judgment. When emotional attachment to the virtual community is enhanced and negative cognitive judgments coexist, emotional attachment will dominate the user's behavioral tendency.

At present, there is no theoretical basis to directly prove that virtual community attachment leads to continuous willingness to share knowledge. Users' knowledge sharing behavior in the virtual community will generate immersive experience, and such experience dominated by psychological emotion will promote users' willingness to experience with high expectations again, so as to continue to repeat the knowledge sharing behavior^[13]. However, immersion experience is essentially a short-term psychological feeling, and it does not penetrate into the long-term emotional factors that have a stronger impact on user behavior. The intrinsic motivation of users' long-term knowledge sharing behavior is irrational, which needs to be explained by emotional factors that are closer to the instinctive behavior and can explain the long-term interpersonal relationship dynamics.

2.3 Attachment theory

Based on the previous discussion, there is a lack of research on the willingness of continuous knowledge sharing in virtual communities from the perspective of long-term emotion. Therefore, this paper introduces the theory of attachment into the context of continuous knowledge sharing in virtual community.

Attachment theory is a psychological model that attempts to describe the dynamics of long-term and short-term human relationships, which is suitable for explaining long-term persistent behavior. The initial attachment of an individual is to one's parents, and at other moments in his life, the individual can also establish a lasting attachment to others outside the family^[14]. Further research transformed interpersonal attachment into personal and group attachment, believed that attachment was the core of various relationships in brand community^[15]. Knowledge sharing is a purposeful interaction between the sender of knowledge and the receiver of knowledge. In this interaction process, both users promote the development of the community, and the effect of the community on the relationship between users may also be strengthened through attachment. Attachment, one of two strategies used in connection research, can infer emotional connections in social networks.

In this paper, attachment is defined as a long-term and strong emotional connection that users show to a self-consistent virtual community. This positive emotional attitude can shorten the psychological distance between the community and customers and enhance the active degree of knowledge sharing in the community. Attachment can promote the long-term knowledge sharing behavior of users in the virtual community, and enable knowledge providers to continue knowledge sharing on the premise of ensuring positive confirmation of users, even if they have to pay more costs.

3. STUDY MODELS AND ASSUMPTIONS

The continuous knowledge sharing behavior of virtual community is similar to the buyback decision behavior of consumers. Therefore, this study still takes ECT theory as the basic theory of this study, introduces the latent variable of attachment on this basis, and studies the continuous knowledge sharing behavior of virtual community from the perspective of psychological emotion. The research model is shown in Figure 1.

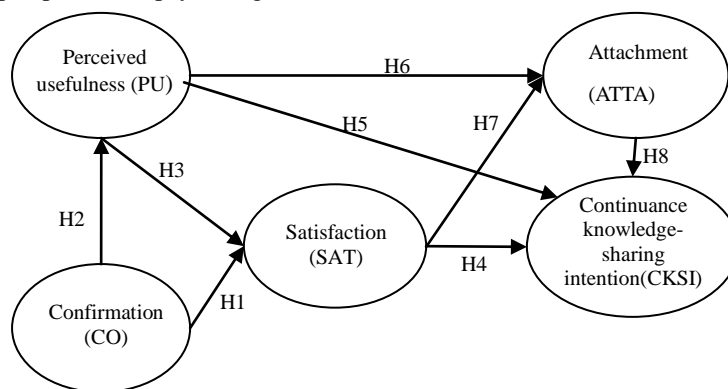


Figure 1. Research model

Expectancy confirmation theory assumes that users' satisfaction is determined by their expectation of information system and expectation confirmation after actual use. Users determine their satisfaction based on the expected standard evaluation^[9]. Accordingly, we divide the expectation of knowledge sharing into high expectation (the effect that knowledge sharing is expected to achieve) and low expectation (the impact that knowledge sharing is not expected to have). Before knowledge sharing, community members will have an expectation of its effect (ex ante expectation), and the ex post expectation generated after the user's first knowledge sharing behavior is compared with ex ante expectation. If the expectation afterwards meets the expectation beforehand, confirmation is generated. In user's knowledge sharing behavior, the user's ex-ante

expectations of the usefulness of knowledge sharing significantly affects users' post-acceptance affect (satisfaction)^[16].

H1: The degree of confirmation of community members is positively correlated with their satisfaction with knowledge sharing.

H2: The degree of confirmation of community members is positively correlated with their perceived usefulness to knowledge sharing

H3: The perceived usefulness of community members is positively correlated with their satisfaction.

Perceived usefulness and satisfaction are both effective indicators of the user's continued willingness. Satisfaction includes the sense of experience in the process of user interaction in the virtual community and the value evaluation after knowledge sharing behavior^[17]. When users are satisfied with their past knowledge sharing experience in virtual communities, they are more likely to have the next knowledge sharing behavior. The higher the user's perception of the performance of using the platform in the virtual community, the more likely they are to have the willingness to contribute their knowledge to communicate with other users^[18]. After users share knowledge in the virtual community, they gain practical expertise, which improves work efficiency and saves the cost of searching for knowledge. Also, their idea will be broadened and inspired, and their willingness to continue knowledge sharing will become stronger^[19].

H4: Community members' satisfaction with knowledge sharing for the first time is positively correlated with their willingness to share knowledge continuously.

H5: The perceived usefulness of community members is positively correlated with their continuous knowledge sharing intention .

As a new IS system, users' attachment to virtual community IS influenced by subjective factors. Usefulness has a positive effect on organizational attachment in the context of Internet brand community^[20]. Also, it has been found that satisfaction has a significant predictive effect on users' attachment to the virtual community through an empirical study on XiaoMi community^[21]. For the virtual community, users will become attached to the organizational environment after they expect to obtain strong satisfaction based on information, benefits and satisfaction from knowledge sharing. Therefore, this paper proposes the following hypothesis:

H6: Perceived usefulness is positively correlated with attachment.

H7: Satisfaction is positively correlated with attachment.

As a long term emotion, attachment may affect human behavior. Further empirically study based on the model of continuous use of information system, believed that attachment has strong motivation and tendency, which can prompt users of virtual reading community to consume resources and generate behavioral reactions such as continuous use^[22]. User's excellent experience of knowledge sharing in the virtual community will produce a pleasant feeling, and this psychological feeling will promote users' continuous knowledge sharing^[23]. Therefore, this paper proposes the following hypothesis:

H8: Attachment is positively correlated with the intention of continuous knowledge sharing.

4. SCALE DESIGN AND DATA

4.1 Scale design

The research model of this paper includes 5 potential variables, each of which is composed of 3~4 measurement variables. In order to ensure the content validity of potential variables and measurement variables, all potential variables and measurement variables in the research model in this paper were adapted from the existing literature. Confirmation, satisfaction and willingness to continue knowledge sharing are all adapted from the study of Bhattacharjee, A^[5] et al. Perceptual usefulness was adapted from the study of Davis, F.D^[24]. Attachment is adapted from the study of Allen, N.J^[25]. Measurement variables were measured using a 7-point

Likert scale, with 1 indicating strong disagreement and 7 indicating strong agreement. The scale of this study is shown in Table 1.

Table 1. contents and sources of measurement variable

Noun	Main points (questions)	Source
Perceived usefulness	Sharing knowledge is good for me	Davis. F.D etc [24]
	When completing a specific task, using virtual community for knowledge sharing can improve work efficiency	
	Knowledge sharing makes it easier for me to get things done	
Confirmation	My knowledge sharing experience in the virtual community was better than I expected	Bhattacharjee,A etc. [5]
	My actual experience of sharing knowledge with other users in the virtual community was better than I expected	
	In general, most of my expectations for the virtual community were met.	
Satisfaction	I like to share knowledge with others in the virtual community	Bhattacharjee,A etc. [5]
	I am satisfied with the experience of sharing knowledge in virtual communities	
	My experience with knowledge sharing in virtual communities has been very rewarding	
Attachment	The virtual community I use is important to me	Allen, N.J, etc [25]
	I miss virtual communities when I haven't used them for a long time	
	I have an emotional attachment to the virtual community	
Continuance knowledge-sharing intention	If possible, I would like to continue to share knowledge in the virtual community in the future	Bhattacharjee,A etc. [5]
	I will continue to share knowledge with other virtual community users in the future	
	I am confident that I can reply to or add comments to messages or articles posted by other members of the virtual community	
	I will use this virtual community as often as I do now	

4.2 The data collection

Before the formal questionnaire was issued, this paper conducted a preliminary survey. Firstly, 25 college students with knowledge sharing experience were invited to participate in the pre-survey, and some statements of the questionnaire were adjusted according to their feedback. Subsequently, this study conducted a formal survey on users of virtual communities (ZhiHu, BaiDu TieBa, etc.) by means of online questionnaire survey. After eliminating invalid questionnaires (the filling time is less than 180 seconds), 209 samples were finally obtained. The statistical table of basic information of these samples is shown in Table 2.

Table 2. basic information statistics of respondents

Category	Item	Frequency	Percentage (%)
Gender	male	98	46.89
	female	111	53.11
Age	<18	7	3.35
	18-25	103	49.28
	26-35	73	34.93
	More than 35	26	12.44
Record of formal	Junior high school or below	16	7.66
	High school	120	57.42
	Undergraduate course	58	27.75
	Bachelor degree or above	15	7.18

Category	Item	Frequency	Percentage (%)
Virtual community knowledge sharing experience	Less than 6 months	37	17.70
	Six months to a year	34	16.27
	1-3 years	89	42.58
	More than 3 years	49	23.44

5. DATA ANALYSIS AND RESULTS

5.1 Validation of measurement model.

The validity of measurement model is usually expressed in content validity, convergent validity and discriminant validity. In terms of content validity, all the potential variables and measurement variables (items) in this paper are adapted from the existing literature, so as to ensure that the measurement model has a good content validity. As shown in Table 3, average variance extracted (AVE) for each construct both exceed 0.50, indicating that the measurement model in this paper has ideal convergent validity^[26]. The Reliability of the measurement model can be tested by Composite Reliability (CR) and Cronbach's alpha. All CR and AVE values are significant and meet the recommended thresholds(>0.7)^[28]. Therefore, the measurement model in this paper has a good reliability.

Table 3. AVE, Cronbach's alpha and CR values of the model were measured

	Item number	AVE	Cronbach's alpha	CR
ATTA	3	0.719	0.805	0.884
CKSI	3	0.648	0.818	0.880
CO	3	0.802	0.876	0.924
PU	3	0.814	0.885	0.929
SAT	4	0.674	0.759	0.861

Discriminant validity can be tested by comparing the square root of potential variable AVE with the correlation coefficient between potential variable. When the square root of potential variable AVE is larger than the correlation coefficient between potential variable AVE and other variables, it indicates that the measurement model has good discriminant validity^[28]. Table 4 shows that the AVE square roots of potential variables in the measurement model are all larger than the correlation coefficients between this variable and other variables. The result suggest an adequate discriminant validity of the measures.

Table 4. correlation coefficients between potential variables and AVE square root

	ATTA	CO	CKSI	PU	SAT
ATTA	0.848				
CKSI	0.705	0.827			
CO	0.709	0.657	0.896		
PU	0.723	0.700	0.715	0.902	
SAT	0.791	0.689	0.731	0.733	0.820

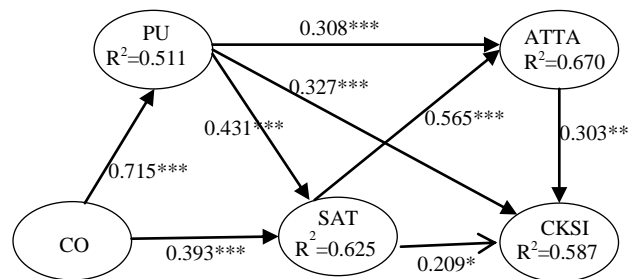
Table 5 shows loading and cross-loading analysis. It can be seen that item loadings in the corresponding columns are all higher than the loadings of the items used to measure the other constructs. The same is true across the rows. Both results further verify that the measurement model has good convergent validity and discriminant validity.^[28]

Table 5. loadings and cross-loading

	ATTA	CO	CKSI	PU	SAT
ATTA1	0.885	0.697	0.683	0.668	0.751
ATTA2	0.863	0.574	0.590	0.671	0.656
ATTA3	0.792	0.513	0.502	0.478	0.591
CO1	0.659	0.906	0.619	0.680	0.685
CO2	0.630	0.915	0.619	0.636	0.667
CO3	0.613	0.864	0.523	0.601	0.607
CKSI1	0.595	0.506	0.848	0.558	0.569
CKSI2	0.547	0.562	0.764	0.568	0.619
CKSI3	0.614	0.583	0.852	0.627	0.573
CKSI4	0.506	0.453	0.749	0.488	0.443
PU1	0.669	0.652	0.615	0.912	0.663
PU2	0.677	0.691	0.679	0.914	0.677
PU3	0.606	0.587	0.596	0.879	0.643
SAT1	0.536	0.478	0.424	0.446	0.735
SAT2	0.670	0.648	0.578	0.661	0.852
SAT3	0.724	0.653	0.665	0.668	0.871

5.2 Research model results

Partial Least Squares (PLS) Structural Equation Model (SEM)^[24] was used to verify the research Model. Its significance was tested by bootstrap repeated sampling method. The number of repeated samples was selected as 5000 in this paper, larger than the threshold value(500)^[28]. The results of the research model are shown in Figure 2.



*** means $p < 0.001$; ** means $p < 0.01$; * means $p < 0.05$

Figure 2. Results of the research model

It can be seen that R (explained variance) of perceived usefulness, satisfaction, attachment and Continuance knowledge-sharing intention are 0.511, 0.625, 0.670 and 0.587, indicating that the research model has a good prediction effect^[28].

Confirmation has a significant positive impact on users' perceived usefulness and satisfaction with knowledge sharing in virtual communities (0.715, 0.393), so hypothesis H1 and H2 are established. Perceived usefulness of users has a significant positive impact on user satisfaction and willingness to continue knowledge sharing (0.431, 0.327). Hypothesis H3 and H5 are established. Satisfaction also significantly positively affected the willingness to continue knowledge sharing (0.209), assuming that H4 was true. Perceived usefulness has a significant positive impact on attachment (0.308). Hypothesis H6 is valid. Satisfaction has a significant positive

impact on attachment (0.565), and hypothesis H7 is valid. In terms of the effect of emotional attachment, attachment significantly positively affects the willingness of users to continue knowledge sharing in the virtual community (0.303), assuming that H8 is valid.

5.3 Mediating effect test

To test the mediating effect of attachment, Baron and Kenny's^[29] steps were used to test the mediating effect.

Step 1: Test whether the regression coefficient c of independent variable (IV) versus dependent variable (DV) is significant

Step 2: Whether the regression coefficient a of independent variable \rightarrow mediating variable (M) is significant.

Step 3: Test the influence of independent variables and mediating variables on dependent variables, and the influence of both mediating variables and independent variables is significant, indicating the influence of part of mediating variables on dependent variables.

The mediating effect test results of emotional attachment are shown in Table 6.

Table 6. Mediating effect of attachment to virtual community

					IV+M \rightarrow DV	
IV	M	DV	IV \rightarrow DV	IV \rightarrow M	IV	M
SAT	ATTA	CKSI	0.696***	0.791***	0.353***	0.426***
PU	ATTA	CKSI	0.701***	0.724***	0.396***	0.418***

*** means $p < 0.001$; ** means $p < 0.01$; * means $p < 0.05$

The model analysis results of the above mediating variable M show that, on the one hand, satisfaction and perceived usefulness have a direct positive effect on the intention of continuous knowledge sharing, that is, the higher the degree of satisfaction of users with virtual community knowledge sharing and the degree of usefulness of users with knowledge sharing, the more willing the users are to continue knowledge sharing. On the other hand, satisfaction and perceived usefulness have an indirect positive effect on the willingness to continue knowledge sharing through the user's attachment on the community. In other words, the higher the user's satisfaction and usefulness degree of knowledge sharing in the virtual community is, the more likely they will become attached to the virtual community, and the attachment will affect the user's willingness to continue knowledge sharing.

6. DISCUSSION AND REVALATION

In this paper, the continuous knowledge sharing model of virtual community is constructed from the emotional perspective of psychology, and the latent variable of attachment is introduced on the basis of expectation confirmation model to discuss the continuity of knowledge sharing intention of users in virtual community from the long-term situation.

6.1 Satisfaction and positive confirmation work together on continuous knowledge sharing

Satisfaction and positive confirmation of knowledge sharing in virtual communities significantly affect user satisfaction ($t > 3.29$). The higher the user satisfaction is, the more consistent the ex-post feelings and ex-ante expectations of the knowledge sharing behavior of the virtual community are, and the higher the value brought by the behavior is. The value brought by users' effective knowledge sharing in virtual communities will help users increase the promotion of the virtual community among their friends. This trend can increase the users' attachment to the virtual community, and reduce the promotion cost of the virtual community as well.

6.2 The effect of attachment on the continuous intention of knowledge sharing of virtual community users in the long-term context

The research results show that attachment not only has a direct and significant positive impact on the long-term sustainable intention of knowledge sharing of virtual community users, but also mediates the relationship between satisfaction, perceived usefulness and sustainable intention of knowledge sharing.

On the one hand, attachment to the virtual community reflects the importance of the virtual community in the eyes of users. As shown in figure 2, the explanatory quantity of attachment to the intention of continuous knowledge sharing in virtual community is 0.303, second only to perceived usefulness, and its importance is higher than satisfaction, which is an important decisive factor of continuous knowledge sharing in virtual communities. For users who are accustomed to sharing knowledge in virtual communities, knowledge sharing behavior has become an essential part of their daily lives, and gradually developed into emotional attachment, and the willingness to pay extra for virtual communities such as personal time and energy resources, in the virtual community knowledge sharing activities. In this case, attachment to the virtual community represents the users' strong cognitive and emotional connection to the virtual community and can be one of the influencing factors in the long run.

On the other hand, the attachment part mediates the influence of perceived usefulness and satisfaction on the intention of continuous knowledge sharing. Specifically, perceived usefulness and satisfaction can change users' attitudes and emotions towards virtual communities (attachment to virtual communities), thus further affecting users' willingness to continue knowledge sharing. This indicates that perceived usefulness and satisfaction have a long-term slow effect on the intention of continuous knowledge sharing in virtual communities. Perceived usefulness is users' cognitive judgment of the virtual community, which will affect their attitudes towards the virtual community (such as satisfaction), and thus affect the tendency and behavior of knowledge sharing. At the same time, the continuous accumulation of perceived usefulness and satisfaction will gradually change users' feelings towards the virtual community and make them generate their attached to the virtual community. Users will regard the virtual community as a part of them and are willing to spend more time, energy, knowledge and other personal resources on knowledge sharing in the virtual community. Under the effect of this emotional mechanism, users' willingness to share knowledge in the virtual community is more permanent and stable. Users' attachment to the virtual community often means continuous participation and use, including voluntary contribution, blind exclusion and many other irrational factors. This emotional attachment transcends the rational judgment of the user. Although the user's long-term knowledge sharing behavior will inevitably produce some dissatisfied behavior perception, this dissatisfied perception will be partially diluted due to the role of attachment. Even if the long-term behavior will produce several unpleasant experiences, the user will continue to use this virtual community because of the user stickiness formed by the accumulation of previous satisfaction.

This indicates that the manager of virtual community needs to conduct fine management on users at present. For first-time users or potential users, the emphasis of management should be placed on guiding and encouraging users to share knowledge, and the satisfaction of users will be improved through a series of incentive mechanisms and personalized services. For loyal users, the key to reducing user loss should focus on deepening users' attachment to the virtual community through internal factors such as the atmosphere, culture and activities of the community, so as to enhance user stickiness.

6.3 Short-term and long-term factors affecting knowledge sharing

The research results show that among the influencing factors of continuous knowledge sharing behavior in virtual communities, the effect of perceived usefulness on the willingness of continuous knowledge sharing is greater than the effect of attachment on it. This is because perceived usefulness, which means whether the users

believe that the behavior is beneficial to themselves, plays a leading role in affecting the short-term effects of knowledge sharing. Attachment is a long-term influencing factor caused by the goodwill of a virtual community and may promote the creation of knowledge sharing behavior. Its effect will not be obvious because of the time span. From a product perspective, a virtual community is a service experience product. Users are no longer just receiving information. They also pay more attention to the experience of sharing behaviors. A long-term good experience will promote the provision and dissemination of knowledge and make the allocation of long-term knowledge resources more efficient.

7. CONCLUSION

This research combines expectation confirmation theory and attachment theory, and explores the common influence of cognitive and emotional factors on the willingness of virtual communities to continue knowledge sharing. The results show that perceived usefulness, satisfaction and attachment all significantly affect the willingness to continue knowledge sharing. The role of attachment mediating perceived usefulness and satisfaction on continuous knowledge sharing. This study theoretically combines the theory of attachment with the theory of expectation confirmation, expanding the scope of knowledge sharing research. The findings of this study can help virtual community developers recognize the direct and mediating effects of attachment and develop appropriate content, functions and services, and it has some practical significance.. In addition, the research in this paper has a certain time limitation, and the future research can add some new variables generated by the development of virtual community on the basis of this paper, so that the research can be meet the needs of the long-term construction of virtual community.

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Idea Response and Adoption in Open Innovation Communities: The Signaling Role of Linguistic Style

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Abstract: Organizations are increasingly using open innovation communities to gain external ideas and foster user innovation. However, mass user generated content is making idea selection a tricky and time-consuming work. From the perspective of linguistic styles, this article explores the effect of writing style cues in the content of ideas (i.e., negative emotionality, self-interest oriented, cognitive oriented, future oriented) on idea response and adoption. 1,579 ideas collected from the Fantasy Westward Journey Online II forum are used to extract writing style cues. The hypothesis tests, via logistic regression models, demonstrate that the linguistic styles of ideas can indeed function as a signaling role and deliver novel insights into the relationship between these linguistic cues and the likelihood of idea responses and adoption. Specifically, a community member's use of self-interest oriented, cognitive oriented and future oriented writing styles has a positive effect on idea response; negative emotionality and cognitive oriented writing styles signal more possibility of idea adoption. This study offers theoretical implications by extending the innovation management research stream to the big data era and also provides managerial implications that can lead to more effective exploitation of open innovation communities.

Keywords: open innovation community, user innovation, linguistic style, idea response, idea adoption

1. INTRODUCTION

Organizations are increasingly using open innovation communities (OICs) to gain external ideas and foster user innovation. However, OICs are data-rich, cloud-based environments that can quickly overwhelm community managers and most ideas submitted by members are of low quality. Therefore, the issue of finding promising innovation ideas has attracted enormous attention from scholars. Prior studies mainly focus on behavioral data, and the exploitation of textual data is largely lagged behind. In fact, natural language processing techniques such as writing style analysis can be utilized to understand and analyze the postings ideas. A focus on language styles ("how it is said") is preferable to a focus on language content ("what is said") because detection models need to function across all innovation challenges and only language styles are independent of the context ^[1]. Members' communication style alignment symbolically reflects their community identification ^[2]. In view of this, our research focuses on solving the following issues: (1) can the writing styles of ideas affect OIC community managers' response behavior? (2) can the writing styles of ideas affect community managers' adoption behavior? (3) Is there any difference in the factors affecting idea response and adoption?

2. THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Four representative indexes (i.e. negative emotionality, self-interest oriented, cognitive oriented and future oriented writing styles) were selected to conduct data analysis. Emotional words are pretty common if a member wants to emphasize his/her passion and conviction regarding the idea. The pronouns such as "I", "you", "we", and "they" are essential expression when writing a post. Positive emotional and self-interest writing styles could be used to detect inferior member participation (IMP) ^[3]. As cognitive oriented writing style reflects how well elaborated contributions are, the number of cognitive words has been used to measure members' participation

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quality. Compared with the current situation, participants will inevitably use more future words when formulating novel ideas. Taken together, we can conclude that negative emotionality, self-interest oriented, cognitive oriented and future oriented linguistic styles are classical expression in members' posts. Our hypotheses focus on the effects of these four writing style cues on idea response and adoption.

3. RESEARCH METHODOLOGY

We obtained data from the OIC of Fantasy Westward Journey Online II (www.xyq.netease.com), which is one of the most famous massively multiplayer online role-playing game (MMORPG) in China. Our data collection included all information available on this OIC between October 2018 and November 2019. After data cleaning, 1,579 ideas posted by 1,181 community members were selected. Logistic regression is used to test our hypotheses with binary dependent variables. Since different ideas may originate from the same contributor, we adopt robust standard errors clustered within each contributor to account for possible heteroskedasticity and autocorrelation of errors within contributors in our analysis.

4. RESULTS

Through descriptive statistics and correlation matrix, we get a rough understanding of these data. None of the variables suffer from major multicollinearity issues as the maximum of the VIFs equals 1.22. The final regression results demonstrate that the linguistic style expressed in idea content does play the signaling role and can be the guidance for organizations to filter ideas. In particular, (1) utilizing self-interest oriented, cognitive oriented and future oriented writing styles when posting ideas has a positive and significant impact on manager's response behavior, while the negative emotionality writing style has no significant effect; (2) member's use of negative emotionality and cognitive orientated writing styles has a positive and significant impact on manager's idea adoption behavior, while self-interest oriented and future orientated writing styles have no significant effect.

5. CONTRIBUTION

All of these findings are of great significance both in theory and in practice. Theoretically, this article proposes a new perspective for idea selection and responds to the call in the innovation literature. Moreover, we broaden the research scope of linguistic style in innovation management field. Finally, we increase the generalizability of empirical results by gathering data from an online game OIC. From a managerial perspective, our research offers insights that can facilitate better exploitation of OICs. First, participants should leverage linguistic style and be aware of using specific vocabulary to increase the likelihood of idea attention. In addition, analyzing the writing style cues expressed in idea content can be a shortcut to filter ideas for managers. Further study could use other methodological advances in big data analytics, consider company-specific factors by conducting enterprise surveys, and extend to other similar communities to increase the generalizability of our results.

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The Impact of Corporate Social Responsibility on the Trust Repair of Brand with Negative Publicity: Mental Account as a Mediator

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Abstract: With the development of internet and popularity of mobile terminals, negative publicity of brand has become more and more widespread. This paper aims to study the impact of corporate social responsibility (CSR) on the trust repair of brand with negative publicity. From Chinese cultural aspect of the differential mode of association, CSR is divided into public morality behavior and private one. The concept of mental account is introduced as a mediating variable and CSR history as a moderate one. By a 2 (CSR type: public VS. private morality behavior) × 2 (CSR history: long VS. short) between group experiment, it is found that public morality is more likely to be classified into charity account by consumers, thereby promoting integrity-based trust repair; private morality is more likely to be classified into remedy account, thereby promoting ability-based trust repair. Public morality behavior with long history is more tend to be attributed to charity account by consumers; and CSR including public and private one with short history are more tend to be attributed to remedy account by consumers.

Keywords: corporate social responsibility, mental account, negative publicity, trust repair

1. INTRODUCTION

With the development of Internet and popularization of mobile terminals, the influence of enterprises' negative exposures is more extensive, and the harm is far more than before. In recent years, the negative exposure of enterprises such as Hai Di Lao hotpot chain "back kitchen incident", Ctrip child abuse incident and so on, not only brings great damage to the reputation of the enterprise involved in the incident, but also seriously reduces consumers' trust of the market. A large number of studies show that trust breach will cause negative effects such as revenge, psychological contract damage and uncooperative behavior. So how can the company repair damaged trust after negative exposure? In addition to deny, apology, recall and some other ways, how does CSR affect trust repair? What is the mechanism of the repair? And what is the boundary? Previous literature doesn't well answer these questions. This study, introducing mental accounts, explores the differences between different CSR on the trust repair of negative exposure brands, the mediating role of mental account in the above relationships, and the moderating role of CSR history between CSR and mental account. This study makes contributions to the previous trust repair research, and provides theoretical guidance for enterprises to correctly and timely fulfill CSR to cope with negative exposure crisis.

2. LITERATURE REVIEW

2.1 Corporate social responsibility (CSR)

CSR is an important academic concept, which refers to the organization's behavior and policy in a specific context based on the stakeholder's performance expectations for balance in economic, social, and environmental aspects (Aguinis & Glavas, 2012)^[1]. CSR goes beyond the corporate responsibility of shareholders in the past,

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emphasizing the social responsibility of corporate, including shareholders, employees, consumers, communities and governments. Homburg, et al. (2013) divided CSR into commercial and philanthropic responsibilities^[2] from a stakeholder perspective. Chinese scholar Tong, al. (2015) based on the "5 human relationships of 5 generations" from the cultural aspect of the differential mode of association, divide CSR into public and private morality behavior, and hold that the morality behavior acted to government, shareholders, employees, partners and consumers belongs to private morality behavior, while the morality behavior outside these belongs to public one^[3]. This paper will use Tong's classification to divide CSR into public and private morality behavior.

2.2 Trust repair

Trust is the core relationship between business and consumer. When the trustors perceive their expectations are not in accordance with the behavior of the trustee, there is a breach of trust. But many researches prove trust can be repaired. Kim, et al. (2004) argued that the enterprise's efforts, such as active social responsibility not only help to restore consumer trust, but also even make the repaired trust exceed the past level^[4]. Xie and Peng (2009) summarized previous studies on trust methods as affective, functional, and informative repair strategies^[5]. Base on the previous research of trust breach and repair, this paper divides trust repair into capability and integrity trust repair.

2.3 Mental account

In 1985, Richard Thaler formally put forward the theory of "mental account". He thinks including individual, family, enterprise, and so on, all have the mental account system. Mental account has its own unique accounting rules which are different from traditional economic account. People often make irrational decisions based on this accounting. Existing research on mental account mainly focuses on the cognition of wealth on the funds owned by people. This study tries to explore how consumers view the financial and material inputs of enterprises to fulfill their social responsibilities from the outside. This paper divides the consumer's mental account into remedy account and charity one, the former refers to the expenses incurred by the enterprise fulfilling its social responsibility to recovery from the crisis, and the latter refers to the expenses incurred to promote the well-being of the whole society.

3. MODEL AND HYPOTHESIS

3.1 Model

Basing on the review of previous studies, we divide CSR into public and private morality behavior from the cultural aspect of the differential mode of association, and introduce the concept of "mental account" as a mediator to explore how different types of CSR affect consumer trust repair, and the moderating role of CSR history between CSR behavior and mental account. The research framework of this paper is shown in Figure 1:

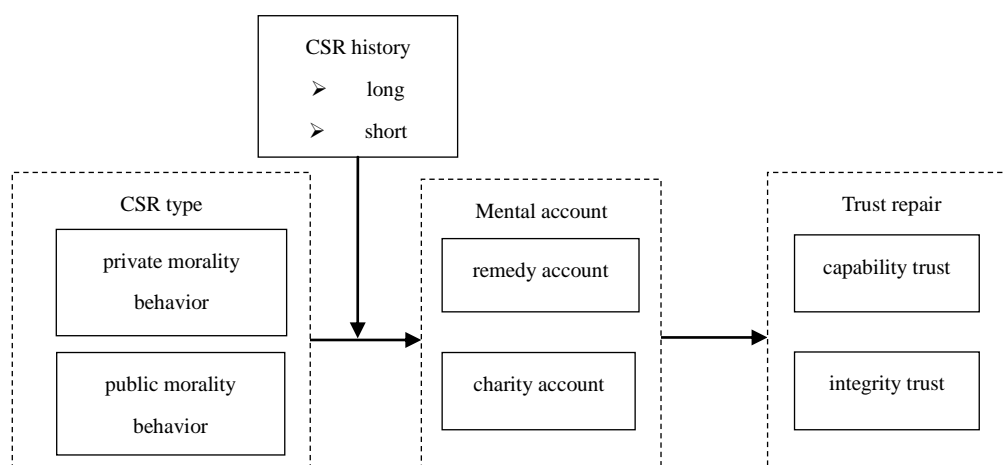


Figure 1. Research framework

3.2 Hypothesis

(1) The impact of CSR on consumer trust repair

CSR belongs to the legitimate ethical behavior of the enterprise, so CSR can generate a strong sense of trust. Compared with the initial trust, the trust repair after the product harm-crisis belongs to the "non-zero starting point", and the occurrence of the breach makes the trust party reinterpret and evaluate the past relationship between the two sides. Dirks et al. (2011) proposed two trust repair mechanisms: perceived confession and perceived prevention^[6]. After the product-harm crisis, compared with the public morality behavior, the private one is more likely to make the public perceive the enterprise's hypocrisy. Tong, et al. (2015) found that private morality behavior made consumers more likely to generate corporate capacity association, thus can promote the ability trust repair; public one made consumers more likely to generate corporate integrity association, which can promote the integrity trust repair. Thus hypothesis H1 is proposed:

H1: Different types of CSR lead to different dimensions of consumer trust repair.

H1a: Compared with public morality behavior, private one tends to repair capacity trust.

H1b: Compared with private morality behavior, public one tends to repair integrity trust.

(2) The intermediating role of mental account

Consumers will judge the motivation of the money spent on CSR activities. They may divide the expense into two categories: charity and remedy account. When an enterprise engages in public morality behavior, consumers will tend to think that it is altruistic, the enterprise is contributing to the society. So consumers will include the behavior of the enterprise in the charity account. However, when enterprises engage in private morality behavior, especially after the negative exposure, consumers will think that the enterprises is self-interest and its CSR is used to copy with the crisis to minimize the negative impact, in this case, consumers will classify the CSR expense as a remedy account. Thus hypothesis H2 is proposed:

H2: Different types of CSR are classified by consumers as different mental accounts.

H2a: Private morality behavior compared with public tends to be classified as remedy account.

H2b: Public morality behavior compared with private tends to be classified as charity account.

(3) Mediating role of mental account

The theory of social exchange holds that all activities carried out by people are in pursuit of various kinds of social resources that can meet their own needs. The breach of trust of enterprises will bring material and emotional losses to consumers, and consumers will reduce their trust in the enterprise in order to prevent their own resources from being devalued in the future, thus triggering a series of negative behaviors such as reducing buying, abandoning the enterprise and spreading negative reputation. A series of efforts by companies after the negative exposures are aimed at reducing the sense of disequilibrium that consumers feel in the exchange. When consumers classify corporate CSR behavior as a charity account, they tend to think that the enterprise is willing to contribute its own strength to social development, so consumers will feel that the exchange with the enterprise is valuable, consumers will tend to trust that enterprise is integrity; and when the CSR behavior of the enterprise is classified as a remedial account, consumers will tend to think that the enterprise is capable and good at improving its own products, consumers can obtain better products in the future exchange, so they are willing to trust the enterprise. Thus hypothesis H3 is proposed:

H3: Different mental accounts have different dimensions of consumer trust repair.

H3a: Remedy accounts are more likely to repair capacity trust than charity ones.

H3b: Charity accounts are more likely to repair integrity trust than remedy ones.

The hypothesis H4 can be deduced by combining H2 with H3:

H4: Mental account plays a mediating role between CSR and trust repair.

(4) The moderating role of CSR history

In this study, CSR history is divided into long and short one. Long CSR history refers to enterprise has been engaged in various CSR activities for a long time before it suffers from negative exposure, Short CSR history refers to enterprise engaged in social responsibility just after it suffers from negative exposure. The CSR history plays a moderating role in the process of CSR acting on trust repair, which can be explained by the anchoring effect. When people make decisions, they pay more attention to the initial information. If a company engages in CSR for a long time, it will generate halo effect, and the public morality behavior after the crisis is more likely to be classified as a charity account. But if the CSR history of the enterprise is short, no matter the CSR behavior is public or private, both are regarded as the tool to copy with the crisis, which is easier attributed to the remedy account. Thus hypothesis H5 is proposed:

H5: CSR history plays a moderating role in CSR type and mental account.

H5a: Compared with short CSR history, companies with a long CSR history, the differences between public and private morality behaviors is classified as charity account by consumers is more significant.

H5b: Compared with companies with a long CSR history, for companies with a short CSR history, the differences between public and private morality behaviors is classified as remedy account by consumers is insignificant.

4. EXPERIMENT AND PRETEST

4.1 Pretest

The control material is first developed. We use company S to avoid the subject's bias, and adapt the negative exposure events that occur in real life. In the simulated scenario material, we first give a brief introduction of company S, and then describe its negative exposure, the series of CSR activities conducted by Company S, and its CSR history. Following the material, we display the definition of public morality behavior and private one. Then, we have a pretest. 22 undergraduate students were recruited to test the authenticity of the simulated situation in the questionnaire, and whether the subjects could accurately judge the type and the history of CSR. Among the 22 subjects, 20 subjects accurately judged the CSR type, accounting for 91%, and 21 subjects thought the events described in the simulation scene were authentic, accounting for 95.5%, and all the subjects were able to accurately judge the CSR history. The manipulation is successful.

4.2 Formal experiment

In this study, we design a 2 (CSR type: public morality VS. private morality behavior) \times 2 (CSR history: long VS. short) between group experiment. The control material of above is used. The measurement of mental account is edited according the combination of past research. Charity account and remedy account has 3 items respectively. The measurement of consumer trust is based the scale of Mayer and Kim (2004) including 3 items of capability trust and 3 items of integrity trust respectively. Likert 7-level scale is introduced. The formal experiment consists of four scenarios, 40 questionnaires are distributed in each scenario, 158 questionnaires are collected and 26 invalid questionnaires are eliminated. In the end, 132 valid questionnaires are obtained, with an effective rate of 82.5%. More than 30 questionnaires are guaranteed for each scenario.

5. DATA ANALYSIS

5.1 Reliability and validity check

Cronbach's Alpha examination results: charity account 0.901, remedy account 0.907, capability trust 0.805, integrity trust 0.884, all are greater than 0.7, indicating good reliability of the questionnaire. KMO test results: charity account 0.747, remedy account 0.754, capability trust 0.708, integrity trust 0.724, all are greater than 0.7. Bartlett spherical test probability is 0.000 which is less than 0.001, indicating that the questionnaire has good

structural validity. Because all the questions in the questionnaire are adapted from the mature scales, the questionnaire has good content validity.

5.2 hypothetical test

5.2.1 CSR type and consumer trust repair

Table 1. Capability trust, integrity trust mean comparison

Test variables	Independent variable	Single sample T test				Independent sample T test		
		Mean	T	Df.	Sig.	T	Df.	Sig.
Ability trust	Public morality	4.1940	31.132	66	0.000	-6.440	130	0.000
	Private morality	5.2872	51.820	64	0.000			
Integrity trust	Public morality	5.1791	52.680	66	0.000	-13.22	130	0.000
	Private morality	3.1846	27.723	64	0.000			

(1) Capability trust.

In the public morality control group, the subject's capability trust mean $M=4.1940$, $t=31.132$, $df=66$, $p<0.05$; in the private one, the subject's capability trust mean $M=5.2872$, $t=51.80$, $df=64$, $p<0.05$. It can be seen that the mean of capability trust in private morality control group is obviously greater than that of public one, and $p<0.05$, which is significant, so hypothesis H1a can be proved.

(2) Integrity trust

In the public morality control group, the subject's integrity trust mean $M=5.1791$, $t=52.68$, $df=66$, $p<0.05$; in the private one, the subject's integrity trust $M=3.1846$, $t=27.723$, $df=64$, $p<0.05$. It can be seen that the mean of integrity trust in the public morality control group is obviously greater than that in the private one, and the $p<0.05$, which is significant, so hypothesis H1b can be proved.

5.2.2 CSR types and consumer trust repair

Table 2. Remedy account, charity account mean comparison

Test variables	Independent variable	Single sample T test				Independent sample T test		
		Mean	T	Df.	Sig.	T	Df.	Sig.
Remedy account	Public morality	3.0597	28.403	66	0.000	-19.111	130	0.000
	Private morality	5.6154	71.885	64	0.000			
Charity account	Public morality	5.1542	52.023	66	0.000	-20.398	130	0.000
	Private morality	2.5590	32.354	64	0.000			

(1) Remedy account.

In the public morality control group, the subject's remedy account mean $M=3.0597$, $t=28.403$, $df=66$, $p<0.05$; in the private one, the subject's remedy account mean $M=5.6154$, $t=71.885$, $df=64$, $p<0.05$. It can be seen that the mean of remedy account in the private morality control group is obviously greater than that in the public one, and $p<0.05$, which is significant, so hypothesis H2a can be proved.

(2) Charity account

In the public morality control group, the subject's charity account mean $M=5.1542$, $t=52.023$, $df=66$, $p<0.05$; in the private one, the subject's charity account mean $M=2.5590$, $t=32.354$, $df=64$, $p<0.05$. It can be seen

that the mean of charity account in the public morality control group is obviously greater than that in the private one, and the $p < 0.05$, which is significant, so hypothesis H2b can be proved.

5.2.3 Mental account and consumer trust repair

We conduct a regression analysis using mental account as independent variable and trust repair as dependent variable.

Table 3. The result of capability trust regression

Modles		Non-standardized coefficient		Standardized coefficient	T	Sig.
		B	S.E.	Trial version		
1	(Constant)	6.084	0.241		25.270	0.000
	Charity account	-0.349	0.058	-0.466	-6.013	0.000
2	(Constant)	3.330	0.269		12.360	0.000
	Remedy account	0.325	0.059	0.435	5.507	0.000

It can be seen from table 3, $p < 0.05$, indicating that compared to charity account, remedy account is more significantly positive related to capability trust. H3a is proved.

Table 4. The result of integrity trust regression

Modles		Non-standardized coefficient		Standardized coefficient	T	Sig.
		B	S.E.	Trial version		
1	(Constant)	1.636	0.215		7.614	0.000
	Charity account	0.661	0.052	0.746	12.761	0.000
2	(Constant)	6.920	0.249		27.821	0.000
	Remedy account	-0.631	0.054	-0.713	-11.580	0.000

It can be seen from table 4, $p < 0.05$, indicating that compared to remedy account, charity account is more significantly positive related to integrity trust. H3b is proved.

5.2.4 Mediating effect test

Table 5. The indirect effect of CSR on Y

Y	M	Effect	BootSE	BootLLCI	BootULCI
Ability mean	Remedy account	0.912	0.3243	0.6226	0.7115
Integrity mean	Charity account	0.818	0.2474	0.5360	0.8642

It can be seen from table 5 that the bootstrap confidence interval of indirect effect of the capacity mean are both positive, which indicates that mediating effect of remedy account is significant, and the bootstrap confidence interval of indirect effect of the charity mean are both positive, which indicates that mediating effect of the charity account is significant. H4 is proved.

5.2.5 Moderating effect of CSR history test

Taking the mental account as the dependent variable, ANOVA analysis is conducted. The results are showed as follows:

Table 6. The result of CSR history moderating effect test

Source		Type III square sum	df	Mean square	F	Sig.
Correction Model	Charity account	240.952	3	80.317	202.798	0.000
	Remedy account	218.270	3	72.757	125.982	0.000
Intercept	Charity account	1958.558	1	1958.558	4945.275	0.000
	Remedy account	2484.988	1	2484.988	4302.898	0.000
CSR history	Charity account	16.672	1	16.672	42.096	0.000
	Remedy account	1.932	1	1.932	3.345	0.070
Type of corporate social responsibility	Charity account	225.039	1	225.039	568.214	0.000
	Remedy account	216.914	1	216.914	375.600	0.000
CSR * CSR history	Charity account	1.879	1	1.879	4.745	0.031
	Remedy account	0.889	1	0.889	1.540	0.217
Error	Charity account	50.694	128	0.396	—	—
	Remedy account	73.922	128	0.578	—	—
Total	Charity account	2275.000	132	—	—	—
	Remedy account	2753.556	132	—	—	—
Corrected total	Charity account	291.646	131	—	—	—
	Remedy account	292.192	131	—	—	—

a. $R^2=0.826$ (adjusted $R^2=0.822$)

— Public morality

b. $R^2=0.747$ (adjusted $R^2=0.741$)

- - Private morality

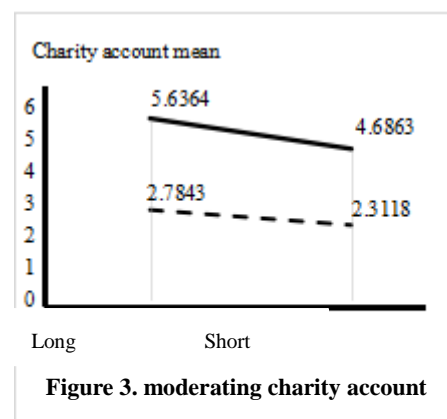
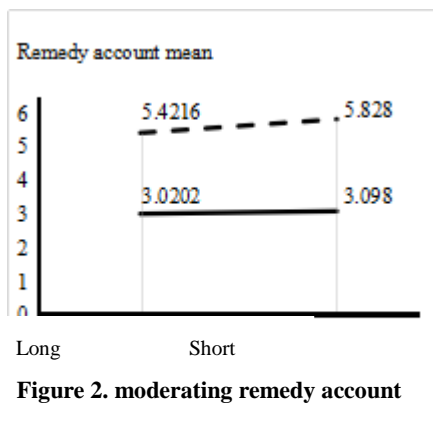


Table 6 shows that CSR type and the history of CSR have a cross significant impact on consumer trust repair, but this effect is mainly manifested in the impact on charity accounts, $p=0.031<0.05$, that is, the behavior of public morality of enterprises with a long history of CSR is more likely to be attributed to charity accounts by consumers, and the CSR with short history is easily attributed to remedy account even if it is engaged in public morality, $p=0.217$, so H5 can be proved.

6. CONCLUSIONS

This study explores the impact of CSR on the trust repair of brand with negative publicity which is a supplement to previous research on consumer trust repair. Firstly, this paper divides CSR into public and private morality from Chinese cultural aspect of the differential mode of association, which makes this study have Chinese local characteristics. Secondly, it introduces mental account as a mediating variable which provides a new explanation for consumers' perception of CSR. Thirdly, this paper introduces CSR history as a moderate variable between CSR and mental accounts, and finds the boundary of CSR to repair brand trust. This research also brings some management implications to companies experiencing negative publicity. First of all, CSR is a good tool to repair consumer trust when companies suffer from negative exposure, but if they want to maximize the role of CSR, they should take reasonable measures based on the type of crisis and damage. There are still limitations in the paper: firstly, this paper adopts the method of scenario experiment, the subjects are mainly student, which leads to external validity questions. Future studies should select more representative and broader samples to further improve validity. Secondly, this study only examines the impact of the mental account as cognitive process, and future research should consider the impacts of emotional factors.

ACKNOWLEDGEMENT

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A Model Construction for Investigating the Impact of Enterprise Social Media Affordances on Employees' Perceived Creativity

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Abstract: Enterprise social media (ESM) is increasingly applied in modern enterprises to promote knowledge sharing and social interactions among employees, and has an important potential for enhancing employees' creativity. However, it is still unclear whether ESM can help boost employee creativity, and the technical design factors that cast ESM as a creativity support system needs investigation. To fill this research gap, this study constructs a research model based on the affordance lens to examine the influences of association and visibility affordances of ESM on employees' perception of creativity. The moderating role of job autonomy in the relationship between ESM affordances and employees' perceived creativity is further explored. Conclusions and implications of this study will be discussed.

Keywords: enterprise social media, creativity support system, affordance, job autonomy

1. INTRODUCTION

Creativity support systems (CSS) have attracted much attention in organizational practice and academic research due to the important value for employee innovation and subsequent organizational competitive advantage ^[1]. As an emerging communication and collaboration tool based on Web 2.0 technology, Enterprise social media (ESM) plays an important role in promoting employee performance, knowledge sharing and organizational learning ^[2], and has the potential for stimulating creative thinking and new perspectives. However, whether ESM can help boost employee creativity and act as a CSS still needs to be explored.

Affordance provides an alternative perspective for social media research by taking into account both technical capabilities and user goals. Scholars have focused on different affordances in existing research, such as visibility, editability, persistence, association, and searchability ^[3]. Among these affordances, visibility and association are closely related to creativity. Visibility can improve employees' understanding of the organizational environment ^[4], make communication and social network more transparent, reduce knowledge stickiness, and promote knowledge interaction and collaboration among employees. Association helps to enrich employees' social networks and social capital, break down hierarchical constraints within the organization, expose employees to different sources of knowledge, gain different ideas, opinions and perspectives, and thus accelerate the creative process ^[5]. Therefore, this study focuses on the effect of the visibility and association affordances of ESM on employees' perceived creativity.

As an important situational condition, job characteristic has an important impact on employees' creativity by influencing their work motivation. In the CSS literature, the interaction between job characteristics and technical factors on employee creativity has not received much attention. Among the five dimensions of job characteristics, job autonomy means that employees have more control over employees in their work, which enables employees to actively manage the work environment to get more returns ^[6]. Therefore, we consider that the job autonomy will affect employees' motivation to utilize ESM affordances for innovation. Based on the

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above, this study aims to address the following two research questions: (1) Do the visibility and association affordances of ESM affect employees' perceived creativity? (2) Does job autonomy have a moderating effect on the relationship between ESM affordances and employees' perceived creativity?

2. RESEARCH METHOD

An online questionnaire survey targeting at the full-time employees who use Dingtalk was conducted to test the effectiveness of the research model. The measurement items for each variable were based on the existing literature.

3. DISCUSSION AND IMPLICATIONS

This study can enrich relevant academic research and provide guidance for enterprise practice. In terms of theoretical contributions, this study takes job autonomy as a situational condition to explore the influence of ESM affordances on employees' perceived creativity, and examines whether ESM can act as a CSS, which can further enrich research on CSS. This study also adopts the perspective of affordances and comprehensively considers technical capabilities and user intentions to explore the influences brought by ESM.

With regard to practical contributions, this study provides guidance for employees to make use of the visibility and association affordances of ESM for innovation. This study also provides guidance for designers to consider whether it is necessary to increase the visibility and association affordances of ESM. Finally, by exploring the moderating effect of job autonomy, this study helps managers consider entrusting authority or tasks to capable co-workers or subordinates, so as to motivate them to innovate with ESM affordances.

ACKNOWLEDGEMENT

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Research on Medical Overtreatment Based on LDA and Structural Equation Model

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Abstract: Medical overtreatment has caused a lot of waste of medical resources. In the face of the increasingly serious medical overtreatment phenomenon, it is of great significance to clarify the factors of medical overtreatment to help solve this problem in China. In this study, we use the medical overtreatment text as a corpus and use latent Dirichlet allocation (LDA) topic model for topic extraction. Based on the extracted topics, a path model is established and the structural equation model (SEM) is used to test the path model. Finally, the influence factors of medical overtreatment are obtained. The results show that this study has extracted three main reasons that affect medical overtreatment, namely doctors, hospitals and patients. The factors influencing doctors' medical overtreatment are the institutions, benefits, and induced demand. The factors that affect patients' overtreatment are health and medical insurance. The factors that influence hospitals' medical overtreatment are monopoly, economics, and management. These factors significantly affect the occurrence of medical overtreatment. Therefore, public health organizations should proceed from these three aspects and formulate effective measures to solve the problem of medical overtreatment.

Keywords: medical overtreatment, influencing factors, LDA, SEM

1. INTRODUCTION

Medical overtreatment is a diagnosis and treatment that exceeds the actual needs of patients, causing unnecessary waste of medical resources and lost of patients^[1]. With the development of medicine and the advancement of science and technology, although more and more medical problems have been solved, medical overtreatment problem have become increasingly prominent and have gradually become world-class medical problems. Although different countries have different systems, they all have serious over medical treatment. Lyu Heather^[2] surveyed the extent to which 2,106 physicians at the American Medical Association used medical overtreatment care in their practice. The results showed that 20.6% of medical care, 22.0% of prescription drugs, 24.9% of examinations, and 11.1% of surgery were unnecessary at the time of treatment. The WHO recommends the use of antibiotics in hospitals as 30%. In China, the median use of antibiotics in patients is as high as 79%, which is more than double the recommended use rate worldwide^[3]. In the face of the increasingly medical overtreatment phenomenon, exploring the causes of medical overtreatment and finding solutions is of great significance for maintaining the smooth operation of China's health service.

Many scholars have studied and published opinions on the causes of medical overtreatment. Shi^[4] pointed out from the perspective of large hospitals that the extensive operation and management of hospitals will lead to the increase of operating costs which are ultimately transferred to patients, and inevitably lead to the phenomenon of medical overtreatment. Zhu^[5] said that the information asymmetry between doctors and patients will lead to doctors to implement medical overtreatment behaviors. Chioloroa^[6] pointed out in the research on prevention of medical overtreatment problems that patients have a strong subjective demand for diagnosis and medication to promote medical overtreatment problems.

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However, the way of the above research is subjective inference of influencing factors, lack of empirical analysis of the results, and few literatures use empirical analysis to study medical overtreatment issues. In this context, this paper uses machine learning and empirical analysis to explore the issue of medical overtreatment. We use the LDA topic model and perplexity to determine the optimal number of topics, reveal the influencing factors of medical overtreatment and establish a path model, and finally use the structural equation model to verify the path model.

2. STRUCTURE EQUATION MODEL AND LATENT DIRICHLET ALLOCATION

2.1 Structure equation model

Karl Joreskog first constructed a structural equation model (SEM) to study multivariate relationships [7]. SEM is a commonly used empirical analysis model to find the structural relationship between variables. In SEM, latent variables can be used for target analysis, but they cannot be directly observed. Observed variables can be directly measured to estimate latent variables and support target analysis. SEM can reflect the relationship between latent variables and observed variables, making variables that could not be directly observed can be measured and embedded in the system of equations that reflect causality [8].

SEM has been widely used in various fields, such as high-order factor analysis, path analysis and causal analysis, etc. It can measure the relationship between variables, such as causal and co-occurrence. The relationship between the variables can be visualized by using a path model. In the schematic diagram of the structural equation model, an ellipse is used to represent the latent variable, a rectangle is used to represent the observed variable, a single arrow indicates a causal relationship, and a two-way arrow indicates a co-occurrence relationship. As shown in Figure 1, the figure contains three observation variables X1, X2, X3 and one latent variable Y, among which X1 and Y, X2 and Y are causal relationships, X3 and Y are co-occurrence relationships, ε is the error term. μ is the path coefficient, indicating the degree of relationship between variables [9].

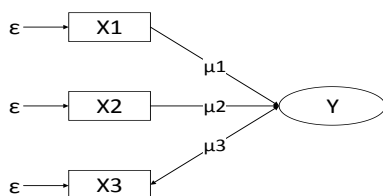


Figure 1. SEM diagram

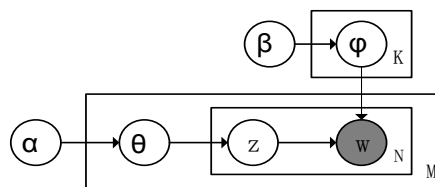


Figure 2. LDA model

2.2 Latent Dirichlet allocation

The latent Dirichlet allocation (LDA) topic model was proposed by BLEI In 2003. It is essentially a three-layer Bayesian model, which can extract the research topics contained in the text [10]. The LDA model consists of three parts: documents, topics, and words. It can retain the essential statistical information in the corpus and process the documents quickly and efficiently.

The LDA topic model is an unsupervised algorithm that can effectively analyze unstructured document sets and extract multiple topics from it. When the model is generated, it is assumed that "each word selects a certain topic with a certain probability, and selects a certain word from this topic with a certain probability". The LDA model is shown in Figure 2. M represents the total number of articles in the corpus, K represents the number of topics set, N represents the number of all words, and W is the number of words observed. θ is a matrix of $M * K$, which represents the topic distribution of the document. Φ is a matrix of $K * V$ (V represents the vocabulary of all words that appear in all training corpora), which represents the word distribution of the topic. α is the hyperparameter of the Dirichlet distribution of θ , and β is the hyperparameter of the Dirichlet distribution of Φ [11]. Therefore, the probability of the i th word in the document can be calculated by equation (1).

$$P(w_i) = \sum_{j=1}^K P(w_i|z_i=j)P(z_i=j) \quad (1)$$

In the formula, $P(z_i = j)$ indicates the probability that the word selected from the article is topic j , and $P(w_i|z_i = j)$ indicates the probability that the word taken is i when the topic is j ^[7].

The process of LDA topic modeling is expressed as follows:

- (1) Select $\vec{\theta}_i \sim \text{Dir}(\vec{\alpha})$, $i \in \{1, 2, \dots, M\}$
- (2) Select $\vec{\varphi}_k \sim \text{Dir}(\vec{\beta})$, $k \in \{1, 2, \dots, K\}$
- (3) For each word position $w_{i,j}$, $j \in \{1, 2, \dots, N\}$, $i \in \{1, 2, \dots, M\}$
 - ① Choose a theme from $z_{i,j} \sim \text{Mul}(\theta_i)$
 - ② Choose a word from $w_{i,j} \sim \text{Mul}(\Phi_{z_{i,j}})$

2.3 Perplexity

In natural language processing, perplexity evaluation is one of the important methods in measuring the pros and cons of language probabilistic models. The lower the model's perplexity, the stronger the generalization ability of the model, and the better the model's effect^[11]. The perplexity formula is expressed as equation(2):

$$\text{perplexity}(D) = \exp \left(- \frac{\sum_{d=1}^M \log p(w_d)}{\sum_{d=1}^M N_d} \right) \quad (2)$$

In the equation(2), D is the test set in the corpus, M is the total number of documents, N_d is the number of words in each document d , w_d is the word in document d , and $p(w_d)$ is the probability of the word w_d in the document.

3. ANALYSIS PROCESS USING LDA WITH SEM

This paper combines LDA and SEM methods to explore and analyze the important factors affecting medical overtreatment. The main process flow is corpus extraction → topics extraction → construction of path model → analysis by SEM. The process is shown in Figure 3.

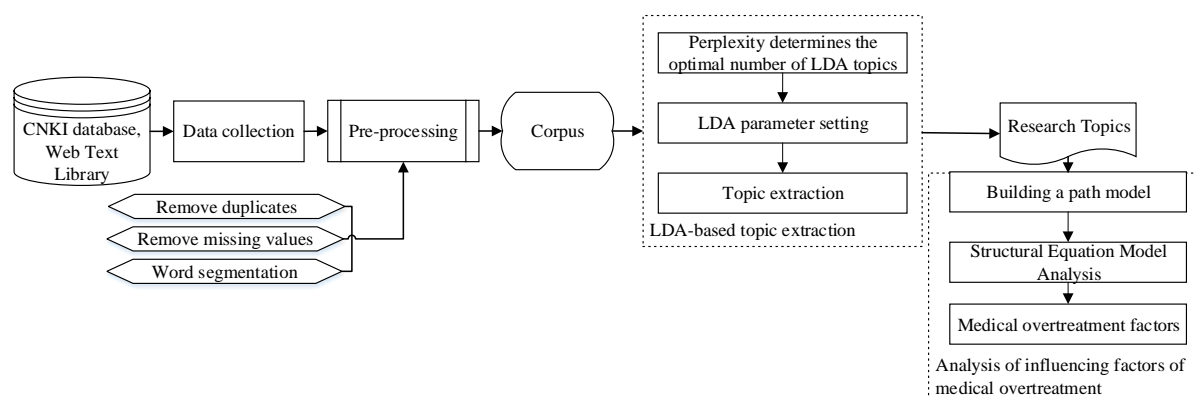


Figure 3. LDA and SEM construction process

3.1 Corpus extraction

The step of corpus extraction is mainly based on the data mining method to obtain text data, and then through filtering the text, deleting missing items, segmenting words, removing stop words, loading custom dictionaries and other pre-processing operations to form a corpus for easy reading and analysis.

3.2 Topics extraction

The topic extraction uses LDA topic modeling method. During the topic modeling, a suitable number of topics needs to be selected. Too few topic selections will lead to reduced interpretable information and accuracy; while too many topic selections may cause unrecognition topics to lead to a decrease in the reliability of the data^[12]. Therefore, the choice of the number of topics is generally 3-8. In the traditional LDA topic extraction, the number of topics is often determined based on experience. Generally, the optimal number cannot be directly

selected. In order to ensure a suitable number of topics, a perplexity auxiliary topic selection can be selected. The lower the value of perplexity, the better the corresponding number of topics^[13]. The topic names is determined according to the keyword contribution, the relationship between topics and the relationship between documents in LDA analysis results.

3.3 Construction of path model

The words in the results generated by the LDA topic model are arranged in descending order according to the degree of contribution. After removing the words that have no practical meaning to the topic, three words with higher contributions are selected as observation variables, and the word frequency is used as a measure of the observed variables. When choosing words, we avoid choosing the same words for different topics. After the latent variables and observation variables are determined, the path model of the latent variables pointing to the target variable can be determined.

3.4 Analysis by SEM

The word distribution data and the established path model were used for SEM analysis, and the Amos software was used to detect various indicators. In order to verify the fitting degree of the model, representative model fitting indexes GFI (goodness fitness index), CFI (comparative fitting index), and RSMEA (root mean square error of approximation) were selected for measurement. The GFI index needs to be greater than 0.9 and less than 1, the closer to 1, the better the effect; RSMEA should be less than 0.1, preferably less than 0.08; the CFI value is greater than 0.9 and less than 1, the closer to 1, the better the effect^[9].

4. MODEL BUILDING TESTING

4.1 Corpus extraction

In order to study the influencing factors of medical overtreatment, this paper uses data mining to crawl the data. The main sources of data include web review articles, web news and CNKI text related to medical overtreatment. In the final collected data, there were 27 web review articles, 54 web news, 160 CNKI papers, and a total of 241 relevant texts. After preprocessing, this was used as a corpus for subsequent analysis.

4.2 Topics extraction and construction of path model

In the process of topic extraction, this paper uses the method of perplexity evaluation to determine the optimal number of topics. This paper calculates the perplexity of different topic number models.

As the topic number changes, the value of the perplexity will also fluctuate. When the topic number is 4, the perplexity values the lowest, as shown in Figure 4. Therefore, the best topic number for the model can be determined to be 4.

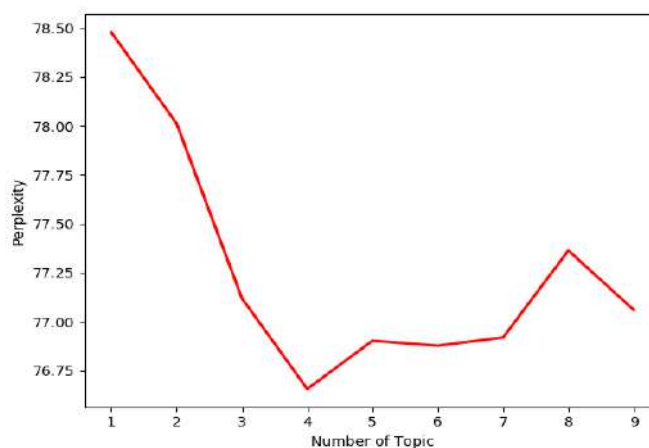


Figure 4. Number of topics-curve of perplexity

We use the LDA topic extraction method provided by the gensim package, set the number of extracted topics to 4, and iteratively filter out words that are not related to the topic and output related words. The results are shown in Figure 5.

Part of the samples are extracted from the corpus, and content mining is carried out in the way of deep reading. It is found that the categories of doctors, hospitals, and patients promote the occurrence of medical overtreatment. By observing the expression categories of the topic words in Figure 5 distributed in the sample articles, the word- category table shown in Table 1 is established.

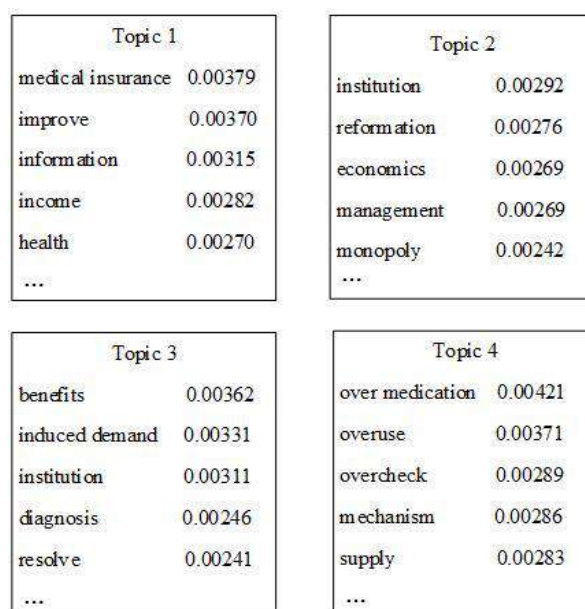


Figure 5. LDA topic distribution

Table 1. Word category table

Data	Category labeling	Source
#1:At present, the "grimace" of over treatment has been formed in China, which is characterized by minor diseases and serious diseases, more examinations, more prescriptions, more treatment and long-term hospitalization.	medical overtreatment	CNKI
#2:Doctors violate professional ethics and ethics, in order to allow them to obtain the maximum benefits , so as to take advantage of their positions and information advantages, to carry out diagnosis and treatment of patients beyond the actual conditions of patients. #3:This special status of doctors determines that they have absolute advantages in medicine and medical information, and this advantageous position also creates a good opportunity for them to induce the medical demands of patients.	doctor factor	CNKI
#4:But hospitals are not companies, especially public hospitals. Placing the company's management model in the hospital distorts the medical staff's diagnosis and treatment behavior. #5:In order to improve the economic benefits of the hospital, the hospital managers must allocate enough task indicators for each clinical department every year. #6:The monopoly , externalities and information asymmetry of the medical service market affect the normal operation of the medical service market.	hospital factor	CNKI
#7:People's material and cultural living standards have greatly improved and increased, and their economic income has been increasing. Coupled with the establishment and improvement of various medical security systems , this has enabled the people to see a doctor for medical treatment. #8:With the continuous progress of society, people's psychological needs for health continue to grow. Patients are willing to try any medical treatment for the sake of their health.	patient factor	CNKI

According to the comparison of vocabulary data in Figure 5 and Table 1, topics 1 to 4 can be summarized into four topics: patients, hospitals, doctors, and medical overtreatment. Taking the three topics of patients, hospitals, and doctors as latent variables that affect the topic of medical overtreatment, a path model of doctors, hospitals, and patients influencing medical overtreatment is established. Three highly-contributing words of each topic were selected for topic measurement. Therefore, the words selected for the four topics are patients ("health", "income", "medical insurance"), hospitals ("economy", "monopoly", "management"), doctors ("benefits", "institutions", "induced demand"), medical overtreatment ("overcheck", "overuse", "overmedication"). The structural equation model test is performed with the word frequency data representing the words.

4.3 Structural equation model testing and evaluation

From the statistical word frequency data, 50 pieces of data that are all 0 are eliminated, and 191 experimental data are finally obtained. By using amos software to verify the model and observe the indicators. The results show that GFI = 0.925, greater than 0.9; RSMEA = 0.071, less than 0.08; CFI = 0.885, which is close to 0.9 and slightly lower than the standard. Based on these indicators, it can be found that the model has an acceptable degree of fit^[14]. The final path model results are shown in Figure 6.

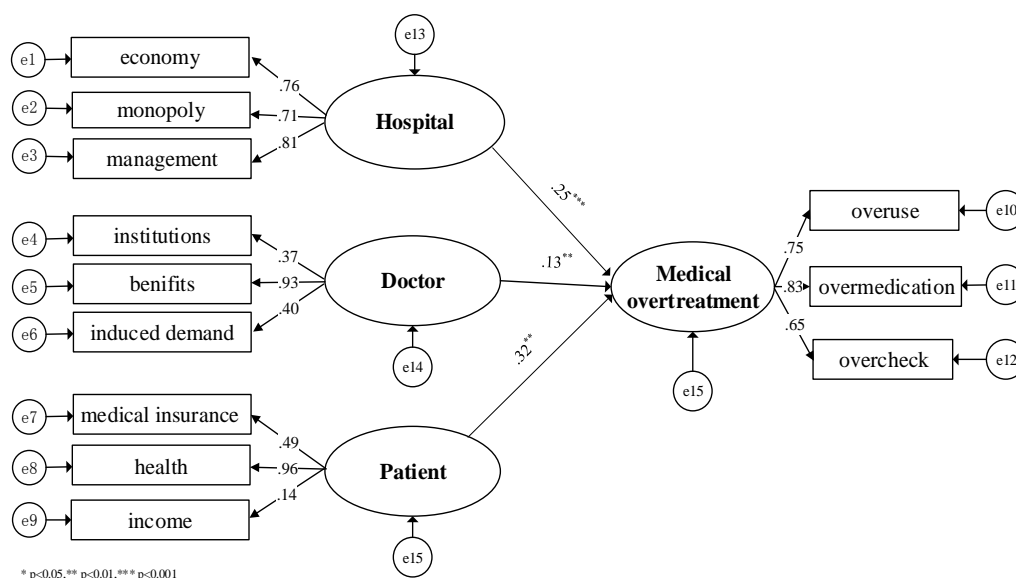


Figure 6. Path model results

5. RESULT AND DISCUSSION

According to the results of the path model in Figure 6, it can be found that the factors that affect medical overtreatment are mainly doctors, hospitals, and patients. These three factors can positively affect the generation of medical overtreatment problems.

5.1 Doctor factors

According to the results in Figure 6, "institutions" and "induced demand" have a certain effect on doctors' medical overtreatment behavior, but "benefits" are the most important influencing factor. Due to the imperfect institution of the hospital, the economic benefits of doctors are linked to the patient's medical services, and even performance competition between doctors appears. In order to maximize their own benefits, doctors will inevitably promote the occurrence of medical overtreatment. Patients are often in a passive position when they receive medical services from doctors, which increases the uncertainty of medical consumption. In order to

obtain economic benefits, doctors use the initial position of doctors relative to patients to induce patients to have excessive demand for medical services. Therefore, they issue expensive drugs to patients and carry out expensive examinations, so that patients spend more money to buy medical services, thus resulting in medical overtreatment.

5.2 Hospital factors

According to the results in Figure 6, factors such as "monopoly", "economy", and "management" can significantly affect hospital medical overtreatment. From the results, the "management" of the hospital is the most important factor. National medical and health services are mainly monopolized by public hospital, including medical information and medical resources. Patients tend to choose large hospitals when they seek medical treatment. However, due to insufficient management mechanisms, hospitals purchase high-consumption medical equipment. In order to make up for the cost of purchasing and obtain economic and social benefits, the hospital has developed an unreasonable hospital management mechanism. This mechanism encourages doctors to prescribe more drugs and check more for patients, and even relates the income of departments to the interests of doctors, which leads medical overtreatment.

5.3 Patient factors

According to the results in Figure 6, among the factors that affect patients' medical overtreatment, the impact of "income" is not significant. Both the "medical insurance" and "health" factors can significantly affect patients' medical overtreatment, of which health factor is the most important indicator. With the development of Chinese society, people's living standards have also continuously improved, and people have gradually shifted their perspectives to their own health fields. However, the sources of people's health information are still not extensive, mainly focused on search engines or medical apps, resulting in information asymmetry of between patients and doctors. Patients simply believe that the use of more expensive drug treatments and advanced equipment examinations can help their health, resulting in a strong demand. Benefiting from the increase in patient income, doctors are often required to prescribe medicines and perform detailed examinations during treatment. In addition, the strength of China's medical insurance has continued to increase, and the cost-sharing mechanism has further reduced patients' medical expenses. The suppressed medical needs of the masses have been released, which has further promoted patients' medical overtreatment behaviors such as excessive medication and examinations.

6. CONCLUSION

Although many scholars have studied the influencing factors of medical overtreatment, few have carried out quantitative analysis. This paper uses LDA model and SEM to explore the factors that affect medical overtreatment. Using the obtained medical overtreatment text as a corpus to perform topic mining and analyze the element structure.

According to the results of this study, China is facing a severe situation of medical overtreatment. Medical overtreatment not only increases the financial burden on patients, but also reduces the effective allocation of medical resources. At the same time, this is also one of the focuses of China's current medical reform. Therefore, relevant government departments must take measures from the perspectives of doctors, hospitals, and patients to curb the development of medical overtreatment.

The limitation of this paper is that there is a strong subjectivity in the identification and extraction of topic words and topic generalization. Different people may have different explanations for the model established in this paper.

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The Impact of Beneficiary Facial Expressions on Donation Intention in Medical Crowdfunding

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Abstract: In recent years, medical crowdfunding has become an emerging and effective way to raise funds for patients with severe illness and their families, and has solved huge economic problems for many families. This study studies the information expression of medical crowdfunding projects. This study combines the S-O-R model, considered the model of altruistic and egoistic motives for helping, adopted laboratory research methods, studied the effect of the facial expressions of beneficiary on individual donate intention. The results showed that individual altruism and guilt can positively influence individual donate intention. The facial expressions of beneficiaries affected both egoistic motivation and altruism motivation at the same time, and there were significant differences in the two types of motivation. In addition, research has found that individual guilt has a moderating effect on altruism. This study enriched the research of the SOR model and the altruistic and self-interest motivation model in the context of medical crowdfunding, at the same time studied the impact of facial expressions on personal motivation to provide recommendations for medical crowdfunding content writing.

Keywords: medical crowdfunding, facial expression, guilt, altruism

In recent years, social media such as WeChat and Weibo as well as third-party payment platforms have provided a basis for the development of medical crowdfunding. Compared with traditional charitable donations, medical crowdfunding has the characteristics of high efficiency, transparency, and pertinence, and can quickly raise funds for patients seeking help. However, although many medical crowdfunding platforms have developed rapidly and performed well today, they still face the problems of many projects failing to achieve their stated goals and shortage of medical assistance funds. Therefore, how to improve individual's donate intention to medical crowdfunding projects has become an issue of great concern to both academia and industry.

In general, a medical crowdfunding project mainly includes information such as text, pictures and fundraising goals. Among them, pictures occupy a more prominent position on the page. Compared with text, pictures can convey more intuitive information. Therefore, some projects attach pictures of the beneficiary's facial emotional state (positive or negative). Researching the facial expressions of people in pictures is a hot research topic in the donation literature^[1]. However, the existing research also has inconsistent conclusions about which facial emotional state in projects may promote the donation of potential donors. This article combined the SOR^[2] model and considered the egoistic motivation and altruistic motivation of individuals in donation simultaneously^[3], and explored how the facial expressions of beneficiaries stimulate the intrinsic motivation of individuals, and ultimately affect their donate intention.

H1: Individuals' altruism positively affects donate intention

H2: Individuals' guilt positively affects their donate intention.

H3: Individuals' guilt has a significant positive moderating effect on the relationship between altruism and donation intention.

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H4: Compared with negative facial expressions, beneficiaries' positive facial expressions can stimulate individuals to be more altruistic.

H5: Compared with positive facial expressions, beneficiaries' negative facial expressions can motivate individuals to have higher guilt

The study used laboratory experiments. The participants consisted of 86 students and staff from a university. The participants scanned a crowdfunding page developed by the researchers and completed a questionnaire. SPSS 24.0 and AMOS 22.0 were used for data analysis. The results show that all hypotheses are supported. According to the experimental results, we found that guilt and altruism positively affect individuals' donate intention, negative facial expressions affect individuals' guilt, and positive facial expressions affect individual altruism. Guilt plays a moderating role between altruism and donate intention.

We believe this research has contributed the study of individuals' facial expression for charity crowdfunding filed. The theoretical contribution of this study is mainly reflected in three aspects. First, our study from the perspective of motivation and combined the SOR model to study how the facial expressions of beneficiaries can dynamically affect individual donation in medical crowdfunding. Second, we explore the moderating effects of guilt on individual altruism. Third, as in previous studies, many scholars have studied individual expression, but the results have been inconsistent.

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Impact of Informativeness and Social Cues of Medical Crowdfunding

Projects on Cognitive Trust and Willingness to Donate

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Abstract: With the rapid development of the Internet and mobile payments, medical crowdfunding is becoming more and more popular. However, the success rate of crowdfunding projects is low, and many patients are unable to raise the money they need to pay for their medical treatment in a timely manner, so how to increase user donation Willingness is a worthwhile research problem. In this paper, from the perspective of website interface design, we take project informativeness as the central route and social cues as the peripheral route to create a research model based on the Elaboration Likelihood Model (ELM). Around this model we explore how different website design factors on healthcare crowdfunding platforms affect users' perceived trust in the platform and project, which in turn influenced users' willingness to donate. Laboratory experiments were used to obtain data and the data were analyzed by SPSS24.0 and AMOS23.0 software. The results showed that the richer the project informativeness and the presence of social cues positively influenced potential donors' intention to donate, and cognitive trust has a mediating effect on the relationship between them. The results of this study are instructive for fundraisers to conduct efficient fundraising campaigns and for medical crowdfunding platform managers to better manage platforms.

Keywords: medical crowdfunding, website interface design, elaboration likelihood model, cognitive trust, intention to donate

As China's medical security system is still not perfect, the vast majority of the low-income population is still unable to afford the large amount of medical expenses required for a serious illness. With the development of the Internet, the continuous expansion of social medical demand and the increase of pressure on patients' medical expenses has promoted the rise of medical crowdfunding platforms. Medical crowdfunding is the practice of using websites to raise money from donors to pay for medical care or expenses related to medical care^[1], and it has the characteristics of low participation threshold and high information transparency, which are favored by the majority of users. However, due to the information asymmetry between donors and help-seekers, the success rate of most crowdfunding projects on crowdfunding platforms is very low. Therefore, how to improve the success rate of medical crowdfunding help-seeking projects is a major issue that needs to be studied. Besides, previous research has found that trust is a major factor in investors' willingness to invest^[2]. Today's research on medical crowdfunding is mostly focused on qualitative studies on the safety and regulation of platforms and the fairness of fund distribution^[1], and fewer studies have examined the impact of interface design factors on donors' intention to donate from the perspective of website design. A large body of literature in the field of information systems and human-computer interaction demonstrates that website design factors have a significant impact on user trust. Therefore, based on the elaboration likelihood model theory (ELM), this paper investigates how different design factors affect potential donors' cognitive trust and thus their intention to donate from the perspective of website design.

The elaboration likelihood model (ELM) is a persuasion theory^[3], and it is mostly used in online behavioral research. The theory posits that there are two different routes that influence an individual's processing of information: the central route and the peripheral route. The central route requires more cognitive effort to scrutinize the information, while the peripheral route does not require deeper reflection, Judgment of information based primarily on environmental features. In this study we argue that interface design factors on

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medical crowdfunding platforms influence potential donors' cognitive trust and intention to donate in two distinct paths (central route: project informativeness, peripheral route: social cues). Based on the analysis of previous literature, we propose the following hypothesis:

H1:Project informativeness positively influence the intention of donors to donate.

H2:Project informativeness is positively related to donors' cognitive trust.

H3:Donor's cognitive trust in a medical crowdfunding websites with social cues is higher than that in a medical crowdfunding websites without social cues.

H4:Donor's intention to donate in a medical crowdfunding websites with social cues is higher than that in a medical crowdfunding websites without social cues.

H5:Donor's cognitive trust in a medical crowdfunding websites positively influence the intention of donors to donate.

We employed a 2 (Project Informativeness: high vs. low) \times 2 (Social cues: with vs. without) full factorial between-subject design test our hypotheses, and 148 university students were recruited to participate in the laboratory experiments.

We validated the experimental data using SPSS24.0 and AMOS23.0, and tested the mediating role of cognitive trust using PROCESS. The results show that all hypotheses are supported. The results suggest that project informativeness and social cues in the medical crowdfunding interface significantly influence donor intentions, and this mechanism is mediated by cognitive trust. It further indicates that the project informativeness are more high, the more information about the platform and the project a potential donor gets. This in turn helps users to make logical inferences and increases trust in the platform and project, reduces uncertainty and donation risk, promotes donations. Besides, Most donations on medical crowdfunding platforms are spread through friends. In general, most of the relationships between donors and helpers are between strangers. The emergence of social cues, especially "friend invitations" and "social proof", enhances the credibility of charitable projects. At the same time, based on "peer pressure", when donors find their acquaintances or friends in the circle of friends to help the helper, if they do not Reaching out for help can feel like a "loss of face". As a result, social cues further enhance the donor's perceived trust in the platform and project, and increase intention to donate.

This study further expands the literature in the field of medical crowdfunding. Based on the perspective of website design, combined with the ELM theory, this study highlights the important influence of social cues as peripheral routes on potential donors' cognitive trust, expanding trust and the application of ELM to the field of medical crowdfunding. Besides, This study also has important implications for practitioners. First, this study is helpful in clarifying the trust mechanism that people have when facing medical crowdfunding projects, which provides fundraisers with efficient fundraising activities to reference. Second, This study helps managers to identify the interface design factors that influence the cognitive trust of potential donors. By reducing information asymmetries and enhancing funding traceability helps them manage the platform more efficiently and orderly. As a result, platform managers should more carefully review the informality of their projects to ensure that the information provided on crowdfunding platforms is accurate, specific, and complete.

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Research on the Influencing Factors of the Continuous Use of Online Health Information —Health Literacy as a Moderator

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Abstract: Studying the influencing factors of users' willingness to continue using online health information will help the online health platform to provide health information that meets users' needs and improve the users' experience, and can promote the popularization of health information. Based on the theory of expectation confirmation, this study explores the influencing factors of users' willingness to continue to use online health information from the perspectives of information quality and health literacy theory, and uses PLS to verify the conceptual model. The research results show that: (1) Both users' satisfaction and perceived usefulness positively significantly affect the willingness to use online health information continuously and the perceived usefulness has a decisive influence. (2) Perceived usefulness plays a part intermediary role between the quality of information content and the users' continued willingness to use online health information, and it partially plays a intermediary role between the credibility of information sources and the users' willingness to use online health information continuously. (3) Users' health literacy negatively regulates the relationship between information source credibility and perceived usefulness, and positively regulates the relationship between information content quality and perceived usefulness.

Keywords: expectation confirmation model, health literacy, willingness to use continuously, information quality

1. INTRODUCTION

With the development of society and the progress of health, people have turned more perspectives into the health field, and the demand for health information has never been higher. With the advent of the "Internet +" era, users have a new way to obtain health information, which promotes the formation of new service concepts and the development of new technologies, and brings a qualitative improvement to traditional medical services^[1]. Because of the use of online health information, people can get health information without going to specialized medical institutions, and can get resources at the same medical level more easily and quickly, which greatly reduces the time cost and economic cost of finding health information. As health awareness continues to increase, people are more willing to search for online health information for their own or others' needs. Not only can you search repeatedly according to your needs, but you can also be satisfactory in terms of cost savings, privacy protection, and high accuracy. On the other hand, although the Internet provides people with convenient conditions for obtaining information, it also contains false medical information and business inducement information. Without strong health literacy, it will seriously affect users' willingness to accept information and continuous use behavior^[2].

Research on online health information related fields has been carried out successively in the world. Zhang Xing^[3] modeled the credibility factors of online health information based on the fine processing possibility model. Hesse BW^[4] explored users' online health information activities through surveys. Zhao Dongxiang^[5] studied the quality of online health information based on bounded rationality and evolutionary games. However, these studies

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did not take into account health literacy factors, nor did they conduct in-depth research on users' continued willingness to use online health information. In this paper, the expectation confirmation model is improved. The dual-path model is used as a guide to select the information source credibility and information content quality as research variables from the perspective of information quality. The perceived usefulness in the model is used as an intermediate variable and health literacy is used as a moderator. We strive to reveal the impact of people's willingness to continue to use online health information with an improved new theoretical model. This paper collects data through questionnaires, and uses structural equation models for testing and analysing.

2. RESEARCH HYPOTHESES AND MODEL

2.1 Expectation confirmation model

Expectation confirmation model (ECM) is a brand-new model of continuous use information system obtained by Bhattacherjee based on expectation confirmation theory ^[6]. Related research variables include expected confirmation, satisfaction, perceived usefulness, and willingness to use continuously. The model reveals that the degree of expectation confirmation has a positive impact on perceived usefulness and satisfaction, that perceived usefulness has a positive impact on satisfaction and willingness to use continuously, and that satisfaction has a positive impact on willingness to use continuously.

The proposal of ECM has opened up a new direction for the continuous use of information systems, and has caused many follow-up scholars to study this model in depth. Mou ^[7] researched online medical information services based on this model and verified the relationship between various factors in the model, and Yao C ^[8] successfully analyzed the users' willingness to use social websites continuously based on this model. The above research validates the powerful explanatory power of the model and proves the validity and broad applicability of the model in the study of the willingness to use information continuously. Therefore, the model is also applicable to this study.

Users' satisfaction mainly refers to the users' cognitive attitude to the use process after experiencing a product or service, which will have a positive impact on the users' information acceptance and willingness to continue using the information. In the context of the Internet, users' satisfaction may have an impact on the willingness to continue using online health information. Therefore, this paper makes the following hypothesis:

H1: Users' satisfaction positively affects users' willingness to continue using online health information

Expected confirmation refers to the degree of comparison between the actual experience and the expected experience of users after experiencing a product or service. Perceived usefulness refers to the subjective experience of the users after using the product, and refers to the "feeling of satisfaction" after receiving the service. The better the users' acquisition experience, the higher the users' expected degree of confirmation, and the higher the corresponding satisfaction. Therefore, this paper makes the following hypotheses:

H2: Users' expectation confirmation positively affects the satisfaction of using online health information

H3: Expected confirmation positively affects the users' perceived usefulness

The higher the perceived usefulness of a user after the use of online health information, the higher the level of satisfaction that the user has. The users' own health information needs are greatly satisfied, and life and work are significantly improved. This increase in perceived usefulness may have a positive effect on users' satisfaction. Therefore, the following hypothesis is made.

H4: Perceived usefulness positively affects users' satisfaction

The higher the users' perceived usefulness when using online health information, the higher the degree of improvement in life or work, which is more likely to drive the users' continuous use of online health information. Therefore, this paper makes the following hypothesis:

H5: Perceived usefulness positively affects users' willingness to use continuously.

2.2 Information quality

Information quality is the basic criterion for evaluating the information obtained, and it is also the main basis for judging the validity of the information. Information quality is a complex multi-dimensional variable. Although there is no uniform judgment standard, the main dimensions and characteristics of information quality evaluation have similarity. Many scholars have conducted empirical research on user information quality. Zheng Y M^[9] divided the information quality into 6 aspects: information objectivity, value-added, reliability, richness, timeliness, and formality. Lin J C^[10] judged the quality of information from 5 aspects, including accuracy, completeness, update time, suitability, and reasonableness of arrangements. However, although the above-mentioned judgment indicators have some basis, the research indicators and perspectives are confused. Petty & Cacioppo proposed that the dual-path indicator divides the problem into two aspects for analysis from two perspectives^[11], and has been widely used in information quality evaluation and has achieved significant results. Therefore, based on the above research, this paper uses information quality is measured in terms of quality of information content and credibility of information sources.

2.2.1 Information content quality

With the development of "Internet + Medical", while health information becomes more abundant, it also brings the hidden dangers of false information. People are more susceptible to the erosion of bad information, and they are likely to make wrong decisions after obtaining information. Therefore, it is necessary to judge the quality of the information content. The quality of information content includes the authenticity, timeliness, and integrity of the information. The higher the quality of the information content, the more it can help online health information users to analyze, summarize health information, and make rational judgments^[12]. Sussman^[13] pointed out that the degree of users' perceived usefulness increases with the quality of information content, and then affects the users' behavioral intention. Ahn Tony^[14] found that high information content quality will increase the users' perceived usefulness, thereby affecting the continuous use of information websites. It can be seen that high-quality information content can help users clearly determine the positioning of information products, reduce the uncertainty of use, and enhance users' motivation. Therefore, this study makes the following hypothesis:

H6: The quality of information content positively affects the users' perceived usefulness.

2.2.2 Information source credibility

The credibility of information sources can assess and reflect the persuasiveness of the information. The credibility of information sources mainly refers to the authoritativeness and accuracy of information. In daily life, people are more willing to believe and adopt health information issued by authoritative institutions or scholars, even if there is no difference with information from other channels. The credibility of the source of online health information means that it can help users assess the richness of the information provided. At present, the credibility of information sources has been applied to the research of social media, online health and other fields. DG Ko^[15] pointed out in the research on the antecedents of knowledge transfer that information with high credibility of the source has greater value, which improves users' recognition of the information and can promote the transfer of information. Zhu^[16] found that information with high source reliability would enhance the users' perceived usefulness, and then affect the users' decision motivation. In summary, it is found that when the source of information is reliable, that is, when the source of information is highly credible, it will increase the users' perceived usefulness. Therefore, this study introduces it into the online health information research, and proposes the following hypothesis:

H7: The credibility of information sources positively affects the perceived usefulness of online health information

2.3 Health literacy

Health literacy (HL) refers to an individual's ability to seek, acquire, evaluate, and use health information,

which can affect people's reading, understanding, and adoption of health information^[17]. Good health literacy should have the ability to demand health information, the ability to recognize health information, the ability to search for health information, and the ability to evaluate and use health information.

Cho^[18] found that the higher the users' health literacy, the stronger the users' perception of the usefulness of using a smartphone medical app, which will affect the continued use of the app. Diviani N^[19] found in research that users with low health literacy would reduce the usefulness evaluation of the information when using online health information, thereby affecting users' motivation to continue using it. Tang Xuli^[20] pointed out that users' health literacy will affect the role of information quality in supporting information, and then affect users' behavioral willingness. Studies by the above scholars have shown that health literacy can directly affect users' ability to judge information, thereby affecting users' willingness to continue using online health information. From the above research, it can be found that health literacy does not directly affect users' willingness to use online health information, but it can have an indirect impact on the willingness to use online health information.

Health literacy will have an important impact on users' information judgment and processing capabilities, and ultimately affect information decisions. The higher the user's health literacy, the deeper they can understand the service form of health information. In the process of information judgment, users tend to choose auxiliary means to enhance the ability to judge the authenticity of information and increase the usefulness of perception. Therefore, this paper makes the following hypothesis:

H8: Health literacy positively regulates the relationship between credibility of information sources and perceived usefulness

The higher the users' health literacy, the greater the emphasis on the credibility of the information source, the more support for the use of information with high credibility of the source, the less attention to the information content itself^[20], and the reduction of the dependence on the quality of the information content. Therefore, this paper makes the following hypothesis:

H9: Health literacy negatively regulates the relationship between information content quality and perceived usefulness

2.4 Research model

Based on the above theoretical review and research hypotheses. Based on the expectation confirmation model, this paper selects the information content quality and information source credibility as the research variables, health literacy as the moderator, and finally establishes a research model shown in Figure 1. The definition and source of each design variable are shown in Table 1.

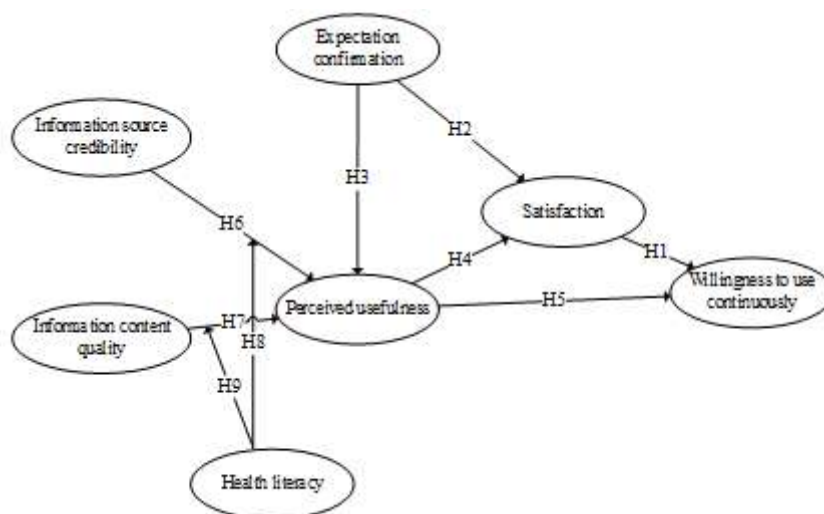


Figure 1. Research model

Table 1. Research variables and reference sources

variables	definition	Source
Information content quality	Accuracy, validity and completeness of health information.	[21]
Information source credibility	The professional and credible nature of health information sources.	[22]
Perceived usefulness	Subjective evaluation of usefulness using online health information.	[6]
Expectation confirmation	Expected compliance before and after online health information.	[7]
Satisfaction	Psychological satisfaction of users using online health information.	[6]
Willingness to use continuously	Users' continue to use online health information for a period of time.	[6]
Health literacy	Ability to obtain health information and make correct decisions based on it.	[17]

3. EMPIRICAL METHODOLOGY

3.1 Measures

There are 7 latent variables in the model of this study, and each latent variable includes 3 measurement variables. In order to ensure the reliability of the content, the design of the measurement items is modified based on the existing literature and the characteristics of online health information. Scale measurement items and sources are shown in Table 2. A 7-point Likert scale was used to measure the measurement items.

Table 2. Scale measurement items and sources

variables	measurement items	Source
Information content quality (ICQ)	Online health information can answer my questions in a timely manner.. The content described in the online health information is usually complete. The content of online health information has high authenticity.	[9]
Information source credibility (ISC)	The online health information platform has a high reputation in this field. Many sources of online health information are reliable. The content of online health information is usually accepted and adopted by most people.	[15]
Perceived usefulness (PU)	Using online health information can reduce the cost of my information. Online health information can help me understand my own diseases. Online health information can help me make medical decisions.	[16]
Expectation confirmation (EC)	The scope of online health information is wider than I thought . Online health information is more informative than I thought. The quality of online health information is better than I thought.	[16]
Satisfaction (SAT)	Online health information can resolve my health concerns. Online health information can meet my information needs. The process of obtaining and using online health information went smoothly..	[15]
Willingness to use continuously (WC)	In the future, I will also use online health information. I would recommend using online health information to friends in need. I will keep using online health information even more frequently.	[15]
Health literacy (HL)	I can easily read the health information instructions. I know where to get disease-related information in case of illness. Faced with a lot of health information, I can choose a solution that suits me.	[23]

3.2 Data collection

The questionnaire production is designed by the questionnaire professional website “Questionnaire Star”.

The questionnaires are sent mainly through the Internet, including "WeChat circle of friends", "Questionnaire mutual filling platform", "Weibo" and "e-mail". A total of 527 questionnaires were retrieved, and 122 questionnaires that were too short to be filled out were excluded, and a total of 405 questionnaires were obtained. The effective recovery rate was 76.85%.

4. DATA ANALYSIS

4.1 Reliability and validity analysis

Reliability is a measure of consistency, stability and reliability of measurement results. Reliability test measures Cronbach's alpha (α) coefficient and combined reliability (CR). The $\alpha > 0.6$ and $Cr > 0.7$ indicate that the reliability of the measurement results is high. In the data test results of this paper, except that the quality of information content is close to 0.7, the other indicators are all greater than 0.7, and the CR value is all greater than 0.7, which proves that the sample data has good reliability and validity, as shown in Table 3.

Table 3. Reliability and validity

variables	Measurement items	Standard factor load	α	CR	AVE
EC	EC1	0.876	0.817	0.891	0.732
	EC2	0.858			
	EC3	0.832			
HI	HI1	0.894	0.850	0.903	0.758
	HI2	0.911			
	HI3	0.803			
ICQ	ICQ1	0.803	0.689	0.832	0.623
	ICQ2	0.843			
	ICQ3	0.717			
PU	PU1	0.782	0.746	0.855	0.663
	PU2	0.812			
	PU3	0.848			
ISC	ISC1	0.802	0.723	0.843	0.642
	ISC2	0.827			
	ISC3	0.774			
SAT	SAT1	0.892	0.777	0.873	0.699
	SAT2	0.896			
	SAT3	0.705			
WC	WC1	0.830	0.820	0.893	0.735
	WC2	0.873			
	WC3	0.868			

Validity evaluation consists of three parts: content validity, convergence validity, and discriminant validity. The measurement items in the scale used in this study have been verified in the relevant literature. In this study, only a moderate adaptation was made, so it has good content validity. As shown in Table 3, the standard load factors in the model measurement results are all greater than 0.7, and the AVE values are all greater than 0.5, indicating that the model has a good convergence validity.

The discriminant validity is measured using the model's latent variable AVE square root. The square root of the variable AVE should be greater than the cross-correlation coefficient between other variables. As shown in Table 4, the square root (diagonal) of the latent variable AVE is larger than the cross-correlation coefficients of

other variables, indicating that it has better discriminant validity.

Table 4. Correlations of latent variables

Construct	EC	HI	ISC	PU	ICQ	SAT	WC
EC	0.855						
HI	-0.298	0.870					
ISC	0.605	-0.224	0.801				
PU	0.587	-0.380	0.611	0.815			
ICQ	0.650	-0.253	0.784	0.646	0.789		
SAT	0.647	-0.265	0.788	0.646	0.726	0.836	
WC	0.645	-0.329	0.548	0.604	0.579	0.565	0.858

4.2 Structural equation model test

Smart PLS 3.0 was used to test the structural equation model and verify the causal relationship between latent variables. The significance level was tested by P value, and $P < 0.05$ indicated that the relationship between the variables was significant. The model test results in this paper are shown in Figure 2. The analysis results between the model variables are shown in Table 5. All the hypothetical results are at a significant level. H1-H7 and the hypotheses have been verified, but the test results of H8 and H9 are exactly the opposite of the original hypotheses, as shown in Table 5.

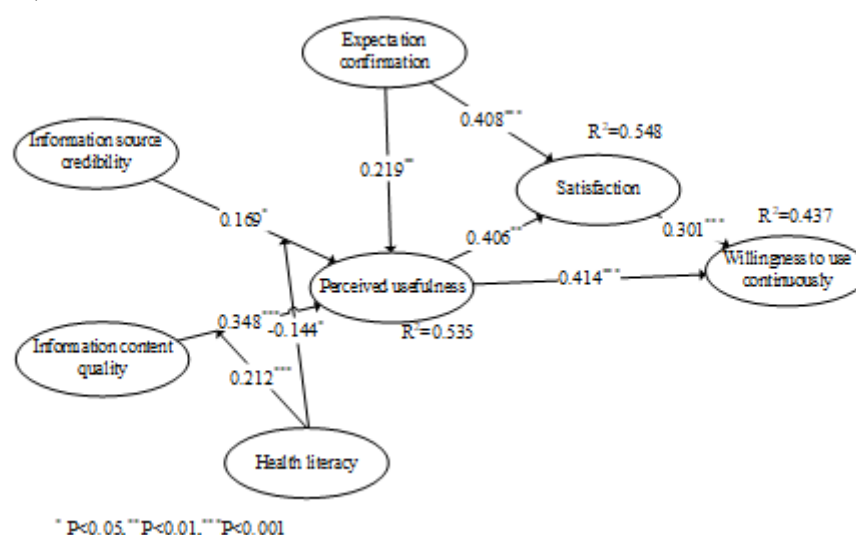


Figure 2. SEM analysis of the research model

Table 5. Summary of hypotheses tests

	Hypothesis	Path coefficient	T-value	P-value	Significance level	Support
H1	SAT→WC	0.301	5.159	0.000	significant	Yes
H2	EC→SAT	0.408	7.263	0.000	significant	Yes
H3	EC→PU	0.219	3.378	0.008	significant	Yes
H4	PU→SAT	0.406	7.091	0.000	significant	Yes
H5	PU→WC	0.414	8.096	0.000	significant	Yes
H6	ISC→PU	0.169	2.310	0.021	significant	Yes
H7	ICQ→PU	0.348	0.892	0.000	significant	Yes
H8	ISC*HL→PU	-0.144	2.393	0.017	significant	No
H9	ICQ*HL→PU	0.212	3.629	0.000	significant	No

4.3 Mediation effect test

This paper uses the causal stepwise analysis method proposed by Baron & Kenny to test the mediation effect. In this paper, the testing process of independent variable IV, intermediate variable M, and dependent variable DV is divided into four steps. ① The effect of IV on DV ($IV \rightarrow DV$); ② The effect of IV on M ($IV \rightarrow M$); ③ The effect of M on DV ($M \rightarrow DV$); ④ The effect of IV + M on DV ($IV+M \rightarrow DV$). If the indirect effect is significant and the direct effect is also significant, this intermediary effect is a partial intermediary. If the indirect effect is significant and the direct effect is not significant, it is a full intermediary. The test results are shown in Table 6, which shows that perceived usefulness plays a part of the intermediary effect.

Table 6. Mediating test of perceived usefulness

IV	M	DV	$IV \rightarrow DV$	$IV \rightarrow M$	$M \rightarrow DV$	$IV+M \rightarrow DV$		Intermediary scope
						$IV \rightarrow DV$	$M \rightarrow DV$	
ISC	PU	WC	0.091*	0.169*	0.536***	0.292***	0.430***	part
ICQ	PU	WC	0.187***	0.348***	0.536***	0.344***	0.386***	part

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

5. DISCUSSION

Through empirical research on the influencing factors of the continued willingness to use online health information, it is concluded that the credibility of the information source, the quality of the information content, and the degree of expected confirmation all significantly affect the perceived usefulness of users. Perceived usefulness plays a part intermediary role between the quality of information content and the users' willingness to use online health information continuously, and it partially plays a role between the credibility of information sources and the user's willingness to use online health information continuously (This path coefficient is the largest). Health literacy negatively regulates the relationship between information source credibility and perceived usefulness, and positively regulates the relationship between information content quality and perceived usefulness.

The results of this article show that health literacy negatively regulates the relationship between information source credibility and perceived usefulness, indicating that an increase in health literacy will reduce the positive effect of information source credibility on perceived usefulness. Health literacy positively regulates the relationship between information content quality and perceived usefulness, indicating that the improvement of health information literacy will enhance the positive effect of information content quality on perceived usefulness. These two points are contrary to the research hypotheses of this paper. The reason is that the ability of personal health literacy is mainly reflected in the ability to search, identify and use health information. In addition, a large number of literatures show that^{[24][25]}, health literacy and health knowledge have a positive correlation. When obtaining health information, users with higher health literacy have higher ability to screen and judge health information. At this time, people pay more attention to the quality of the information content itself, while the attention paid to the information source is weakened, thereby reducing the role of health literacy between the credibility of the information source and perceived usefulness. At the same time, the higher the health literacy, the stronger the users' ability to acquire and identify information, without the need for external health information service forms, thereby enhancing the role of information content quality in perceptual usefulness.

6. IMPLICATIONS AND LIMITATION

The research value of this paper is to improve the theoretical model of expectation confirmation, based on

the perspective of information quality and health literacy, to construct a model of influencing factors for continued use of online health information. Through the empirical analysis to verify the constructed conceptual model, it can be seen from the results that from the perspective of information quality, the credibility of health information sources and the quality of health information content will use perceived usefulness as an intermediary variable to affect the users' continuous use of information behavior, where the impact of the quality of information content is stronger than the credibility of the information source. In addition, due to the regulating effect of health literacy, the significant effect of the credibility of health information sources weakens with the enhancement of health literacy, and the significant effect of the quality of health information content increases.

Therefore, when users obtain health information, they not only need to pay attention to the credibility source of the information, but more importantly, pay attention to the content quality of the information in order to accurately obtain the required information. When publishers of health information release health information, they should pay attention to health information quality, rather than putting too much emphasis on diversified channel forms to build a better health information service platform.

There are still some limitations in this article. First, the data acquisition method is a questionnaire. The survey objects are mainly college students of the same age or newcomers to the society, and there is a lack of diverse sample space. Second, this article focuses on information as the main influence variables are researched, but the factors that influence users' continuous use behaviors include other variables such as perceived value, trust, and demographic variables. These variables will be introduced in future research to enrich relevant theories.

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Study on the Continuance Usage of Mobile Health Management

Application based on Uses and Gratifications Theory

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Abstract: In order to examine the influence effect of uses and gratifications of mobile health services. A research model was developed to study the influence of users' utility gratification, hedonic gratification and social gratification from the perspective of Uses and Gratifications theory. SPSS and Smart PLS were employed to verify the research hypotheses using the empirical data collected via survey questionnaires. Research results show that utility gratification, hedonic gratification and social gratification all exert significant and positive effects on users' continuance usage intention. Especially, gratification of health management, perceived fantasy, social image play important roles in users' uses and gratifications. Providers of Mobile health management application should design and take personalized operating strategies and marketing strategies according to different needs.

Keywords: mobile health management application, Uses and Gratifications theory, continuance usage intention

1 INTRODUCTION

The traditional way of individual health management has been changed with the rapid development of Internet and smart health devices. A large number of mobile health management applications (MHMA) which including functions of health information searching, personal health status recording and evaluation based on the Internet and mobile terminals have emerged, and involved sports, fitness, weight loss, and health management related mobile applications. Users use MHMA mainly to meet their own health needs. When users' health needs are met, users' continued willingness to use the MHMA will be stronger. The Uses and Gratifications theory (U&G) is widely used to study the impact of need satisfaction on users' behavior^{[1][2]}, but at present, there is less research on the impact of need satisfaction on MHMA usage behaviors.

Mobile health services are still in the development stage. How to retain users is the key issue for providers to develop MHMA and enhance their competitiveness. The U&G theory is mainly used in the study of users' continuance usage behaviors^[2], and how to satisfy users' needs is key of continuance usage of MHMA. Therefore, this paper mainly studies two questions: Q1-What are users' health related needs satisfied by MHMA? Q2-What are the influences of different gratifications on continuance usage behavior of MHMA? Thus, a continuance use research model of MHMA was constructed based on U&G theory, and data collected through questionnaire, research results are obtained through the empirical analysis. This research will be helpful for understanding users' continuance usage behavior of MHMA, and designing MHMA products, developing marketing strategies, innovating business models. It has important theoretical and practical significance for mobile health related research and the development of MHMA.

2 THEORY AND LITERATURE REVIEW

2.1 Uses and Gratifications theory

Uses and Gratifications theory (U&G) has been widely used in usage behaviors research of media after it

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was developed in the 1940^{[1][3]}, U&G theory believe that users' purpose of choosing and using the media is to meet their needs^{[4][5]}, and then generate the continuance usage behavior. U&G theoretical framework lays the foundation for scholars to study users' behaviors of new media through the need satisfaction perspective, and has been expanded into different research scenario by many scholars to research users' needs and continuance behaviors, such as email^[6], virtual community^[7], social network^[8] and online games^[2] and etc. In short, researches based on U&G has extended from traditional media to online media, and from social media to mobile services.

Besides the social media^[9], information system is another one main research domain of U&G. Users choose an information system or social media mainly because the system or social media can meet their physical or psychological needs, such as information needs, hedonic needs, emotional needs, social needs and etc, and users will continue use an information system or social media when their needs are satisfied. Li et al. (2015) confirmed that the use of online games mainly meets users' utility needs, hedonic needs and social needs based on the U&G theory^[2]. And Gallego et al (2016) researched the continuance usage behavior of online education based on the U&G theory, which showed that the gratifications of convenient need, hedonic need, social need, and information need all have significance influence on continuance usage, and among them, the impact of hedonic gratification and information gratification are greater^[10]. Therefore, the uses and gratifications of an information system can impact users' continuance usage behavior. MHMA is one kind of information system which can provide different functions to meet users' health related need. Thus U&G theory also can be applied in the continuance usage behavior research of MHMA.

2.2 Users' continuance behavior research based on U&G

U&G theory was integrated with the expectation confirmation theory, social support theory to research users' continuance usage behavior of information services, mobile applications. Li et al (2015) demonstrated that the needs satisfaction have significant influence on users' continuance usage of online games^[2], and Lin et al (2017) also got the same results that meet the needs of social benefits, social improvement, economic and information also has a significant impact on word-of-mouth behavior^[9]. From previous studies, it can be seen that the higher degree of the meet of users' different kinds of needs, the stronger the user's willingness to continue using mobile services.

U&G theory can not only study the users' behavior solely, but also integrate other theories to study users' behavior through multiple aspects and angles of the effects of system characteristics, characteristics of users, characteristics of research scenario and etc. Gratifications of utility needs, social needs, hedonic needs, cognitive needs and esteem needs all have significant influences on users' continuance usage behavior of information system, social media, and mobile applications, which was confirmed in previous researches^{[2][11][12]}. And there are many other different factors which have significant influence on users' continuance usage behavior according to the research contents and characteristics of research scenario. Therefore, U&G theory can be applied in the research of users' continuance usage behavior of MHMA with integrating the characteristics of MHMA.

3 RESEARCH MODEL AND HYPOTHESES

3.1 Research model

MHMA not only include utility function of health data recording, analysis, assessment, and programming, but also have social functions and E-commerce functions. MHMA is belonging to a vertical mobile application integrated health management, health social and health related e-commerce. Users can manage their health data, share individual experiences, health knowledge, results of health behavior with their friends and purchase health related products such as running shoes, healthcare medicine and health related services through the MHMA. The

usage of MHMA by users is mainly to meet the individual various need of health management. when the needs are satisfied, users will continue to use the MHMA. Therefore, the U&G theory is applied in this research to study users' continuance usage behavior of MHMA.

In the research scenario of MHMA, health related knowledge, individual health management services, healthcare products and healthcare method are supplied by the instrumental function and e-commerce function of MHMA. Users' health information need and health management need can be satisfied through the using of the instrumental function. Health information need and health management need can be summarized as utility need, since they are directly related to individual's actual health, and their main purpose is to improve individual health. In addition to the instrumental function and e-commerce function, social function also plays an important role. Users can find friends with the similar health issues, communicate and keep in touch with them, share their own health experience, share health knowledge, recommend health products and express their health management achievement, and show individual healthy image to others through the chat function and online or offline friend group of the social function, and users can get likes, encouragement and good impression from other users. All in all, users' need of social interaction, social expression, and social image are gratified through the social functions. Using the MHMA is mainly to alleviate health issues and improve individual health. Before using MHMA, users fantasy that they can lose weight, be healthier, and look more beautiful after adopting the health management methods and services. When users' fantasy comes true, they will feel very happy. Of course, they also feel happy in the during of MHMA using, if users get health information they need, make friends with who have similar health issues, and adopt effective health management methods and etc. In short, hedonic need including perceived happiness and perceived fantasy can be gratified during the using of MHMA.

According to the analysis of MHMA functions above and previous researches based on U&G theory^[2], the gratifications of users' need of MHMA can be summarized into utility gratification, social gratification and hedonic gratification. The utility gratification include health information gratification and health management gratification, the hedonic gratification include perceived happiness and perceived fantasy, and the social gratification include social interaction gratification, social express gratification and social image gratification. Therefore, a second-order construct research model of users' continuance usage behavior of MHMA is constructed based on the U&G theory as the Figure 1.

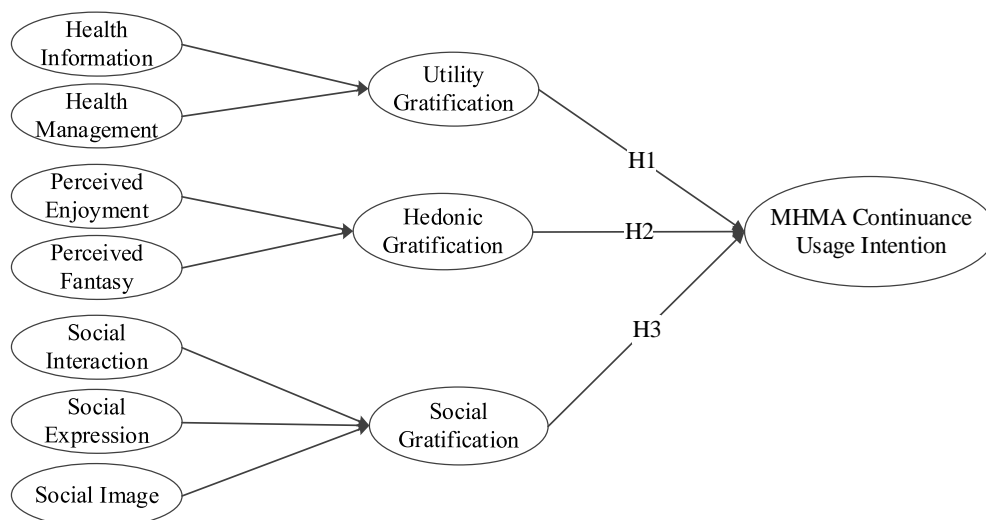


Figure 1. Research model of users' continuance usage behavior of MHMA

3.2 Hypotheses

3.2.1 Hypotheses of utility gratification

Utility gratification mainly refer to users' satisfaction of obtaining health knowledge, sharing health

knowledge, disseminating information, and managing individual health during using the MHMA, especially using the instrumental function of MHMA. For example, through the use of sports fitness applications, users can record their own exercise and diet, analyze daily health status, and get sports health information pushed by the application, and also obtain fitness information and sport experience which shared by other users through the social networks in the application. The main purpose of users using MHMA is to obtain health information and manage individual health. Therefore, we take utility gratification as first-order variable and consist of two second-order variables, which are health management gratification and health information gratification.

Information gratification refers to the satisfaction of user's need to acquire knowledge or information in vertical fields. Health information gratification refers to the user's rapid access to health information about sports, healthcare, weight loss, menstrual management, pregnancy and baby management and other related knowledge and obtain health-related guidance and help through the use of MHMA^{[13][14]}. Health management gratification is refers to the instrumental function of the MHMA can help users record, store, analyze, and evaluate their own health data, and store, process and show the analysis result of health status to users in the process of using MHMA, and then help users adopt health management method and healthy behaviors. When the user's health information and health management needs are met, the user's willingness to continue using MHMA will be strong. Chang et al. (2013) also confirmed that gratification of utility need have significant influence on users' continuance usage intention^[12]. Therefore, we believe that the higher the degree of satisfaction of health information need and health management need, the higher the satisfaction of users' utility need, and the stronger the users' willingness to continue using MHMA. Thus, the following research hypothesis is proposed.

H1: Utility gratification has positive significant influence on users' continuance usage intention of MHMA.

3.2.2 Hypotheses of hedonic gratification

Hedonic gratification mainly refers to satisfaction of getting the pleasant, enjoyable, and obtaining joyful experience and positive emotion through the use of MHMA. The convenience and promptness of acquiring health data and health information, the effectiveness of individual health management, the interactivity of users in the social function all give users use pleasant experience. Users themselves will also fantasy they will achieve their purpose after using them, when users witness the health management effects of other users through the moments and chat with them. Therefore, hedonic gratification is proposed as a first-order variable composed of the users' perceived enjoyment and perceived fantasy.

Perceived enjoyment mainly refers to the user's pleasure and happiness through the use of MHMA, mainly by viewing interesting information, sharing interesting health experience, and getting pleasant experience through the gratification of health information and health management needs^{[13][15]}. Perceived enjoyment is one of the main cognitive of using of social media, and Li et al. (2015)^[2] took online games as an example, confirming that online games can bring entertainment to users and can significantly affect users' continued willingness to use. Ifinedo et al. (2016) took social networks as the research object, and confirmed that the satisfaction of enjoyment in social network has significant impact on users' continuance usage intention of social network^[15]. Shang et al. (2017) also confirmed that perceived enjoyment is the main factor affecting users' social participation and knowledge sharing in the scenario of social media^[16].

Perceived fantasy mainly refers to users have a state of fantasizing about his or her physical and psychological exception will be come true when using the MHMA, for example, users will imagine that they will lose weight, have a more graceful body, greater self-confidence, and a healthier status after using the app^[17]. Hirschman and Holbrook emphasized that user fantasy has an important impact on the satisfaction of users' hedonic need when use hedonic services and products. In the field of information system, Chou (2007)^[18] and Li et al. (2015)^[2] also confirmed the important role of perceived fantasy in users' continuous use of online

games.

Therefore, the higher the degree of gratification of the users' perceived enjoyment and perceived fantasy, the higher the degree of gratification of hedonic needs, and the stronger the users' continuance usage intention of MHMA. Chang et al. (2013) demonstrated that hedonic gratification significantly affects users' continued willingness to use^[12]. Ha et al. (2015) confirmed that users' hedonic gratification affect users' usage attitudes of social media, and then impact users' use behaviors directly^[19]. Hence, the following research hypothesis is proposed.

H2: Hedonic gratification has positive significant influence on users' continuance usage intention of MHMA.

3.2.3 Hypothesis of social gratification

Social gratification mainly refers to satisfaction of social needs which including interacting with others, sharing experiences, exchanging feeling and ideas, forming good relationships with users who have the same issues, hobbies or interests, and becoming members of an organization, and receiving care and support of information and emotions from other users. According to previous researches and analysis of MHMA, social gratification as first-order construct is constructed of social interaction, social expression and social image^{[2][16]}.

Social interaction mainly refers to supporting each other with other users, strengthening contacts, and making new friends by using the social functions and services of MHMA^{[13][19]}. Users in the MHMA can interact with others by sharing health information, commenting on or responding to other users' posts, giving likes to other users' shared information, and sending private messages. At the same time, users can set up circles and groups to form communities with same hobbies. Li et al. (2015) confirmed that social interactions in online game significantly affect users' continued willingness to use^[2]. Shang et al. (2017)^[16] demonstrated that social interaction is the main driving force for users' participation in social media^[16]. In short, social interaction has significant influence on users' usage behavior.

Social expression mainly refers to sharing personal health information, health perspectives, opinions and health information of interest through social functions and services, expressing to other users who they are, what they like, and showing self to other users^[13]. Li et al. (2015) showed that users want to show themselves to other users through online games. When the users' social expressions are satisfied, users' continued willingness to use is strong^[2].

Social image mainly refers to users sharing their positive health information, health outcomes and other content through social functions and services, and transmitting a positive impression to other users in order to have a positive image and be liked by other users^{[13][15]}. Users get their own fans and friends, and feel happy through show themselves through social functions and services, users will continue to use MHMA. Therefore, based on the above analysis, we believe that gratification of users' social interaction, social expression, and social image needs can significantly increase users' social gratification, and then affect users' continued use willingness. Hence, the following research hypothesis is proposed.

H3: social gratification has positive significant influence on users' continuance usage intention of MHMA.

4 RESEARCH METHODOLOGY

4.1 Measurement development

Online questionnaire survey is used in this research, which was constructed by three parts. Three parts of the online questionnaire was designed according to prior studies. The first part is the description of questionnaire, which involve the purpose, and significance of survey, the definition of mobile health management application, and give some example of MHMA, such as Joyrun, Sythealth, dayima mmbang and etc. The second part is basic information survey of participators including gender, age, education, use experience

of MHMA, and health status. The third part is variable measurement. Measurements of the utility gratifications including health information and health management were adapted from Gao et al. ^[13], and measurements of hedonic gratification were adapted from Li et al. ^[2], Gao et al. ^[13], Ha et al. ^[19], and Sherry et al. ^[20]. Measurements of social gratifications were adapted from Gao et al. ^[13] and Ha et al. ^[19]. Measurements of continuance usage intention of MHMA were mainly adapted from Venkatesh ^{[21][22][23]}. All measurements are designed based on previous research and adapted from the characteristics of MHMA. The designed questionnaire was sent to peer scholars and was reviewed and revised by them. The final version was formed after multiple preliminary surveys and revisions.

4.2 Data collection

The online survey service named WJX (www.wjx.cn) was used to collect data. The paid sample collection services of WJX and the WeChat friend group are two main channels of data collection used in this research. 401 data were collected together. Among them, 201 data were collected through paid sample collection service, and 200 data were filled by friends, teachers and students from various regions. In order to ensure the validity of the data and the results, 132 data were deleted according to the answer of trap items and the questionnaire filling time. 269 valid data was acquired in the end, and the valid rate of questionnaire is 67.1%. The demographic characteristics of these survey respondents are shown in Table 1.

Table 1. Demographic Characteristics (N = 269)

Variable	Classification	Freq.	%	Variable	Classification	Freq.	%
Gender	Male	121	45	Time of MHMA using	Half year and below	73	27.1
	Female	148	55		0.5-1 year	81	30.1
Age	18 years old and below	6	2.2		1-2 year	77	28.6
	19-24 years old	119	44.2		2-3 year	28	10.4
	25-35 years old	101	37.5		3 year and above	10	3.7
	36-45 years old	29	10.8	Frequency of MHMA using	Once in a while	64	23.8
	46-60 years old	14	5.2		Once or twice per month on average	24	8.9
	61 years old and above	0	0		Once per week on average	39	14.5
Education	Junior high school and below	2	0.7		Two or three times per week on average	59	21.9
	High school, secondary school, technical school	6	2.2		Once above every day	83	30.9
	Associate degree	33	12.3	Which kind of MHMA do you use.	Lose weight APP	27	10
	Undergraduate	184	68.4		Sport and fitness APP	194	72.1
	Graduate and above	44	16.4		Physical health APP	36	13.4
Health Status	Very healthy	169	62.8		Pregnant infant health	12	4.5
	Minor health problems in the past three months	96	35.7	Health status	Serious health problems in the past three months	4	1.5

5 DATA ANALYSIS

5.1 Validity and reliability

The data analysis utilized a two-step approach. The first step analyses the measurement model, while the second tests the structural relationships among the latent constructs. SPSS and Smart PLS 2.0.M were employed as the primary tool to analyze the model and test the proposed hypotheses. The measurement quality of all the scales was assessed based on their reliability, convergent validity, and discriminant validity.

Firstly, the overall reliability of the questionnaire and the reliability of each factor were measured through the SPSS. The Cronbach's α value of overall reliability of the questionnaire is 0.968, which indicate that the overall reliability of the questionnaire was higher. The value of KMO is 0.956, which indicates that the factor analysis is suitable. The standard loadings, CR and AVE are mainly obtained through the verification factor analysis of Smart PLS. As shown in Table 2, All items load significantly on their corresponding latent construct with loading values well above the minimum threshold, indicating sound convergent validity of the measure model. Reliability was assessed using composite reliability (CR), and average variance extracted (AVE). CR values of all latent variable are greater than 0.7, indicating that the composite reliability of each latent variable is high and has good internal consistency.

Table 2. Reliability, Variance, and Confirmatory Factor Analyses.

Construct	Item	Loading	Mean	St. D	CR	AVE	Cronbach's α
Health management HMN	HMN1	0.834	3.73	0.798	0.899	0.748	0.831
	HMN2	0.885	3.90	0.708			
	HMN3	0.876	3.76	0.799			
Health information HIN	HIN1	0.824	3.72	0.820	0.919	0.739	0.882
	HIN2	0.881	3.84	0.773			
	HIN3	0.877	3.81	0.748			
	HIN4	0.856	3.81	0.756			
Perceived Enjoyment PE	PE1	0.858	3.74	0.751	0.909	0.768	0.849
	PE2	0.883	3.50	0.854			
	PE3	0.888	3.67	0.809			
Perceived Fantasy PF	PF1	0.843	3.67	0.785	0.928	0.764	0.897
	PF2	0.869	3.54	0.870			
	PF3	0.884	3.61	0.829			
	PF4	0.900	3.65	0.871			
Social Interaction SI	SI1	0.903	3.55	0.924	0.943	0.846	0.909
	SI2	0.933	3.54	0.928			
	SI3	0.923	3.48	0.908			
Social Expression SE	SE1	0.876	3.68	0.848	0.910	0.771	0.851
	SE2	0.881	3.70	0.816			
	SE3	0.878	3.65	0.897			
Social Image SM	SM1	0.890	3.40	0.890	0.941	0.801	0.917
	SM2	0.901	3.54	0.852			
	SM3	0.895	3.46	0.908			
	SM4	0.894	3.45	0.848			
Continuance Usage Intention CUI	CUI1	0.923	3.94	0.753	0.948	0.858	0.917
	CUI2	0.940	3.93	0.784			
	CUI3	0.916	3.87	0.811			

In order to test the discriminant validity, the square root of AVE value of each variable was compared with the correlation coefficient between variables. The results of the square root of AVE and the correlation coefficients were shown in Table 3. The value bolded on the diagonal lines is square root of the AVE, and the rest are correlation coefficients. As showed in Table 3, although the correlation coefficient between the latent

variables is large, the square root of the AVE is still greater than the correlation coefficients, which indicates that the discriminant validity is good.

Table 3. Discriminant validity

Constructs	HMN	HIN	PE	PF	SI	SE	SM	UI
HMN	0.865							
HIN	0.689	0.860						
PE	0.563	0.685	0.877					
PF	0.589	0.719	0.770	0.874				
SI	0.441	0.574	0.636	0.696	0.920			
SE	0.527	0.643	0.680	0.747	0.732	0.878		
SM	0.444	0.616	0.655	0.765	0.794	0.769	0.895	
UI	0.627	0.645	0.684	0.680	0.540	0.668	0.582	0.926

5.2 Test of hypotheses

A structural equation model was constructed through Smart PLS to verify the path relationships, the level of significance and value of R^2 . The results were shown in Figure 2. Although utility gratification, hedonic gratification and social gratification all have significant influences on MHMA continuance usage intention, the significant level of influence of social gratification on the MHMA continuance usage intention is small. Three kinds of gratifications explain more than 58% of the MHMA continuance usage intention together, which indicates strong explanatory power. Therefore the research model can be accepted in this research.

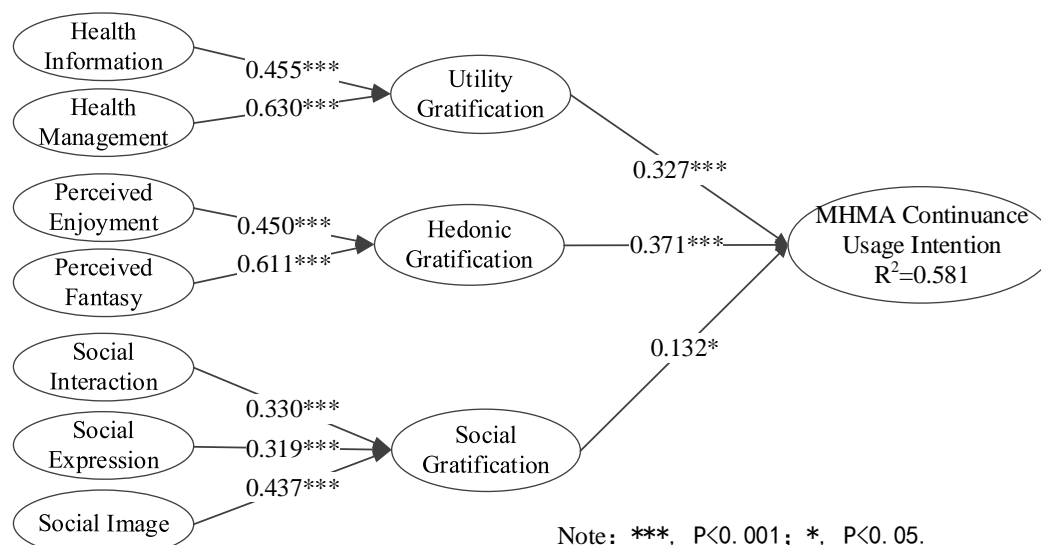


Figure 2. Research Results

5.3 Research results and discussion

As showed in Figure 2, utility gratification, hedonic gratification and social gratification all affect users' continuance usage intention of MHMA significantly, and the influence effect of hedonic gratification on continuance usage intention is largest, then the influence of utility gratification and social gratification. As analysis above, hedonic gratification including perceived enjoyment and perceived fantasy, which all come from using experience of instrumental functions and interactions on social functions. Utility gratification including health information gratification and health management gratification also mainly come from instrumental functions. Therefore, instrumental functions are especially important for a health management application which integrating the "Instrumental-Social-E-commerce" functions to meet users' needs, second is social functions,

and then is E-commerce functions. As providers of MHMA, they should be as complete as possible strengthen the utility related functions, improve health management services so as to increase users' using performance of MHMA.

Utility gratification has significant influence on users' continuance usage intention of MHMA, and the hypothesis H1 is supported. The impact of health management on utility gratification is larger than the impact of health information on utility gratification. As a result, Users use MHMA mainly to get intelligent and useful health management services including recording health data, storing data and giving health report, which was satisfied through the use of MHMA and significantly impact users' utility gratification. Although health information has a significant influence on utility gratification, its influence effect is lesser compared with health management.

Hedonic gratification has significant influence on users' continuance usage intention of MHMA. Hypothesis H2 is supported. Hedonic gratification includes perceived enjoyment and perceived fantasy, and the influence of perceived fantasy is larger than the influence of perceived enjoyment. Perceived enjoyment comes from users' using experience and interactions among users and the APP, and perceived fantasy mainly come from users' beautiful imagination about their outcomes of MHMA use. It can be seen from the research results that MHMA set up a wonderful fantasy, but the outcomes do not meet users' expectations. Therefore, MHMA should focus on improving the outcomes of MHMA use, not only improving the user experience, but also meeting user expectations.

Social gratification has significant influence on users' continuance usage intention of MHMA. Hypothesis H3 is supported weakly. Social gratification was constructed of social interaction, social express, and social image. Among them, social image has the largest impact, which indicates that mobile health services mainly meet the user's social image need. Through the use of MHMA, users can get better individual image, and obtain more likes from friends. Social functions are important for users to exchange information, show their images and share their health management outcomes. Although the influence of social gratification on users' continuance usage intention is weak significant, providers of MHMA should strengthen the services of social functions.

6 CONSLUSIONS

6.1 Research conclusions

According to the previous empirical analysis and research results, utility gratification, hedonic gratification and social gratification all have significant influence on users' continuance usage intention of MHMA. It can be seen from the constitutive second-order variable research model, Health information and health management significantly affect the utility gratification, of which health management have a larger impact; Perceived enjoyment and perceived fantasy significantly affect the users' hedonic gratification, of which perceived fantasy has a greater effect; Social interaction, social expression, and social image significantly affect the user's social gratification. Among them, social image has the largest influence effect. That is, health management gratification, perceived fantasy, and social image play important roles, and has the strongest impact on users' willingness to use MHMA.

6.2 Research significance

6.2.1 Theoretical significance

There are two aspects of theoretical significance in this research. First, this research demonstrates that the main aim of using MHMA is to satisfy users' health related needs, and then introduces the U&G theory into the research of users' continuous behavioral willingness of MHMA, which confirms that U&G can be employed in research scenario of MHMA, and the research scope and field of U&G theory was expanded. Second, three

kinds of gratifications are summarized as utility gratification, hedonic gratification and social hedonic through the analysis of MHMA functions. And then divided three kinds of gratification into seven dimensions including health information, health management, perceived enjoyment, perceived fantasy, social interaction, social expression, and social image, which are all important for users of MHMA. Therefore, this study illustrates that user health-related need are multi-dimensional, and have different effects on different users. This research has laid the foundation for subsequent research on MHMA.

6.2.2 Practical significance

Practical significance can be summarized as two aspects. First, Health service providers should pay more attention to the impact of user needs, and ensure the richness, completeness, comprehensiveness and accuracy of health information, provide users with more and better health management program, and allow users imagine their own outcomes of MHMA use. In addition, providers should pay attention to the social needs of users and satisfy the needs of social image. Second, utility gratification and hedonic gratification are main factors which promote users' continuance using of MHMA. Therefore, MHMA should focus on the utility need, and meet users' personalized needs of MHMA.

6.3 Research limitations and prospects

Although the research hypotheses have been confirmed, there are still some limitations which should be further research in the future. First, although this research uses a variety of methods to collect data, a large part of the 269 data is from students. Therefore, in future research, we can expand the scope of respondents, and study the impact of different users' characteristics on the willingness to use MHMA. Second, health consciousness can be introduced into the research of users' usage behavior, and analyze its moderating effect between the health related needs and users' usage behavior. Third, comprehensiveness, completeness and accuracy of health information and the timeliness and reliability of health management will affect users' continuous use behavior. Therefore, ECM and IS success theory can be employed in future research to test the influence of quality of health information and health management services on users' usage behavior of MHMA.

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Exploring Privacy-traces of Users from Online Community: A Case Study of Diabetes Topic Discussions

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Abstract: Online health communities (OHCs) have already become essential medium for people to obtain medical knowledge, share experiences and emotions. OHC users are able to post user-generated content (UGC) to interact with each other. However, the large amount of UGC may lead to personal information even privacy disclosed online. Although such disclosure may help users to trade some social support, which is the basis of sustaining a successful OHC, the users should be aware of the risks of leaving such traces online. This study selects a popular online Q & A community “Zhihu” in China as the research target. By collecting all questions and corresponding answers from 4 diabetes sub-communities, we would like to identify online privacy-traces of users from UGC. According to the theory of Communication Privacy Management, we build an explanatory model to understand user behaviors of concealing or revealing private information from the aspects of user characteristics, peer attention, and social support effects.

Keywords: online health community, User-generated Content (UGC), Communication Privacy Management theory, privacy leaking behavior

1. INTRODUCTION

By the end of year 2018, the quantity of Chinese internet users has reached 829 millions, in which Health and Medical ranked highest (72.89%) among all mobile searching topics^[1]. With the rapid development of information technologies and increasing attention of individuals towards health issues, online health communities (OHCs) have become valuable venues for people to communicate and receive social support^[2]. OHCs allow users to disclose health related information and share life stories with online strangers, which makes it hard to avoid leaving privacy traces^[3]. Nowadays more and more people started to pay attention to security of privacy, but majority of people did not take steps away from revealing personal information for trading relatively rewards, which is also known as the “privacy paradox”^[4]. In terms of the OHCs, this problem seems more serious since the healthcare related personal information is more sensitive and valuable.

Prior studies about OHCs have worked on user motivations towards knowledge sharing or social support. For example, the health professionals and regular users have different intentions in sharing knowledge in OHCs—the regular users are more influenced by the altruism, reciprocity, and empathy^[5]. Researchers also focused on the participants’ activities from the social support perspective and discussed the mechanism of social support on user churn^[6]. The investigations of self-disclosure in OHCs are emerging as well, such as analyzing the privacy control mechanisms^[7]. However, few studies have conducted work on exploring privacy-traces of users from the online community and further identify users’ privacy-leaking trajectories, especially with the consideration of users’ aggregated behaviors over many different sub-communities.

In this study, we developed a conceptual model about identifying effect of influential factors on users’ privacy disclosure behaviors. By analyzing data scraped from Zhihu, we would like to identify users’ privacy-traces left online. The managerial implication of the study is to improve the design of online community information system and to lower the risks of users at the meantime. For example, the community may adjust the privacy policy and operating strategy while participants need to improve consciousness of privacy protection.

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2. RELATED WORK

2.1 Privacy disclosure in online community

In OHCs, people tend to reveal their private information for different purposes. Inspired by previous studies, we divided the online private information into two types, personal identifiable information (PII) and personal health information (PHI). PII refers to the information which contains individual characteristics and could be used to distinguish, identify, contact, and locate an individual. PHI means the health-related information, including personal treatment information, personal health condition, personal living habits, personal emotional information, and other personal experience.

In online communities, people usually do not show the same extent of privacy behaviors as they do in offline contexts^[8]. When people set their own profile in SNS, lots of PII would be displayed, such as gender, birthday, educational information and occupation. People who have a greater willingness to share personal information online would be more likely to meet the cyber-victimization and engage in other potentially risky behaviors^[9]. Meanwhile, OHC users disclose their PHI in exchange for trading support or advices^[10]. They share their medical histories, feelings and experiences with people who have suffered similar health problems to receive their support^[11]. Also, health information includes both the cognitive aspect, including information for disease prevention and treatment, and the affective aspect, including information for coping with illness emotionally^[12]. According to the prior studies, we listed categories of private information disclosed in OHCs in Table 1:

Table 1. Privacy Information in OHCs

Category	Explanation	Type
Personal Identifiable Information (PII)	It includes both users' demographic features, which includes name, gender, residence, education background, career experience, user's interests and social relationship.	PII
Personal Treatment Information (PTI)	It refers to the medical information, like prevention and treatment knowledge, medical instruments, hospital and doctor's recommendation.	PHI
Personal Health Condition (PHC)	It refers to objective statement of user's health condition, such as physical indicators level, complications, physical reaction after medication.	PHI
Personal Living Habits (PLH)	It refers to the strategy of fighting disease in daily life, such as users' eating habit, exercise plan.	PHI
Personal Emotional Information (PEI)	It refers to the mood and mental statement of participants.	PHI
Personal Other Experience (POE)	It refers to stories related to illness but not specifically on medical aspects.	PHI

In conclusion, there are various privacy information leakage in OHCs, closely related to people's online behavior. It's necessary to figure out the extent of privacy disclosure while participants are enjoying the convenience of OHCs. Hence, the first research question we want to address in this paper is:

RQ1 :What kind of private information would be exposed most in OHCs, and how likely would such information be exposed?

The Pew Research Center reported that roughly 60% Americans believe it is not possible to go through daily life without having their data being collected^[13]. And we cannot ignore that online privacy literacy is an important mediator to a safe and privacy-enhancing online behavior^[14]. When people want to improve their privacy online, they need to pay more attention on their own behavior and privacy literacy as well. Accordingly, we propose the next research question:

RQ2: How does privacy disclosure related to the users' own online activities?

In this research, users' own online activities do not only include users' Q&A from 4 diabetes sub-communities, but also contain users' behaviors in other communities in "Zhihu", such as raising questions, providing answers, writing articles, and collecting columns. The success of OHCs in promoting health, however, depends not just on posting activity by participants, but, crucially, on whether or not responses are subsequently received^[15]. Prior study has found that the informational support and emotional support are closely relevant to users' intention of PHI disclosure^[16]. But from a community perspective, there are still some other factors that are not taken into account, such as other's attention, community policy. Therefore, we raise the last research question:

RQ3: What are the influential factors of users' privacy disclosure behavior from the perspective of the community, and how do they impact?

2.2 Communication privacy management theory

Communication Privacy Management Theory (CPM) points out that individuals developing rules could maximize the benefits while minimizing the risks of disclosure^[17]. The author also explains how and why people decide to reveal or conceal private information across various contexts^[17]. Although CPM was proposed to explain the people's privacy strategy in interpersonal relationships, it also could be applied to other expanding areas^[18]. In online community, information revealing will bring both good and harm as in face-to-face contexts, including more social support, visibility, potential possibility of network tracking, advertisement recommendation, and more permeable privacy boundaries.

Many studies have analyzed online users' behavior based on CPM. There are findings indicate that online consumers do set boundaries around their privacy information and develop regulations to choose when to disclose information in agreement with CPM theory^[19]. Besides, an empirical investigation on Twitter derived from CPM theory shows that "Control and Boundary Rules" of private information on Twitter predict user daily online time significantly^[20]. Users' privacy concern and behavior researches based on CPM theory are arousing as well. Some researchers analyze the narratives and posts of a pro-anorexia website, "prettythin.com", using CPM theory as a framework to explain how people balance their competing needs for revealing and concealing^[21].

In terms of this study, we use the categorization criteria for different influence factors provided by CPM and propose hypotheses based on CPM. In the privacy information control part, two types of criteria, core and catalyst play a decisive role in privacy rules. In other words, the criteria influence people on whether to share or conceal their privacy information^[18]. Combining the factors mentioned before in CPM with some new elements relevant to nowadays users' online privacy disclosure behavior, we design the new core and catalyst criteria.

Table 2. Criteria

Category	Explanation	Type
User Characteristics	It covers the gender and culture factors, like education background, business, residence.	Core
Peer Attention	This means the degree of attention of other users to someone. Usually the more follower count people get, the more possible to be visited. And the voted-up count, thanked count, collected count could also measure the other users' acknowledgement.	Catalyst
Information Support	It refers to the help in aspect of medical information and other objective health-related info, and the answer count and comment count beneath user questions could measure this.	Catalyst
Emotional Support	It refers to the help from emotional level, such as encouragement, empathy. The answer count and comment count beneath user questions could measure this.	Catalyst

As CPM has verified that gender has a great impact on privacy management in off-line communication^[17], we assume that it also works in online environment, so here is the first hypothesis:

HP1: Females are more likely to reveal their privacy information than males in OHC.

In core criteria, education level cannot be ignored too. People with more knowledge will have a better grasp of the privacy policy and will also be more aware of the dangers of privacy leak. We assume that users with a higher education level would show more privacy literacy and we propose the second hypothesis:

HP2: Education level is negatively correlated to privacy disclosure in OHC.

In terms of catalyst criteria, when people gain more peer attention or support, the ratio of risk-benefit in privacy revealing would fluctuate. Previous study has noted that through answering, commenting and liking, people are connected and forming a social network, in which the number of friends is related to his or her online activities. In this study, we intend to use the count of followers and accumulative likes received as indicators of peer attention and try to identify their impact on privacy disclosure. Meanwhile, some researchers have analyzed users' behavior from a social support perspective and indicated that what users get from the community would influence their behavior as well^[6]. As it has been mentioned in CPM that people will change or create privacy rules in order to response to the new situation^[17], we take peer attention and support into account and propose the following hypotheses:

HP3: Peer attention is positively related to privacy disclosure in OHC.

HP4: Information support is positively related to privacy disclosure in OHC.

HP5: Emotional support is positively related to privacy disclosure in OHC.

According to statements above, we build a conceptual model on identifying influential factors on users' privacy disclosure behaviors (shown as Figure 1).

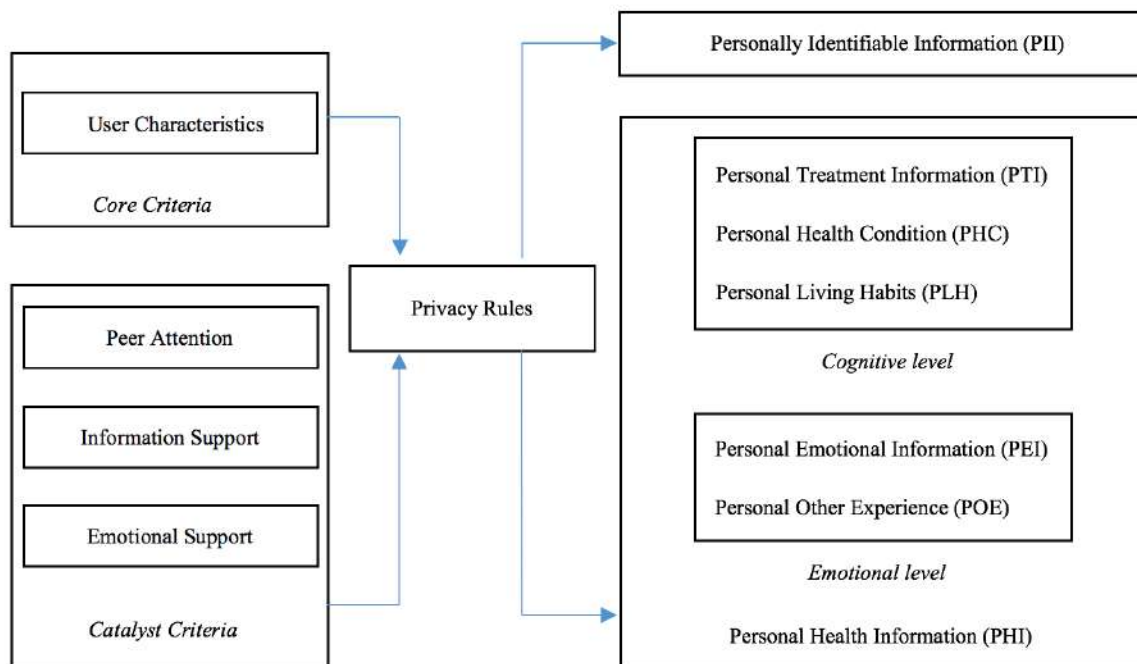


Figure 1. The mechanism of OHCs user's privacy disclosure

3. DATA COLLECTION

"Zhihu" is a well-known online Q & A community, whose diabetes sub-communities are also very popular, the following figures show us what these communities look like and the main activities of people in them.



Figure 2. The questions and answers in diabetes sub-community of “Zhihu”

In order to get an overall comprehension of users' privacy disclosure in their own generated contents, we collected all questions and corresponding answers from 4 sub communities of “Zhihu”, the subject of which is diabetes, and including diabetes subtopics, insulin, diabetic diet, diabetic complications as well.

Table 3. Question Number of Different Sub-communities

Theme	Question Number	Theme	Question Number
Diabetes	5,096	Diabetic Diet	326
Insulin	543	Diabetic Complications	878
Grand total	6,843		

Furthermore, we have gathered all the relevant 6,782 non-anonymous respondents' public information from “Zhihu”, such as questions, answers, articles, interests and basic profiles.

Table 4. User Generated Contents

Theme	Number	Content
Basic Profiles	6,471	1. Gender, business, education background, employments info, self-description, location. 2. Collected count, thanked count, voted-up count, follower count. 3. Following column count, following question count, following topic count, following count. 4. Questions count, answers count, columns count, lives count, independent articles count, pins count.
Interest	6,412	1. Following topics name and introduction. 2. Following columns title and description. 3. Following questions information. 4. Public favorite pages lists name and introduction. 5. Sponsoring lives subject and description.
Questions	6,469	User question id, title, answer count, comment count, follower count, belonging topics, time.
Answers	6,460	Question title, answer contents, comment count, voted-up count, collected count, thanked count, time.
Articles	6,433	Article title, article contents, comment count, voted-up count, belonging column, time.



Figure 3. The main activities of people in diabetes sub-community of "Zhihu"

4. PRELIMINARY RESULTS AND FOLLOWING RESEARCH AGENDA

This study conducted a rough summary on prior works of privacy disclosure in online community and the CPM theory. We identified a research gap of OHCs users' privacy management and further built a conceptual framework based on CPM theory. We assumed that user characteristics, peer attention, information support and emotional support effect people's decision on whether to conceal or reveal their privacy information.

In terms of data analysis, we are going to take the following approaches. First, we aim to apply the text mining on all posts and tag them on the basis of the health privacy information definition in OHCs in table 1. Based on all the questions and answers in 4 communities we've mentioned above, we want to analyze the disclosure of private information and make response to our first research question, finding out the extent of privacy information disclosure. Second, we will analyze 6,782 non-anonymous respondents based on all of their

interests, questions, answers, articles, rather than behaviors in the diabetes communities only, exploring the possibility of privacy disclosure and correlation between their own activities and privacy disclosure degree through a logistic regression. Third, according to the conceptual model we have built, we want to focus on the members who have both raised questions and provided answers in the 4 research communities and explore the impact of feedback from other users in the community in different time periods, separately calculating the index value of user characteristics, peer attention, information support, emotional support. Meanwhile, we want to set up the revealing degree of PII and PHI as the dependent variables, with the criteria as independent variables, identifying the influential mechanism of impact factors and calculating the coefficient of influence between different factors by conducting regression analysis. Furthermore, we will test some moderating effects cause the catalyst criteria's performance may differ due to the different core criteria.

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Evaluating the Information Usefulness of Online Health Information for Third-party Patients

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Abstract: Online health interactions (OHIs) can benefit patients, physicians, and society. However, little research has been conducted that studies the social value of OHIs for third-party patients who view previous OHIs concerning similar health issues to theirs. Drawing on the literature on social support and information uncertainty, this study established a theoretical model to explore the roles of treatment information, prevention information, and emotional support in determining information usefulness perceived by third-party patients, and whether such relationships are contingent on information uncertainty. The model was tested using “health questions and answers” textual data from 1,848 OHIs. The results indicate that prevention information and emotional support significantly improve information usefulness perceived by third-party patients. When the level of information uncertainty regarding physicians’ replies is high, the effect of treatment information is strengthened and the effect of emotional support is weakened, indicating both positive and negative contingent roles of information uncertainty. This study has implications for practitioners and also contributes to the literature on online health information, social support, information science, and information uncertainty.

Keywords: Online health interaction, third-party patients, treatment information, prevention information, emotional support, information uncertainty

1. INTRODUCTION

Online health interaction (OHI) platforms have become an alternative channel for patients to consult online physicians. The Pew Internet and American Life Project estimated that 8 in 10 Internet users search for online health information in United States, making it the third most popular online activity ^[1]. Through online health platforms, patients can interact with other patients or physicians to access informational or emotional support ^[2, 3]. The existing literature has verified that online support not only enables patients to obtain treatment quickly and cheaply ^[4], but also improves physicians’ income ^[5] and reputation ^[6], as well as enhancing physician–patient relationships. Therefore, OHIs have become an effective approach for exchanging health information and benefiting the physicians and patients encountered in the online health services.

Since OHIs are public and thus other patients can view previous interaction processes with or without payment, there may be a spillover value for society ^[7]. Viewing previous OHIs is useful for third-party patients to obtain more information about their health issues ^[8]. Moreover, it can be an effective approach for exchanging health information, although it has been largely neglected in the current literature.

To manifest precisely physician–patient interactions, and drawing on social support theory, we measured online support according to informational support and emotional support ^[2, 3]. The extant literature mainly treats informational support as a holistic concept and thus cannot provide a detailed view of how diverse types of health information can benefit online patients ^[9, 10]. Third-party patients may already understand a little about their diseases, so they can choose and view a specific OHI, which means they have already known the

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symptoms and diagnoses about their health issues. Their purpose for information seeking can be curing diseases, understanding side-effects, prevention, and emotional support^[11]. Based on the characteristics of online health information exchange, this paper identifies two dimensions of online health informational support—treatment information and prevention information—as well as online health emotional support that constitute OHI.

Uncertainty exists when details of situations are ambiguous, complex, unpredictable, or probabilistic^[12, 13]. One of the greatest obstacles of OHIs is that it is more difficult for physicians to evaluate patients' health issues or conditions compared with face-to-face communication^[14]. Further, illness is often complex and changeable^[15]. Thus, during OHIs, physicians are more cautious when helping online patients and tend to provide uncertainty information in the online context. However, patients wish to decrease uncertainty through online information seeking^[16] or communicating with others^[17]. In the health care literature, those studies involving uncertainty often focused on uncertainty management^[17, 18] and the impacts on patient behaviors^[19]. However, little research to date has examined the role of information uncertainty in OHIs, such as whether it shapes the linkage between the interaction process and information value. In our context, the uncertain information contained in previous OHIs may also shape the social value perception of the third-party patients.

To plug the research gaps previously mentioned, this study develops a theoretical model to investigate how OHIs influence spillover value for third-party patients and the moderating role of information uncertainty. Specially, this study aims to address the following research questions.

- 1) *How do third-party patients value previous OHIs?*
- 2) *Are the effects of the interaction process on information value contingent on information uncertainty?*

2. RESEARCH MODEL

Fig. 1 presents the research model in this study.

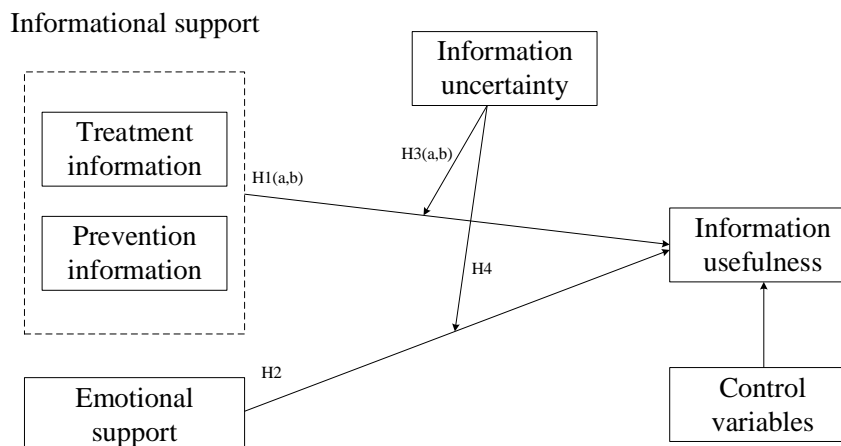


Fig. 1. Research model

Informational support, in this context, is the transmission of information, suggestions, or guidance to third-party patients via OHIs^[20]. Treatment information relates to curing diseases, and prevention information relates to preventing diseases or injuries from occurring or worsening. On online health platforms, third-party patients act as support seekers by viewing previous OHIs. Informational support can benefit them either through the direct effect of improving their health condition via the treatment information^[21, 22] or through the indirect effect of providing prevention information to enable them to manage their health condition better^[21, 23]. Thus, for third-party patients seeking health information from previous OHIs, more treatment and prevention information provided in OHIs can be more useful to them because it presents more choices in curing or managing their health issues. Based on the above arguments, we hypothesize that:

H1a. *Treatment information provided in previous OHIs positively influences the information usefulness perceived by third-party patients.*

H1b. *Prevention information provided in previous OHIs positively influences the information usefulness perceived by third-party patients.*

Emotional support is providing care or concern, understanding, empathy, and encouragement to third-party patients^[24]. Such support can help patients reduce their levels of stress or anxiety when dealing with their health issues^[20, 25]. Third-party patients have generally developed anxiety about their health issues, which has induced them to read previous OHIs. In addition to professional treatment information to deal with the issues, they may also need emotional comfort from physicians to increase their confidence in recovery or reduce their anxiety. Therefore, besides informational support, emotional support acquired from previous OHIs can also benefit third-party patients. The more information gained from previous OHIs for emotional support, the more likely it is to help third-party patients increase their confidence and reduce their anxiety. We therefore hypothesize that:

H2. *Emotional support provided in previous OHIs positively influences the information usefulness perceived by third-party patients.*

Cutrona and Russell^[26] characterized illnesses as uncertain events because illnesses are often perceived to be uncontrollable in health-related circumstances, in which patients tend to seek certain health information. Third-party patients who view previous OHIs are seeking further information about their health issues, either for treatment or prevention purposes. If the treatment and prevention information obtained is uncertain, third-party patients may question whether the information provided to the original patients encountered in the OHIs fits their own health condition. If not, they would need to view more OHIs to seek more health information^[27], which diminishes the value of the information obtained from the previous OHIs. Based on this, we propose that:

H3a. *Information uncertainty weakens the effect of treatment information on information usefulness perceived by third-party patients.*

H3b. *Information uncertainty weakens the effect of prevention information on information usefulness perceived by third-party patients.*

According to Cutrona and Russell^[26], for uncontrollable events (uncertainty) such as those experienced in health-related circumstances, emotional support is more beneficial for patients than in controllable events. When seeking health information from previous OHIs, third-party patients are also experiencing similar diseases to the patients initially engaged in the OHIs, and have concerns about their present conditions. Thus, third-party patients are also eager to obtain emotional support, such as comfort or commitment, from the physicians or previous OHIs to increase their confidence to manage their health issues. With regard to OHIs demonstrating a high level of uncertainty, third-party patients may require more emotional support because the uncertain information provided may cause concern about whether the support is suitable for their condition^[26]. Consequently, they will perceive that the emotional support offered in the OHIs is not adequate, thereby weakening the effect of emotional support on their usefulness perception. Based this, we propose that:

H4. *Information uncertainty weakens the effect of emotional support on information usefulness perceived by third-party patients.*

3. RESEARCH METHODOLOGY

We developed a JAVA-based web crawler to collect data from the OHIs on the AliHealth platform. We collected 1,848 OHIs from 15 departments. In this research, we were concerned about the word-level information in the OHIs not the reply-level information. Meanwhile, most of the physicians' replies in OHIs contain emotional expressions and two types of information: treatment information and prevention information. Our model considered whether the treatment words, prevention words, and emotional words appear in the

physicians' replies and the frequency of such words to measure physicians' replies. Thus, we conducted word segmentation to identify the medical-specific vocabularies and emotional vocabularies to analyze physicians' replies in the OHIs.

Four dictionary sources were used for the word segmentation. The treatment information dictionary come from a highly recognized and authoritative professional Chinses health term dictionary. The emotional vocabularies come from a text analysis tool based on word measurement, LIWC, which is widely used to identify emotional support [28, 29]. Since there is no mature dictionary of uncertainty information and preventive health information available at present, two specific dictionaries for use in this study were constructed. Both the assistants and researchers highlighted the uncertainty words and preventive words from physicians' replies in a sample of 90 OHIs in parallel. Then, the words with higher coincidence degree were included in the dictionaries. Finally, we achieved a customized dictionary with 34 uncertainty words or phrases, such as possible, temporary, usually and seems to be.

On the basis of word segmentation, the ratio of the number of usefulness indications (i.e., likes) to the number of views was used to measure information usefulness perceived by third-party patients. The independent variables were measured by the proportion of various types of words apparent in the whole OHI, including treatment information, prevention information, and emotional support. The moderator, information uncertainty, was measured by the presence of uncertain words in the physicians' replies in each OHI. The uncertainty rate, physician title, top hospital, applause rate, the number of likes and the number of views were used as control variables.

To test the hypotheses regarding what factors in OHIs can determine information usefulness perceived by third-party patients, we developed an empirical model with the moderating role of information uncertainty:

$$Usefulness_i = \beta_0 + \beta_1 TreatInfor_i + \beta_2 PrevenInfor_i + \beta_3 EmotInfor_i + \beta_4 Uncertainty_i * TreatInfor_i + \beta_5 Uncertainty_i * PrevenInfor_i + \beta_6 Uncertainty_i * EmotInfor_i + \beta'Z \quad (1)$$

where β parameters are the coefficients to be estimated and Z is the vector controlling information uncertainty, physician title, top hospital, applause rating, the number of likes, the number of views, and hospital level. The models were then tested hierarchically: the model including only the control variables was first tested in Stage 1, then the baseline model including the independent variables was tested in Stage 2. In Stage 3, the model with interaction terms was then tested to verify the moderating effects. Table 1 presents the results.

Table 1. Hierarchical Regression Results

DV: <i>Usefulness_i</i>	Stage 1	Stage 2	Stage 3
<i>TreatInfor_i</i>		0.001	-0.001**
<i>PrevenInfor_i</i>		0.001*	0.001
<i>EmotInfor_i</i>		0.002**	0.004***
<i>Uncertainty*TreatInfor_i</i>			6.98e-04***
<i>Uncertainty*PrevenInfor_i</i>			-2.04e-04
<i>Uncertainty*EmotInfor_i</i>			-0.002***
<i>Uncertainty_rate_i</i>	0.037	0.042	-0.008
<i>Physician_title_i</i>	0.111	0.116	0.105
<i>Top_hospital_i</i>	-0.030	-0.034	-0.027
<i>Applause_rate_i</i>	0.132	0.136	0.121
<i>Like_i</i>	0.000***	0.000***	0.000***
<i>View_i</i>	-4.18e-06***	-4.30e-06***	-4.25e-06***
Hospital level dummy	YES	YES	YES
Department dummy	YES	YES	YES
Constant	-1.378	-1.418	-1.256
Observations	1,891	1,891	1,891
R-squared	0.606	0.609	0.615

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Stage 1 results revealed that only *Like* and *View* both significantly influenced *Usefulness*, and the other controls were not significant. From Stage 2 results, it can be concluded that the ratio of prevention information (*PrevenInfor*, $\beta = 0.001$, $t = 1.79$, $p < 0.10$) and the ratio of emotional support words (*EmotInfor*, $\beta = 0.002$, $t = 2.16$, $p < 0.05$) positively and significantly influenced information usefulness. Meanwhile, the effect of *TreatInfor* on *Usefulness* was not significant ($\beta = 0.000$, $t = 0.38$, $p > 0.10$), which indicates that H1a is not supported while our H1b and H2 are supported.

In Stage 3, the moderating role of information uncertainty was tested. We found that the interaction term *Uncertainty*TreatInfor_i* ($\beta = 6.98\text{e-}04$, $t = 4.18$, $p < 0.01$) was positive and significant, which is contrary to our H3a. The coefficient of *Uncertainty*PrevenInfor* was not significant ($\beta = -2.04\text{e-}04$, $t = -0.45$, $p > 0.10$), indicating H3b is not supported. We also found that the interaction terms *Uncertainty*EmotionInfor_i* ($\beta = -0.002$, $t = 4.30$, $p < 0.01$) was negative and significant, thus supporting H4. Thus, information uncertainty strengthens the effect of treatment information and weakens the effect of emotional support.

To test the moderating role of information uncertainty further, and following the suggestions of Meyer^[30], we calculated the effect of treatment information on information usefulness at different levels of information uncertainty. The results indicate that as the number of uncertain words in one OHI increased from 0 to 8 (accounting for 99.95% of the total sample size), the effect of treatment information on information usefulness became significantly stronger. These results were consistent with our main finding that information uncertainty positively moderates the effect of treatment information on information usefulness among third-party patients. We also calculated the effect of emotional information on information usefulness at different levels of information uncertainty. The results indicate that as the number of uncertain words in one OHI increased from 0 to 8, the effect of emotional support on information usefulness became significantly weaker. These results are consistent with our H4. Therefore, our moderating effects are further supported.

4. CONCLUSIONS

This paper presents four significant key findings. First, informational support from previous OHIs can partially contribute to their social value. We find prevention information from previous OHIs can increase information usefulness perceived by third-party patients, while the effect of treatment information is not significant. Thus, prevention information contained in previous OHIs can augment their social value among third-party patients, while treatment information cannot. This may be because prevention information is related to health suggestions that prevent patients from acquiring diseases or injuries, which are more general for a kind of diseases and the potential value of such information for the other patients is great^[31]. However, compared with prevention information, treatment information is more situation-specific or targeted at specific patients engaged in the OHIs, and different patients in different situations may need significantly different treatments^[32]. Second, we find emotional support from previous OHIs can also positively influence social value perceived by third-party patients. Third, our research findings suggest that information uncertainty strengthens the effect of treatment information on information usefulness. This is consistent with the finding that the direct effect of treatment information is not significant because treatment information that is too specific is not valued by third-party patients^[32]. However, the result suggests the uncertainty positively moderates the effect of treatment information on information usefulness. This positive role of information uncertainty is due to the special situation of evaluating the information usefulness of online health information from the third-party patient perspective who view information uncertainty differently from those patients engaged in one-to one encounters. If the treatment information is uncertain, more third-party patients will believe that the treatment procedures are not specific to the original patients engaged in the OHIs, but can also be suitable for themselves. In contrast, the moderating effect of information uncertainty on the relationship between prevention information and

information usefulness is not significant. One possible explanation for this is that prevention information is less specific and more universal under different disease conditions^[31]. Thus, with the presence of a high or low level of information uncertainty in previous OHIs, third-party patients do not greatly perceive social value changes^[31]. Finally, the effect of emotional support on the social value of OHIs is weakened with the presence of information uncertainty. This is because third-party patients are surrounded by a high level of uncertainty and anxiety in managing their health issues, so they need emotional support from the experiences of patients with similar symptoms^[33]. As a result, if they still encounter uncertain information when seeking emotional support from previous OHIs to reduce their health anxiety, their value perceptions of the OHIs will be lowered.

This study provides several theoretical contributions. First, it contributes to the health information literature by proposing and explaining a new type of online health information value, namely, social value. Second, our study is one of the first effort to investigate the underlying mechanism of the social value of online health information in the information science field. Third, this study extends social support theory by measuring informational support from specific categories to reconcile the theory better with the health care context. Finally, this research indicates that while uncertainty has been widely believed to be a negative factor and to have a dark side, it may play a positive role in certain situations. this study enriches the uncertainty literature by disentangling the positive role of information uncertainty from the dark sides.

This study has some practical implications for related practitioners. First, physicians should take measures to adjust informational and emotional support in their information sharing to increase the information usefulness perceived by third-party patients. Second, physicians also need to pay attention to the use of uncertain words, since we found that information uncertainty positively moderates the effect of treatment information but negatively moderates the effect of emotional support on information usefulness perceived by third-party patients. Third, online platform managers can take measures to improve the social value of previous OHIs perceived by third-party patients, such as organizing OHIs concerning the same topic by their potential social value to increase exposure of OHIs with a higher social value. Finally, when evaluating the social value of OHIs, it is critical for third-party patients on the platforms to realize that information uncertainty can reflect the professionalism of the physicians to a certain extent because of the OHI mechanism.

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What Motivates People to Donate in Medical Charitable Crowdfunding Projects? A Trust Theory Perspective

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Abstract: In recent years, the micro-public welfare model based on social network has been widely used in medical crowdfunding, providing a novel solution for patients facing financial difficulties. Using social networks to eliminate time and space constraints on offline donations, more potential donors can be found. Based on the trust theory, this paper collected the medical crowdfunding projects data of public welfare on Weibo from 2012 to 2018, combined with the number of followers, regions and identity information of the project promoters on Weibo social media, and explored the influencing factors of the amount of public crowdfunding projects by using multi-source data. In the fundraising process of medical crowdfunding projects, the subject of trust construction is the donors, and the object of trust includes not only the relevant information of the patient, but also the promoter and the information characteristics of the project. This paper aims to build a theoretical model of trust from promoters, patients, project information characteristics, so as to explore the factors influencing the fundraising ability of medical projects under the micro-public welfare model. The results show that promoters, patients and project information characteristics can affect the trust of donors, and thus affect the amount of money raised by medical crowdfunding projects. On the basis of the above empirical research, this paper also puts forward some suggestions for the healthy development of micro-public welfare based on the problems found.

Keywords: Micro-public Welfare, Medical Charitable Crowdfunding, Trust Theory

1. RESEARCH QUESTION

This paper takes the charitable crowdfunding projects in the public welfare of Weibo as the research object, selects the medical-related charitable crowd-funding projects, obtains the project description, fundraising information, promoter information and other information of these projects, and studies the influencing factors of the fundraising ability of "micro-public welfare" projects based on the actual data of this platform.

2. HYPOTHESIS AND DATA PROCESSING

The definition of trust by Mayer et.al is accepted by most scholars^[1]. In crowdfunding activities, Trust may be influenced by the value of interaction and sharing^[2], and may also be affected by factors such as project information quality, ability of project promoter, reputation and value similarity^[3]. In general crowdfunding activities, the social status of the project promoter will affect participants' willingness to participate^[4]. Second, the patient's status may also affect the donor's willingness to donate. Previous researchers have found that women can be trusted more than men^[5]. Based on the trust theory and combined with previous research on crowdfunding, this paper proposes a research framework under the micro-public crowdfunding model.

In this paper, a total of 10,434 medical relief projects on Micro Public Welfare of Sina Weibo from 2012 to 2018 were obtained using crawler tools. In this paper, according to the amount of output raised by each region and the amount of charity money actually obtained, it is divided into three regions by clustering algorithm. Through the social network on the geographical information visualization, patients and promoter areas as nodes,

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money as edge weights, we observed the mutual aid between regions.

3. RESULTS AND CONCLUSIONS

The OLS(Ordinary Least Square) regression model is used to test the relationship between independent variables and dependent variables. Then, we get the results of hypotheses testing like Table1. The robustness test is further carried out in this paper.

Table 1. Results of hypotheses testing

Hypothesis	Contents	Hypotheses Testing
H1a	The more fans the promoter has, the better the fundraising.	Supported
H1b	The celebrity promoter help project raise more money.	Supported
H2a	Women receive more donations in medical crowdfunding.	Not Supported
H2b	Children or the elderly receive more donations in medical crowdfunding.	Not Supported
H2c	Patients come from areas with large charitable gaps receive more donations.	Supported
H3a	The more progress reports the better for fundraising.	Supported
H3b	The higher the number of retweets, the better the fundraising.	Supported

In social media, the number of followers of the promoter will affect the exposure of the project and the opportunity to get donations, and the number of followers as a reflection of ability will have a significant positive impact on public crowdfunding. Celebrities have high reputation and influence in social media, and "celebrity effect" is conducive to the publicity, mobilization and organization of public welfare activities in social media. The age and gender of the patient have no significant impact on the fundraising, which means there is no special care for the disadvantaged groups in the traditional sense in the medical crowdfunding. In other words, in the face of serious illness and family difficulties, the label of this disadvantaged group is ignored. However, regional differences will have an important impact on project fundraising, and projects from regions with large charitable gaps can get more attention. This suggests that the development of regional philanthropy is unbalanced and insufficient, which can be alleviated by regional mutual assistance under the micro-public welfare model. The information characteristics of the project include the information disclosure and information dissemination of the project execution. Micro-public welfare is conducive to the spread and mobilization of public welfare projects through social media, but there is still information asymmetry in the implementation of projects and the use of donations. Based on the theory of trust, information disclosure during the implementation of public benefit crowdfunding projects will make potential donors believe that those in need of help are honest, which is conducive to the project to obtain donations.

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Research on Ordering Strategy of Capital-Limited Retailers under Stochastic Market Demand

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Abstract : Under the condition of capital constraint on retailer, the retailers can effectively alleviate the funds shortage by delay payments and financing to third party financial institutions. This method will improve the profit of retailer and the performance of the csupply chain. Newsboy model under conditions of permissible delay payments, considers the capital structure of the company in the study of financing problems, and research two-stage supply chain system consisting of suppliers and retailers. An optimal order strategy model of the retailer is constructed, and the Analytical solution of this model is obtained. Then, this paper obtains a series of useful management conclusions through sensitivity analysis.

Key Words : capital structure; the newsboy model; optimal ordering strategy; financial supply chain

1. INTRODUCTION

With the acceleration of the global economic integration process, competition among enterprises has become increasingly fierce. In order to obtain excess returns in the fierce competition and to be healthy and sustainable, many companies are investing in products, technology, and management in the future or in the future to improve their competitiveness. However, many enterprises in China are faced with insufficient funds in the daily operation and management process, especially the small and medium-sized enterprises that account for more than 90% of the total number of enterprises in China ^[1]. The lack of funds will directly affect the daily operation of the company.

Management, research and development, etc., hinder the further development of the company. At the same time, Gelsomino (2014) ^[2], Hofmann (2013) ^[3], Liu (2015) ^[4] and other research found that through the process of supply chain finance, capital flow, logistics, procurement, distribution and other processes

Harmonic management can effectively improve the overall efficiency of the supply chain. Therefore, for academic and practical circles, supply chain financing in the current market environment is an urgent problem to be solved.

At present, the financing models of SMEs in China mainly include internal financing and external financing. The internal financing is mainly for enterprises to use the deferred payment or the advanced payment method to the downstream enterprises in the supply chain to obtain short-term funds from within the supply chain; the external financing is mainly for the enterprises to use the debt financing or equity financing methods to third-party financial institutions outside the supply chain. Get funding ^[5-7]. Huang (2011) ^[8] and other related research through theory and evidence found that for China's enterprises, these two different financing methods have greater substitution. According to the " 2013 China Enterprise Credit Risk Status Survey Report" issued by the International Credit Insurance and Credit Management Service Coface Group, it has become a relatively wide payment method through the sale of sales by enterprises, and the proportion of total transactions has been from 2007. in the 54.1% rise to 2011 years of 89.5%, accounting for cash on delivery style, it has grown from 2007 in 45.9% reduction to 2011 years of 10.5%. As can be seen from the above data, the internal financing

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model has been widely adopted by many companies in China. The modes of external financing of enterprises to third-party financial institutions outside the supply chain are: accounts receivable financing, inventory financing, prepayment financing, and strategic relationship financing^[9]. Lu Qihui et al (2012)^[10], Arya et al. (2013)^[11] studied the financing decision-making problem of financially constrained retailers from the perspective of accounts receivable financing. Buzacott et al. (2004)^[12] studied the optimal ordering strategy for financially constrained retailers using asset collateral financing.

In the supply chain model that allows for delayed payments, it is generally assumed that the retailer has sufficient ability to pay to repay the supplier's payment when the credit period expires. Shaikh et al (2016)^[13], etc. from multiple angles Research on the ordering of retailers that allow deferred payments. In fact, in real life, due to various factors, many retailers may not be able to pay the full amount of the payment when the credit period expires. At this point, the retailer's business reputation will be greatly impacted, and its upstream supply chain enterprises may also be affected to a certain extent, and even cause greater losses to the entire supply chain. At this point, retailers urgently need to finance third-party financial institutions. However, affected by the scale of business operations, credit, collateral, interest rates and other factors, many small and medium-sized enterprises in China are unable or unwilling to obtain loans from commercial banks at a higher cost. They also hope to obtain funds through equity financing.

In the related research on inventory management, Li et al. (2005)^[22] conducted a research on the multi-stage inventory financing problem with financial constraints based on the newsboy model, pointing out that retailers must achieve the goal of maximizing long-term profit in the future. carried out to a third party financial institution financing to address the plight of insufficient funds; Yang et al (2017)^[23] for the first time takes into account the equity financing model for the retailer, and the establishment of a 1 suppliers and 2 two component supply retailers The chain system has obtained the optimal ordering strategy.

Based on the models of Yang et al. (2017)^[23] and Li et al. (2005)^[22], this paper incorporates the company's capital structure problem into the newsboy model that allows for delayed payments, considering two suppliers consisting of suppliers and retailers. The level supply chain system, research retailers may face the total cost in four different situations in the future, analyze the possible financing model of the retailer, construct an optimal ordering strategy model of the retailer, and obtain the analytical solution of the model. In addition, this model is further discussed through numerical examples, and the influence of factors such as bond financing ratio and capital on retailer's profit and order quantity is analyzed by parameter sensitivity.

2. MODEL DESCRIPTION AND ASSUMPTIONS

2.1 Model description

Based on the newsboy model, this paper integrates third-party financing institutions into a two-tier supply chain system composed of suppliers and retailers based on the supply chain financial business, and this financing institution can provide debt financing or equity financing. The model consists of 1 supplier and 1 retailer. The supplier has sufficient funds, assuming that the initial capital of the retailer is zero, the sales income is used to pay the purchase price on the credit expiration date, and the retailer's sales income prior to the credit expiration date cannot pay the full payment, and the retailer facing the insufficient funds can be on debt financing or equity financing. Before the start of each sales cycle, retailers order products from suppliers to meet the stochastic demand of the market.

2.2 Variable definitions and assumptions

Suppose the retailer orders a quantity of Q from the supplier at a price c for one order cycle. Throughout the sales cycle, the retailer sells the merchandise to consumers at the price p , and the inventory cost per unit of merchandise is h . If the retailer does not complete the sale of all merchandise at the end of the period, and there

is still some inventories, then according to the newsboy model supplier will repurchase these merchandise at the price u . It is assumed that the retailer is unable to pay off the full payment at the credit expiration date, at this time, the retailer can finance with bonds, obtaining the loan from the third-party financial institution at the interest rate of r , or finance with equity.

3. MODEL ANALYSIS

3.1 Model construction

Retailers may face the following four situations throughout the sales cycle:

case 1: The retailer purchases goods that are larger than market demand, and the retailer's sales revenue cannot pay the full payment. that is, $x < Q$, $px < cQ$. At this time, the total market demand satisfies $x \in (0, \beta Q]$. Among them, $\beta = c/p$, β represents a critical value, obviously $0 < \beta < 1$, otherwise the retailer will not sell such goods. In this case, the total cost of the retailer mainly includes product cost and financing cost. Due to a random market demand faced by retailers, and the density function of market demand is $f(x)$, so the total funding gap of retailers is $g_1(y) = \int_0^{\beta Q} (cQ - px) f(x) dx$.

The expected value of the total cost of the retailer is:

$$f_1(Q) = \int_0^{\beta Q} [(c - u + h)(Q - x) + \alpha(cQ - px)r] f(x) dx \quad (1)$$

case 2: The retailer purchases goods that are larger than the market demand, and the retailer's sales revenue can pay the full payment, that is, $x < Q$, $px > cQ$. At this time, the total market demand satisfies $x \in (\beta Q, Q]$. Among them, $\beta = c/p$, β represents a critical value, obviously $0 < \beta < 1$, otherwise the retailer will not sell such goods. In this case the total cost of the retailer mainly includes the cost of the product, and the expected function of the total cost is:

$$f_2(Q) = \int_{\beta Q}^Q (c - u + h)(Q - x) f(x) dx \quad (2)$$

Case 3: The retailer purchases less than the market demand, and retailer's sales revenue can pay the full payment, that is, $x > Q$, $px > cQ$. At this time, the total market demand satisfies $x \in (Q, +\infty)$. Under this circumstance, the retailer's sales revenue can fully pay the full payment, and there is no need to borrow or finance from a third-party financial institution. The total cost at this time mainly includes the cost of stock-out. Because in real life, retailers always try to avoid the shortage of goods, and also to simplify the model, this article assumes that the retailer's stock-out loss is B in the event of stock-out.

Case 4 : The goods purchased by the retailer are less than the market demand, and the retailer's sales revenue cannot pay the full payment, that is, $x > Q$, $px < cQ$, which means that the price of the products sold by the retailer is much less than that of the Wholesale price from the supplier, obviously this situation is unreasonable, so this situation cannot appear in the real world.

For this retailer, the funding gap faced in the next cycle is:

$$g(Q) = \int_0^{\beta Q} (cQ - px) f(x) dx \quad (3)$$

Assume that the proportion of debt financing planned by the retailer in the future is α , which means that the amount of future debt financing is αg and the amount of equity financing is $(1 - \alpha)g$. The expected cost of future debt financing by retailers can be expressed as:

$$C(Q) = \alpha \int_0^{\beta Q} (cQ - px) r f(x) dx \quad (4)$$

Therefore, the retailer's expected total profit is:

$$\pi(Q) = (1-\theta) \left[\int_0^Q px f(x) dx - \int_0^Q (c-u+h)(Q-x)f(x) dx - B - \alpha \int_0^{\beta Q} (cQ-px)rf(x) dx \right] \quad (5)$$

Among them, $\theta = \frac{(1-\alpha)g}{M}$ is the ratio of financing amount to total retail capital (M) in the equity financing model.

In the face of debt financing and equity financing, listed companies in China are more inclined to equity financing^[24-27]. Due to the impact of financing costs and other external factors, so the proportion of financing when using equity financing is generally higher. This article assumes equity financing ratio is not less than 20%, i.e. $\theta > 20\%$. At the same time, in order to simplify the calculation process, this paper assumes that the goods sold by the retailer are commodities that are in the product life cycle, so it can be assumed that the density function of the demand random variable is $f(x) = \begin{cases} kx, x \in [0, X] \\ 0, \text{其他} \end{cases}$, where $k = 2/X^2$, X is the largest market demand obtained by retailers according to previous experience.

3.2 Optimal solution

In this paper, the retailer's order strategy model will be analyzed and solved. Simplify and organize formula (5):

$$\pi(Q) = \left[1 - \frac{kp(1-\alpha)\beta^3 Q^3}{6M} \right] \left[\frac{pkQ^3}{3} - \frac{(c-u+h)kQ^3 - \alpha rkp\beta^3 Q^3}{6} - B \right] \quad (6)$$

Let $D_1 = \frac{pk}{3} - \frac{(c-u+h)k - \alpha rkp\beta^3}{6}$, $D_2 = \frac{(1-\alpha)kp\beta^3}{6M}$, and substitute into equation (6) to get:

$$\pi(Q) = (D_1 + D_2 B)Q^3 - D_1 D_2 Q^6 - B \quad (7)$$

Find the first derivative of equation (7):

$$\frac{d\pi(Q)}{dQ} = 3(D_1 + D_2 B)Q^2 - 6D_1 D_2 Q^5 \quad (8)$$

$$\text{Let } \frac{d\pi}{dQ} = 0, \text{ you can get the stagnation point of equation: } Q = \left(\frac{D_1 + BD_2}{2D_1 D_2} \right)^{\frac{1}{3}} \quad (9)$$

he second order of equation (6) will continue to be solved below to determine whether equation (9) is the optimal solution for this problem.

$$\frac{d^2\pi(Q)}{dQ^2} = 6(D_1 + D_2 B)Q - 30D_1 D_2 Q^4 \quad (10)$$

In real life, retailers are generally in the buyer's market. Through effective inventory control, the probability of out-of-stock situation is relatively low. Even if it is faced with a certain degree of out-of-stock situation, its shortage cost is generally not particularly large. Therefore, this paper assumes that the retailer's shortage cost to total capital ratio is lower than its gross profit margin, namely: $B/M < (p-c)/c$.

Nature 1 : If the retailer's shortage cost as a percentage of total capital is lower than its gross profit margin, that is: $B/M < (p-c)/c$, the Equation (9) is the optimal solution to the original problem.

Proof: Through the above, we know that $0 < \beta < 1$ and the retailer's interest rate r for debt financing from third-party financial institutions satisfies $0 < r < 1$, therefore the following inequality hold $(1 - \alpha r \beta^3) > 1 - \alpha > B\beta^3(1 - \alpha)/M$. In order to get a higher profit, The retailer must require that the sum of the selling price and the buyback price of the goods is greater than the sum of the cost paid to the supplier and the cost of the inventory, that is: $p + u > c + h$. Therefore, it can be seen that the following inequality holds:

$$2p + \frac{Bp\alpha\beta^3}{M} > (c-u+h) + \alpha r p \beta^3 + \frac{Bp\beta^3}{M} \quad (11)$$

Substitute D_1, D_2 into the above equation, and simplify it: $D_1 > D_2 B$. From the above, we know it has the following relationship: $(5\theta - 1) D_1 > D_2 B$, that is, it satisfies $5D_1 D_2 Q^3 > D_1 + D_2 B$. Combined with formula (10), we can know $\frac{d^2 \pi(Q)}{dQ^2} < 0$. Therefore, equation (9) is the optimal solution to the problem.

4. NUMERICAL EXAMPLES AND PARAMETER SENSITIVITY ANALYSIS

4.1 Numerical examples

Through the analysis of relevant numerical examples, this paper will further elaborate the proposed optimal ordering strategy model. At the beginning of the period, the retailer uses deferred payment to obtain the goods from the supplier and pays the full payment at the credit expiration date. If the retailer's sales revenue is unable to pay the full payment before the credit expiration date, the retailer facing insufficient funds can conduct debt financing or equity financing. At the same time, in order to solve the worries of retailers and increase the enthusiasm of retailers to place order, suppliers will buyback the remaining commodities of retailers at a certain price according to the newsboy model. The relevant parameters are as follows: $c = 5$, $u = 3$, $h = 2$, $X = 3 \times 10^5$, $p = 15$, $r = 0.1$, $M = 1 \times 10^5$, $B = 1 \times 10^4$, $\alpha = 0.3$. Under the framework of the optimal ordering strategy model proposed in this paper, according to the formula (7) and formula (9), the retailer's optimal order quantity in the interest-sales cycle is 1.8×10^5 , and the corresponding profit to this order quantity is 2.7×10^5 .

4.2 Parameter sensitivity analysis

In this section, based on the retailer's optimal ordering strategy model proposed above, relevant data in the numerical examples will be used to consider the impact of such parameters as debt financing ratio, retail capital, sales price, purchase price, cost price proportional coefficient on the retailer's optimal order quantity and profit respectively.

Figure 1 and Figure 2 respectively consider the relationship between debt financing ratio, order quantity and profit. As can be seen from figure 1 and figure 2, as the other parameters kept constant in the case, the ratio of debt financing factor increases, the optimal order quantity of retailers gradually increases, so does the profit. This is because according to the formula 5, with the increase of the proportional coefficient of debt financing, the total profits of retailers also show an increasing trend.

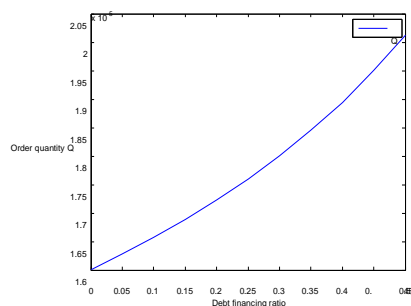


Figure 1. Relationship between debt financing ratio and order quantity

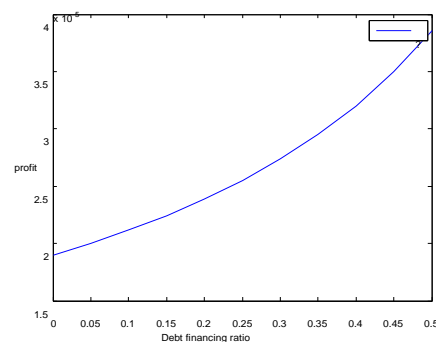


Figure 2. Relationship between debt financing ratio and profit

Figures 3 and 4 consider the relationship between retailer capital, order quantity, and profit respectively. It can be seen from Figure 3 and Figure 4 that, with the other parameters unchanged, as the retailer's capital increases, its optimal order quantity and profit gradually increase. This is because the more capital the retailer has, the smaller the proportion of the same amount of capital in the financing from the third-party financial

institutions through equity financing, and the smaller the amount of capital that needs to be distributed to the third-party financial institutions during profit sharing.

Therefore, its profit and optimal order quantity increase with the increase of capital. This is consistent with reality.

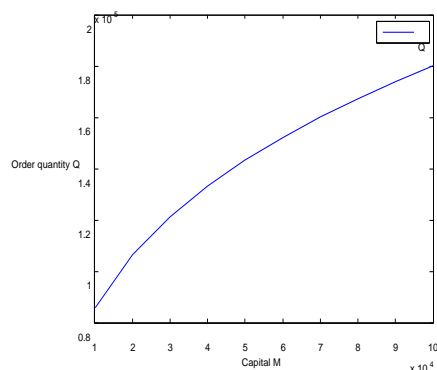


Figure 3. Relationship between retail capital and order quantity

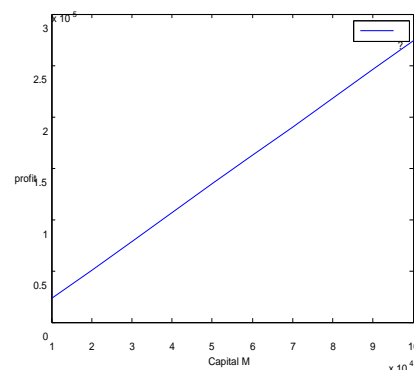


Figure 4. Relationship between retail capital and profit

Figures 5 and 6 consider the relationship between retailer sales price, order quantity, and profit, respectively. It can be seen from Figure 5 and Figure 6 that, while keeping other parameters unchanged, as the retailer's sales price increases, its optimal order quantity and profit gradually increase. This is because the higher the sales price of the retailer and the greater the profit, the other factors remain unchanged. This property can also be confirmed from equation (6).

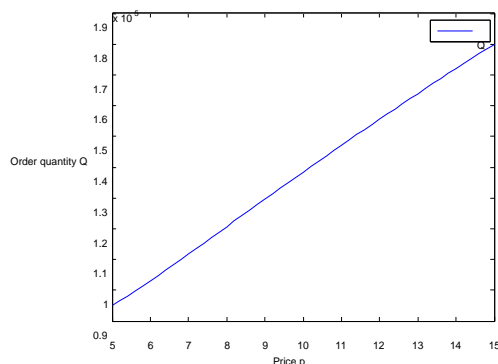


Figure 5. retailer sales price and order quantity relationship

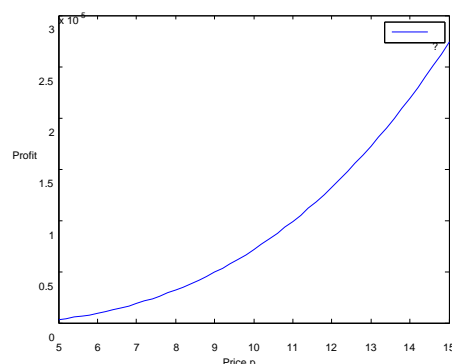


Figure 6. retailer sales price and profit relationship

Figures 7 and 8 consider the relationship between retailer purchase price and order quantity and profit, respectively. It can be seen from Figure 7 and Figure 8 that with the other parameters unchanged, the optimal order quantity and profit of the retailer have a significant decrease with the increase of the purchase price of the retailer. This is consistent with the reality. This is because, with other factors unchanged, the higher the retailer's purchase price, the lower the profit. At the same time, this property can also be confirmed from equation (6).

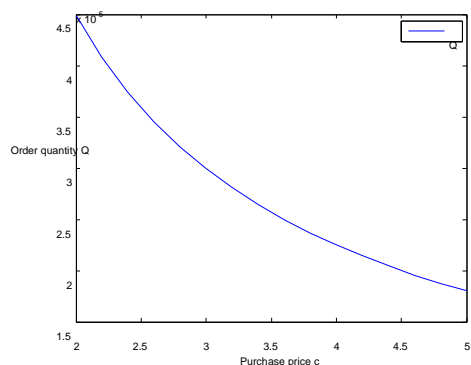


Figure 7. Relationship between retailer purchase price and profit

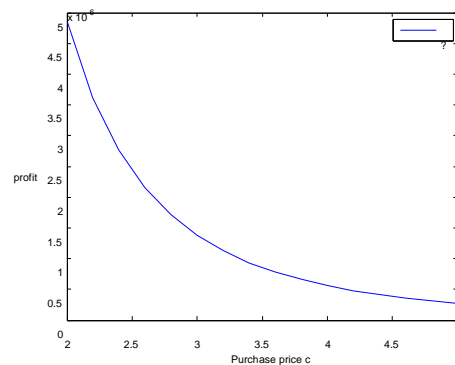


Figure 8. Relationship between retailer purchase price and order quantity

Figures 9 and 10 will analyze the relationship between the retailer cost price ratio (incoming price / sale price) and the order quantity and profit. It can be seen from Figure 9 and Figure 10 that, with the other parameters unchanged, as the retailer cost and sales price ratio coefficient increase, the optimal order quantity and profit are greatly reduced. This is because, with other factors unchanged, the greater the retailer's cost-price ratio coefficient means that the retailer's profit margin is smaller, so the order quantity and profit are less.

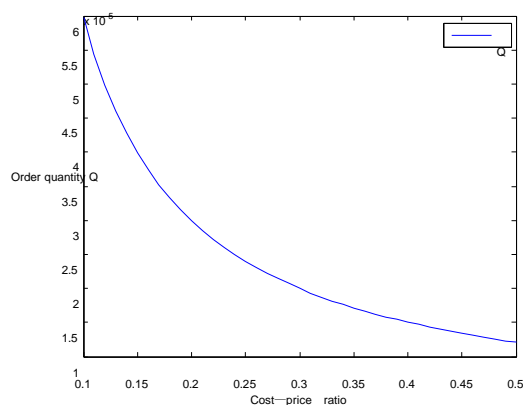


Figure 9. Relationship between retailer cost-price ratio and the and order

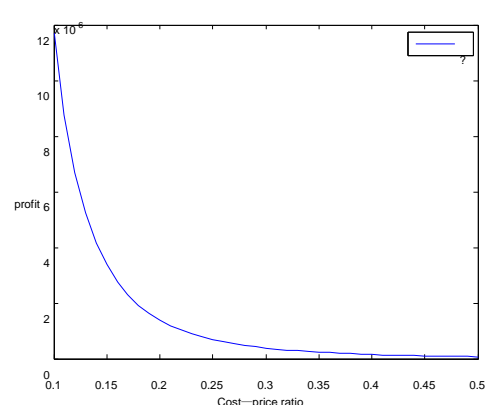


Figure 10. Relationship between the cost-price ratio and profit of retailer

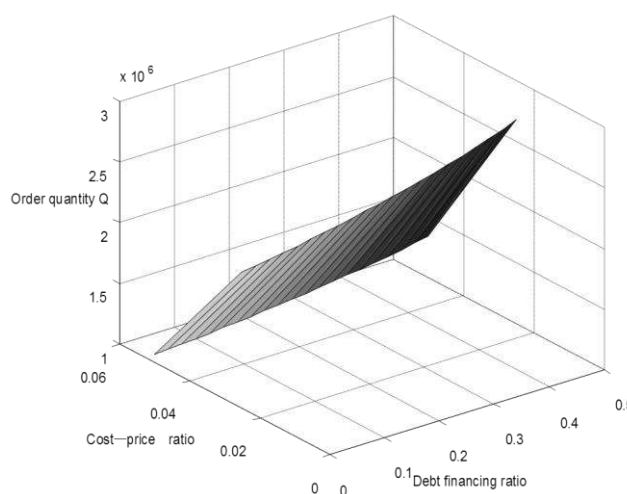


Figure 11. Relationship between cost-price ratio, debt financing ratio and order quantity

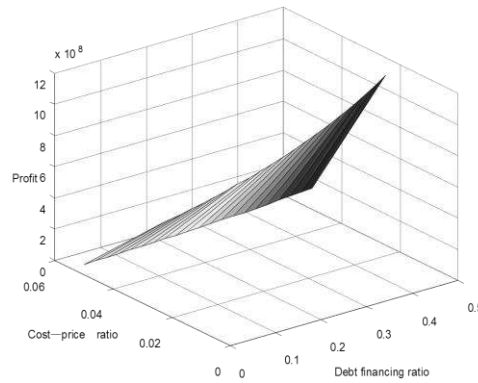


Figure 12. Relationship between cost-price ratio, debt financing ratio and profit

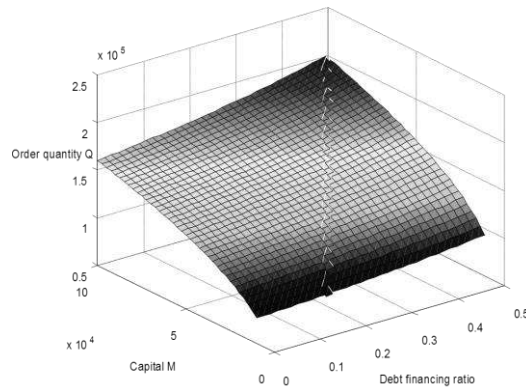


Figure 13. Relationship between capital and debt financing ratio and order quantity

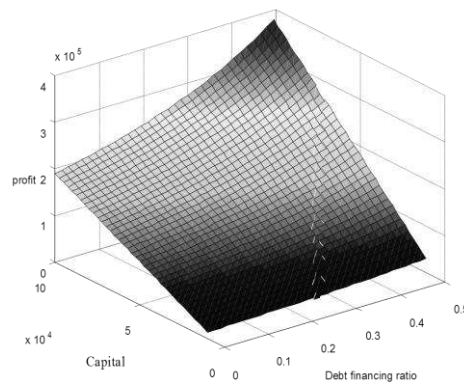


Figure 14. Relationship between capital and debt financing ratio and profit

5 CONCLUSION

In real life, most goods are faced with a buyer's market, in which case suppliers will allow retailers to purchase goods in the form of delayed payments in order to sell more products. However, due to various factors, many retailers may not be able to repay their purchases in full when the credit period expires. At this point, retailers, supply chain upstream companies, and even the entire supply chain system can suffer significant losses. To avoid this, many retailers are getting loans from third-party finance, such as commercial banks, to avoid debt defaults.

Based on the newsboy model that allows delayed payment, this paper integrates the company's capital structure problem into the financing problem in supply chain finance, considers a two-tier supply chain system

composed of suppliers and retailers, and analyzes the retailer's There may be four situations in the future sales cycle , study the cost situation in each case, and consider the issue of debt financing and equity financing that retailers may face when financing, and finally construct a retailer's optimal ordering strategy. Model and get an analytical solution for this model. Further, this model was deeply analyzed by numerical examples and parameter sensitivity analysis. The study found that with the other parameters unchanged, as the retailer's sales price, capital, debt financing ratio and other parameters increase, its order quantity and profit gradually increase; with the retailer's purchase price, cost price ratio As the coefficient increases, the order quantity and profit gradually decrease. Therefore, in order to increase profits and increase the rate of return, the retailer should increase the bond financing ratio, capital and sales price as much as possible when formulating the ordering strategy and reduce the purchase price, cost price ratio coefficient, equity financing ratio, etc.

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Research on Location of Electric Vehicle Charging Station Based on Voronoi Diagram and Improved Particle Swarm Algorithm

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Abstract: In order to reduce the blindness of charging station construction and improve the overall satisfaction of charging station construction and operation enterprises and electric vehicle users, this paper researches the location of electric vehicle charging station. First, the number of electric vehicles in the future is predicted by the grey model. The electric vehicle charging demand is calculated based on the road network, traffic flow and user charging behavior characteristics. Then the charging station service range is quickly divided by the Voronoi diagram. And a mathematical model is established based on the minimum total social cost. Finally, Improved particle swarm optimization algorithm and Voronoi graph are combined to solve the problem. The results of the example show that the algorithm can efficiently and accurately obtain the site selection scheme with the minimum social total cost, which is of great significance to urban development planning.

Key words: electric vehicle, charging station, location, improved PSO, voronoi diagram

1. INTRODUCTION

As a new type of energy-saving and environment-friendly car, electric vehicles have greatly changed the previous energy choice, and its popularity can effectively reduce the consumption of fossil fuels. The State Council has also identified the electric vehicle industry as one of the strategic emerging industries^[1]. In order to realize the popularization of electric vehicles, the rational construction of electric vehicle charging stations will be one of the important links, and scientific and reasonable location planning is an important prerequisite for the rapid development of electric vehicles. "How to develop a healthy charging service market in China"^[2] reports that the increase in the number of charging piles still cannot keep up with the growth of charging demand.

2. LITERATURE REVIEW

Holzman.D took the minimum square of the distance between charging station and charging demand point as the objective function. The location model was constructed by the network planning method and was verified by examples^[3]. G.Celli analyzed the loss cost of the charging station and the user's charging cost, and studied the location and capacity of the charging station through genetic algorithm^[4]. Andy Ip analyzed the factors affecting the location of electric vehicle charging stations and established a two-stage location planning model. In the first stage, the charging demand point and the demand quantity were obtained by the cluster analysis method, and the second stage was the modeling and analysis of the charging station candidate point optimization^[5]. By analyzing the characteristics of the distributed power supply of the charging pile, Yang Yi considered the predicted value of the power supply load and the uncertainty of the distributed power output power. The objective function was the fuzzy expected value of annual operating expenses, and the constraints were various conditions restricting its economic and reliable operation^[6]. In existing research, there have been many studies on the site selection of facilities. Most of them have conducted in-depth research on site selection

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principles, distribution network constraints, and network planning, but less consideration was given to the layout of the road network, traffic flow and user charging behavior characteristics.

3. CALCULATION OF ELECTRIC VEHICLE CHARGING DEMAND

3.1 The prediction of electric vehicle ownership

Grey model is a method to predict uncertain factors. Pingyao Wang used GM (1,1) model to predict the population of Dalian city, and the results were satisfactory^[7]. By identifying the degree of divergence of development trends among system factors, correlation analysis is carried out, and the original data is generated and processed to find the change rule of the system, generate strong regular data sequence, and then establish the corresponding differential equation model, so as to predict the future development trend^[8]. The prediction of electric vehicle ownership in this paper are based on GM (1,1) model. Due to the limitation of space, the theoretical derivation is not carried out here, and the prediction model is as follows:

$$\hat{x}^{(0)}(k+1) = (1-e^a)(x^{(0)}(1) - \frac{u}{a})e^{-ak} \quad (k=1,2,\dots) \quad (1)$$

And in this paper, the model accuracy is tested by posterior test. The procedure of posterior inspection is as follows.

(1) Calculating residuals:

$$e(k) = x^{(0)}(k) - \hat{x}^{(0)}(k), k = 1, 2, \dots, n \quad (2)$$

(2) The variance of the original sequence $x^{(0)}$ and the residual sequence E are S_1^2 and S_2^2 respectively.

$$S_1^2 = \frac{1}{n} \sum_{k=1}^n [x^{(0)}(k) - \bar{x}]^2 \quad (3)$$

$$S_2^2 = \frac{1}{n} \sum_{k=1}^n [e(k) - \bar{e}]^2 \quad (4)$$

among them,

$$\bar{x} = \frac{1}{n} \sum_{k=1}^n x^{(0)}(k) \quad (5)$$

$$\bar{e} = \frac{1}{n} \sum_{k=1}^n e(k) \quad (6)$$

(3) The posterior difference ratio C is calculated as

$$C = S_2/S_1 \quad (7)$$

The value of C is directly related to the accuracy, and the accuracy test level is shown in Table 1.

Table 1. Reference table for accuracy test level

Model accuracy level	The posterior difference ratio C
Level1 (good)	$C \leq 0.35$
Level2 (qualified)	$C \leq 0.5$ & $C > 0.35$
Level3 (reluctantly)	$C \leq 0.65$ & $C > 0.5$
Level4 (unqualified)	$C > 0.65$

3.2 Charging demand distribution

In order to better represent the charging demands of different regions on the map, we regard all road nodes in the road network as charging demand points and allocate charging demands according to the traffic flow of

each road. According to the characteristics of Voronoi diagram that the service scope can be automatically divided, this research uses it to the location process of charging stations.

A Voronoi diagram consists of a set of continuous polygons consisting of vertical bisectors connecting the lines of two adjacent points. Let R be a set of points of n elements contained in the plane. The n points in R act as growth points and expand around at the same speed until a straight line boundary is formed. Finally, except for the vertices near the boundary, they are convex polygons^[9].

$R = \{R_1, R_2, \dots, R_n\}$, $3 \leq n < \infty$ is a set of a set of points in a plane, and the Voronoi diagram generated by the point set R can be defined as follows:

$$V(R_i) = \{x \in V(R_i) | d(x, R_j), j = 1, 2, \dots, n, j \neq i\} \quad (8)$$

Because Voronoi diagram can make the distribution of growing points more uniform in the network optimization and has the remarkable characteristics of partitioning according to distance, it is widely used in many fields. For example, Voronoi diagram can be used to divide distribution areas of logistics centers.

3.3 Charging demand calculation

Accurately describing the travel behavior process law can be used as a basis for analyzing the charging requirements of electric cars^[10]. Therefore, in the calculation of charging demand, this article fully considers the travel behavior characteristics of electric vehicle users. And it is assumed that the maximum driving distance of an electric vehicle is 150 kilometers. Because of the "charging anxiety problem", it is assumed that when the remaining power is only 30% of the maximum power, the user must go to the charging station to charge.

The first step is to distinguish whether the electric vehicle user owns a household charging pile. If so, electric cars can be charged at home every night without having to go to a public charging station, otherwise, electric cars must go to a public charging station to charge. Xing Yan reached a survey conclusion^[11]. Of the 200 car owners surveyed in Beijing, 45% of the respondents said that they own private household electric vehicle charging piles. Therefore, it can be assumed that 45% of electric vehicle users can charge at home every night. It also shows that another 55% of users must use public charging piles for charging.

The second step is to analyze whether to go to a public charging station to charge according to the average daily mileage of electric vehicle users. Shiqi Ou^[12] conducted a detailed investigation and analysis of the travel characteristics of Chinese electric vehicle users. In that survey, 169,296 privately-owned passenger vehicles are investigated from 82 cities in 27 provincial regions in mainland China (excluding Hong Kong, Macao, and Taiwan). It was found that the average daily mileage of electric vehicle users in China is about 34km. It can be inferred from this, considering the problem of charging anxiety, for car owners without home charging piles, they need to go to the public charging station to recharge about once every three days. That is, in one day, the probability that an electric car without a household charging pile will go to a public charging station to charge is 33.33%.

And Shiqi Ou researched and found that there is a 99% probability that the average daily driving distance in China didn't exceed 105 kilometers. In other words, among the owners of household charging piles, there is an 1% probability that they will go to a public charging station to charge in one day^[12].

In summary, at the demand point j , the formula for calculating the demand for electric vehicle charging is as follows:

$$d_j = S_j * 0.45 * 0.01 + S_j * 0.55 * 0.33 \quad (9)$$

In this formula, S_j is the number of electric vehicles at demand point j .

4. LOCATION MODEL AND SOLVING PROCESS

4.1 Objective function

This paper comprehensively considers the investment and construction cost of the charging station, the operation cost of the charging station, and the time cost of the electric vehicle user to the charging station, taking into account the overall cost of the whole society as the objective function of the charging station location planning. The objective function is as follows :

$$\min C = \sum_{i=1}^N (C_{i1} + C_{i2}) \quad (10)$$

In this formula, C is the annual average cost of the charging station planning scheme; N is the number of electric vehicle charging stations; C_{i1} is the annual enterprise construction operating cost corresponding to the i -th charging station; C_{i2} is the annual cost of electric vehicle users corresponding to the i -th charging station.

(1) Charging station enterprise cost

The cost of the charging station enterprise mainly includes the investment construction cost and operation and maintenance cost of the charging station. Among them, the mathematical model of the total cost of the enterprise of the i -th charging station is as follows:

$$C_{i1} = C_{ci} + C_{oi} \quad (11)$$

In this formula, C_{ci} is the annual investment construction cost of charging station i ; C_{oi} is the annual operation cost of charging station i .

- The annual construction investment cost of charging station i

$$C_{ci} = (w + n_i \times p) \times \frac{r_0(1+r_0)^m}{(1+r_0)^m - 1} \quad (12)$$

In this formula, w is the infrastructure cost of each charging station; n_i is the number of charging piles owned by the charging station i ; p is the unit price of the charging pile; r_0 is the discount rate; m is the operating period of the charging station.

- The annual operation cost of charging station i

The operation and maintenance costs of charging stations mainly include the daily maintenance costs of charging station management labor costs. Generally considered that the cost and charging station construction cost is proportional to the number of charging piles^[13], assuming that η is a scale factor, mathematical model is as follows:

$$C_{oi} = \eta * C_{ni} \quad (13)$$

(2) user cost analysis

The cost of the user is expressed as the cost of the time spent by the user on the journey from the demand point to the charging station.

$$C_{i2} = \gamma * 365 * \sum_{j=1}^{S_i} d_{ij} * \theta * w_j / v \quad (14)$$

In this formula, C_{i2} is the annual cost of the electric vehicle user served by the i -th charging station, that is, the annual road time cost of the user who goes to the charging station i ; γ represents the user unit time cost; j is the charging demand point; S_i is the number of charging demand points in the service area corresponding to the charging station i ; d_{ij} is the coordinate distance between the charging demand point j and the charging

station i ; θ is the road tortuosity coefficient between the nodes; w_j is the number of electric vehicle with charging demand at the charging demand point j ; v is the average speed of electric cars.

4.2 Constraint condition

(1) The number of charging piles of charging station i should meet the charging demands of its service area:

$$n_i = \text{ceil}(\mu * w_j / R) \quad (15)$$

In this formula, μ is the simultaneous arrival rate; ceil is the upward rounding function; R is the maximum number of queues for a single charging pile that the user can tolerate.

(2) The maximum distance constraint between the demand point and the charging station, that is, the distance between the demand point and the charging station cannot be too far:

$$\theta * d_{ij} < d_{max} \quad (16)$$

In this formula, d_{max} is the maximum distance between the demand point and the charging station.

(3) The number of charging piles owned by charging stations is limited

$$n_{min} < n_i < n_{max} \quad (17)$$

In this formula, n_{min} is the minimum number of charging piles in the charging station; n_{max} is the maximum number of charging piles in the charging station.

4.3 Model solving

Improved particle swarm optimization (IPSO) heuristic algorithm is adopted in this paper. Improve the inertia weight in the traditional particle swarm algorithm. As the number of iterations increases, the inertia weight changes from maximum to minimum. The formula is:

$$\omega = \omega_{max} - \frac{t * (\omega_{max} - \omega_{min})}{t_{max}} \quad (18)$$

Combined with Voronoi diagram above, the model was solved jointly by Voronoi diagram and improved particle swarm optimization algorithm. The solution process is shown in figure 1 and solved by MATLAB programming.

(1) enter the coordinates of the charging demand point, the number of vehicles with charging demand at the charging demand point, and the number of charging stations N .

(2) randomly generate the position and velocity of the initial particle swarm, and each particle represents a site selection scheme.

(3) For each particle, that is, the initial charging station site, make a Voronoi diagram, divide the service area of the charging station, and calculate the number of charging piles n_i required by the charging demand in the service area. Calculate the annual total social cost of the charging station according to the number of charging piles n_i of each charging station, the distance between the demand point and the charging station in the service range, and use it as the adaptive value of the particle swarm algorithm to record the individual extremum and the total extremum, namely the local optimal solution and the global optimal solution.

(4) Update the particle swarm velocity and position, and compile it into a new charging station site, calculate the total social cost of the year, and obtain the local optimal solution and the global optimal solution. After reaching the number of iterations, the calculation result with the minimum annual social total cost is output.

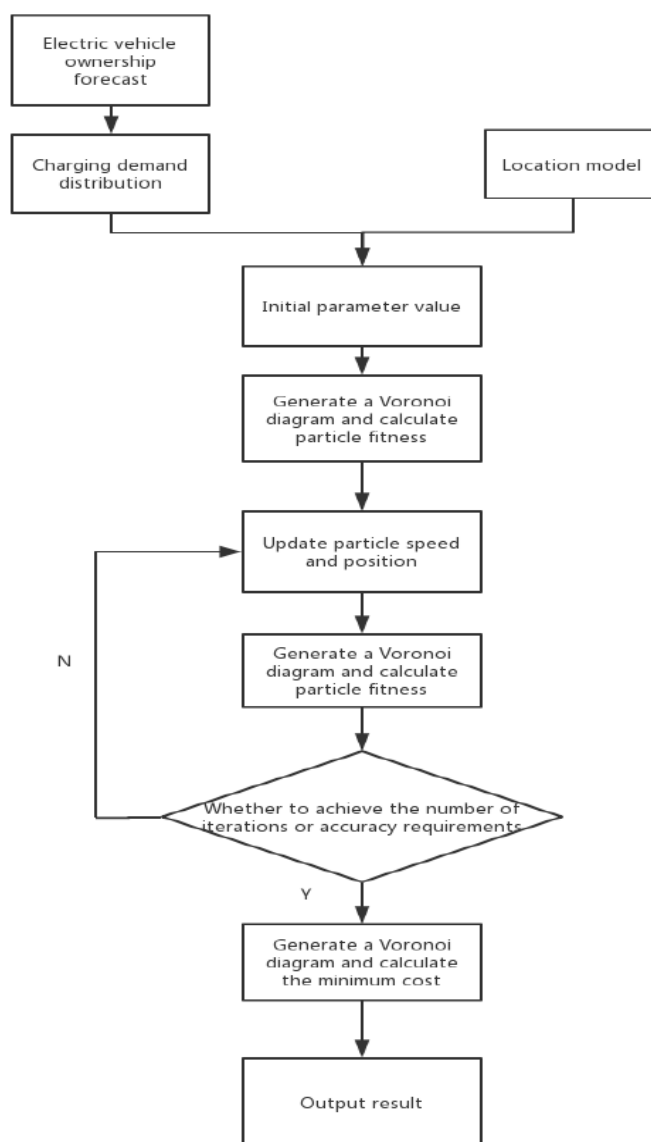


Figure 1. Voronoi diagram and particle swarm algorithm joint solution process

5. CASE ANALYSIS

5.1 Case description

Due to the difficulty in obtaining such data as traffic flow at demand points, this paper simulates relevant data of a certain region. The simulated area covers a total area of 100 square kilometers with 36 major road nodes, approximately expressed as 36 demand points, as shown in figure 2. The planned number of charging stations ranges from 7 to 11. Electric vehicle charging station rate is 0.6 at the same time. Each station on the basis of construction cost is 500000 yuan. The price of a single charging pile is 150000 yuan. The user cost per unit time is 30yuan. The winding path coefficient is 1.2. The average speed of electric car 30 km per hour. A charging station can contain a maximum of 30 charging piles and a minimum of 4 charging piles. On a single charging station, users can accept up to 4 cars in line. The distance between the charging station and the demand point cannot exceed 5000 meters. The charging station has a life cycle of 20 years and a discount rate of 0.8.

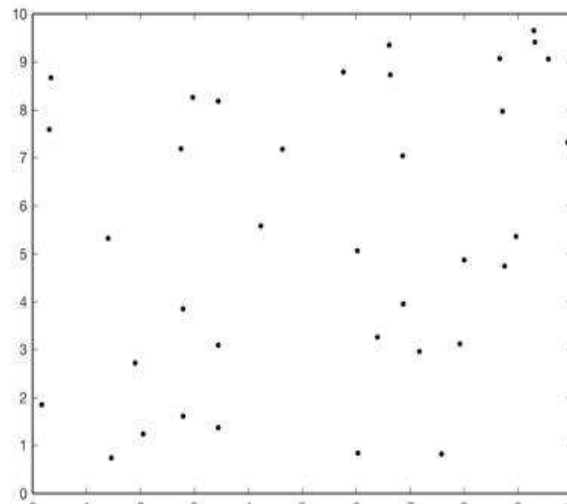


Figure 2. Location map of electric vehicle charging demand point

5.2 Prediction of electric vehicle ownership

The electric vehicles ownership in the region from 2013 to 2018 is shown in Table 2.

Table 2. Electric vehicle ownership from 2013 to 2018

Years	2013	2014	2015	2016	2017	2018
Electric vehicle ownership	103	154	227	303	417	617

Through the gray forecasting process above, it is estimated that the number of electric vehicles in the region will be approximately 6,450 in 2025. The prediction results are shown in Table 3.

Table 3. Forecast of electric vehicle ownership from 2019 to 2025

Years	2019	2020	2021	2022	2023	2024	2025
Electric vehicle ownership	832	1170	1646	2316	3258	4584	6450

The model needs to be tested to verify its validity and availability. This paper uses the posterior difference ratio to test. In this case, the post-test difference ratio test is calculated as 0.1226. Referring to Table 1 for the accuracy test level reference table, the post-test difference is less than 0.35, so the prediction model belongs to a higher precision model and the prediction result is relatively accurate.

5.3 Charging demand calculation

It is difficult to obtain the data of electric vehicle ownership at each demand point. However, the number of electric cars is positively correlated with the traffic flow, so we calculate the electric vehicle ownership at each demand point through the following formula:

$$S_j = S * R_j \quad (19)$$

In this formula, S is the total number of electric vehicles in this region, which is 6450. R_j is the proportion of daily traffic flow of each demand point in the total traffic flow. So the number of electric vehicles in this area is shown in table 4.

Table 4. The number of electric vehicles in each demand point

Demand point number	All-day average flow of road sections (standard car)	Proportion R_j	Electric vehicle ownership S_i	Demand point number	All-day average flow of road sections (standard car)	Proportion R_j	Electric vehicle ownership S_i
1	229707	3.45%	223	19	231969	3.49%	225
2	239960	3.61%	233	20	216885	3.26%	210
3	257345	3.87%	250	21	293438	4.41%	285
4	261789	3.94%	254	22	211184	3.18%	205
5	180362	2.71%	175	23	193935	2.92%	188
6	197818	2.97%	192	24	214639	3.23%	208
7	299525	4.50%	291	25	270561	4.07%	262
8	183186	2.75%	178	26	200412	3.01%	194
9	145819	2.19%	141	27	103888	1.56%	101
10	104490	1.57%	101	28	141115	2.12%	137
11	147729	2.22%	143	29	157500	2.37%	153
12	143306	2.15%	139	30	158573	2.38%	154
13	203369	3.06%	197	31	166973	2.51%	162
14	111877	1.68%	109	32	180741	2.72%	175
15	208318	3.13%	202	33	123668	1.86%	120
16	116716	1.76%	113	34	173274	2.61%	168
17	102225	1.54%	99	35	162929	2.45%	158
18	118735	1.79%	115	36	196056	2.95%	190

We can quickly get the charging demand at each demand point using formula (9), as shown in table 5.

Table 5. Number of vehicles with daily average charging demand at each demand point

Charging demand point number	The abscissa of the charging demand point	The ordinate of the charging demand point	Electric vehicle charging demand d_j	Charging demand point number	The abscissa of the charging demand point	The ordinate of the charging demand point	electric vehicles charging demands d_j
1	0.34	8.67	41	19	5.76	8.79	42
2	7.58	0.82	43	20	1.46	0.74	39
3	8.00	4.87	47	21	8.66	9.07	53
4	9.92	7.32	47	22	0.17	1.85	38
5	6.39	3.26	33	23	2.05	1.24	35
6	1.40	5.32	36	24	6.63	8.73	39
7	7.17	2.96	54	25	2.79	1.61	49
8	0.31	7.59	33	26	6.61	9.35	36
9	8.71	7.97	26	27	3.44	1.37	19
10	4.63	7.18	19	28	3.44	3.09	25
11	8.96	5.36	27	29	6.86	7.04	28
12	6.87	3.95	26	30	2.97	8.26	29
13	2.75	7.19	37	31	9.29	9.65	30
14	8.75	4.74	20	32	4.23	5.58	33
15	1.90	2.72	38	33	6.02	5.06	22
16	6.03	0.84	21	34	9.56	9.06	31
17	9.31	9.41	18	35	2.79	3.85	29
18	7.92	3.12	21	36	3.44	8.18	35

5.4 Model solving result

According to the above example scenario, the programming solution is carried out in MATLAB software. When the number of charging stations is set as 8, the adaptation value change curve is shown in figure 3, and the optimal objective function value is 10745719. In the model, with the number of iterations increases, the adaptive value of the population decreases and becomes stable. This shows that the parameters used in this algorithm are reasonable and the independent simulation can output stable optimization results. And The specific results of charging station location are shown in table 6 and figure 4.

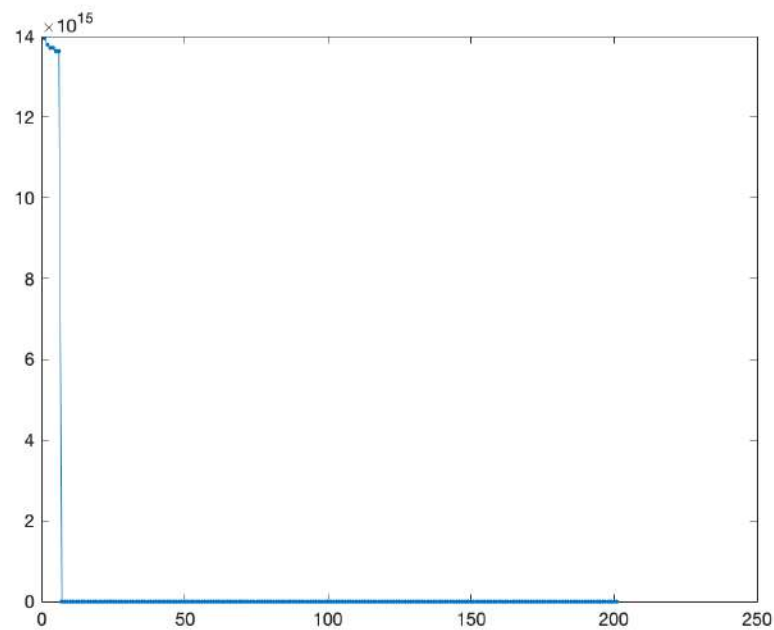


Figure 3. Adaptation value curve

Table 6. Charging station construction information table

Charging station number	The abscissa of Charging station	The ordinate of Charging station	Number of charging piles	Number of charged vehicles being served	Total social cost
1	9.9197	7.3199	11	73	10745719
2	2.6885	7.9021	30	194	
3	9.1915	9.3235	20	132	
4	7.1699	2.9599	30	198	
5	2.7901	3.8497	25	161	
6	6.5698	8.7554	22	145	
7	2.0499	1.2402	27	180	
8	8.0001	4.8700	18	116	

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How Do Types of Explanation in Online Review Affect Consumers' Attitude?

——an Experiment Study Based on the Theory of Regulatory Orientation

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Abstract: Online reviews have taken a significant role in consumers' decision of purchasing. Different from the existing researches which focus more on the usefulness of online reviews, this paper divides consumers into promotion-focused individuals and prevention-focused individuals according to their personality traits based on the regulation orientation theory. And it explores the influence of attitude changing of online explanation types to consumers by experimental research methods. The results show that, the positive and negative explanation type have no significant effect on promotion-focused individuals' attitude change, that is, negative explanation action have a greater impact on their attitude change when selecting utilitarian product; the positive and negative explanation reaction have no significant effect on their attitude change when selecting hedonic product. The negative explanation type has a greater impact on prevention-focused individuals' attitude change, that is, the negative explanation action has a greater effect on their attitude change when selecting utilitarian product; the negative explanation reaction has a greater effect on their attitude change when selecting hedonic product. The conclusions can benefit precision marketing and customer relationship management of e-commerce enterprises.

Key words: Online commentary; Interpretation type; Attitude change; Regulation orientation; Experimental research

1. INTRODUCTION

In the context of online shopping, online comments, as an explanation of previous consumers' behavior and feelings towards the purchase of products or services, can effectively reduce the uncertainty perception of subsequent consumers and serve as an important basis for subsequent consumers to make purchase decisions^[1]. Online comments consist of two parts: explanation type and explanation content. The former emphasizes consumers' behavioral choice or experience, while the latter clarifies the reasons for choosing this behavior or having this feeling^[2]. Some scholars have found that, as an important background for understanding the interpretation content, the type of explanation has a greater impact on consumers' decision-making, and provides a basis for predicting consumers' attitudes towards specific products^[3]. Interpretation can improve people's social cognition, increase the degree of understanding of the event, although some scholars are discussed from the point of view of explaining online reviews influence on perceived usefulness^[4], but for online reviews most of the research is still ignored the following points: (1) the existing research focused on users of online comments to explain more content, in fact compared to explain the content, explain the type to predict consumer attitude plays a key role more^[5]. (2) consumer attitudes is considered effective predictors of behavioral intention^[6], perceived usefulness is simply the attitude and behavioral intention of leading factors^[7], consumers consider useful comments will not necessarily make the attitude change and influence consumers purchase intention (3) simply regarded as homogeneous is unreasonable. Different consumers have different perceived values for the

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same product, which directly leads to the heterogeneity of demand. The heterogeneity of consumers makes different individuals use different information processing methods to process the same information, resulting in different cognition and attitudes^[8]. Therefore, the division of consumer types is very necessary.

As an important factor in predicting consumers' attitudes towards products, the different types of explanation in online reviews are of great significance to the marketing of merchants. Based on this, this study method, through the experiment under the condition of different online comments explain type influence on consumer product attitude, namely: (1) adjusting orientation theory, according to people with the same information when their cognitive ability and the differences in risk appetite, to promote consumers into the crowd and defensive, explore different personality traits of consumers in the face of the interpretation of the same type of comment attitude change effects are the same; (2) according to different product types (search products/experience products), the difference of attitude change between the promoting people and the defensive people when they are faced with positive and negative comments of interpretation types was investigated.

2. THEORETICAL BASIS AND RESEARCH HYPOTHESIS

2.1 Consumer attitude

Attitude was first defined as an individual's response to his own emotions, which is a conscious activity before people take action, and is manifested as an action intention [9]. Rosenberg and Hoveland^[10] put forward the three-component theory of attitude, pointing out that attitude is composed of three dimensions of cognition, emotion and intention, each of which can jointly or separately explain consumer attitude and further affect consumer behavior^[11]. Ajzen believes that attitude, subjective norms and perceived behavior control are the main indicators to predict consumers' behavioral intentions. The theory of planned behavior also points out that consumers' attitude not only affects their purchase intention, but also their final purchase behavior, which can effectively predict consumer behavior decisions^[12]. Hovland constructed an attitude change model with information learning as an intermediary mechanism, which includes four basic elements: persuader, persuasive information, persuasive situation and persuasive object^[13]. As an effective predictor of behavioral intention, it is necessary to explore the influencing factors of attitude change. This paper intends to analyze the influence of online comments on the attitude change of consumer products from the perspective of interpretation types.

2.2 Online commentary explaining the impact of type on consumer attitudes

2.2.1 Interpretation types and content

The explanation of behavior is a basic means of social cognition, which has a unique influence on individuals' understanding of the world and prediction of events^[14]. Studies have shown that interpretation can influence the persuasive effect, and a large number of explanatory languages can be used as arguments to support evaluation^[15]. Online comments, as a kind of explanation^[4], increase the certainty of users' attitude towards the product. With the increase of the certainty of attitude, the attitude is more and more likely to guide the behavior^[16]. Previous studies generally regarded online comment expression as a whole without subdivision. In fact, comment expression consists of two parts, namely explanation type and explanation content^[2]. Explanation types include explanation behavior and explanation response. If a comment is explaining why the consumer has done something (such as buying, choosing, or using, or processing), then the comment is an explanation behavior. Similarly, if a comment is explaining a consumer's experience (like, love, or anger, hate), it is an explanatory response. The explanation content is the reason for choosing this behavior or having this feeling^{[2], [15]}. See table 1-1.

Table 1. Comment representation breakdown icon

Comment expression	Explanation type	Explanation action	Positive explanation action	Example: "I bought this bag"
			Negative explanation action	Example: "I threw this bag"
		Explanation reaction	Positive explanation reaction	Example: "I like this bag"
			Negative explanation reaction	Example: "I hate this bag"
	Explanation content	Example: "(because) it has a large capacity and good quality / (because) it has a small capacity and bad quality"		

2.2.2 Interpretation types and consumer attitudes

Most previous studies on online comments have not subdivided the comments into subsections, focusing on the explanatory content. However, in fact, interpretation type can more directly predict consumers' attitudes towards products and is more critical in shopping decisions, while interpretation content plays a relatively small role^{[5], [16]}. Currently account for online reviews type research are rare, not much to explain the types of existing research its focus on the dependent variable is comments usefulness, namely customer perceived usefulness, such as Moore found that explain types (behavior versus response) and product type compatibility between vs. enjoyment (utility), choose when reading comments containing explain behavior and utilitarian products choose pleasure product reading contains explain response comments will add to consumer attitudes, predictability, and increase the likelihood of product selection^[2].

Attitude is an effective predictor of behavioral intention, which is also supported by the technical acceptance model (TAM). Its basic point is that perceived usefulness and perceived ease of use will have an impact on individuals' attitudes towards using target technology, and attitudes will further influence behaviors^{[7], [17]}. According to the theory of communication persuasion, persuasion can influence the attitude of the target object in a certain way^[18]. Explanation, however, can affect the persuasive effect, for the reason that interpreting events in explanatory language helps individuals to understand and predict events and behaviors^{[2], [15]}. In other words, explanation is more likely to cause a change in consumer attitudes than no explanation. Therefore, in the research on explanatory types, the dependent variable focusing on attitude change can better predict the actual behavior of consumers. However, there is still a lack of research on the relationship between interpretation type and consumer attitude change in the existing literature.

2.3 The effect of regulatory orientation on the role of interpretation types

2.3.1 Effect of regulation orientation

According to the regulation orientation theory first proposed by Higgins, individuals can be divided into two types of regulation orientation according to the difference of motivation orientation when achieving goals, namely, promoting orientation and defending orientation^[19]. Individuals who promote orientation have higher cognitive ability, obvious risk taking tendency, are sensitive to positive information and actively search for information related to benefits. Defense-oriented individuals have low cognitive ability, take a cautious attitude and prefer conservative strategies, are sensitive to negative information and actively search for loss-related information^[20]. The regulation orientation theory has been widely used, but no scholars have considered the heterogeneity of consumers in the study of online comment interpretation types. This study explores the differences in attitudes of consumers with different regulatory orientations in the face of different types of explanatory comments through the classification of consumers' personality traits.

Regulatory orientation has a significant effect on persuasion and consumer buying behavior. In the process of information processing, individuals' cognitive ability and personality traits will affect their final attitude

^[20]When faced with different types of comments, consumers with different personality traits pay different attention to information and have different motivations for information processing. In accordance with the behavioral strategy of one's own preference, the adjustment matching will be achieved and the corresponding attitude will be generated. Promote the targeted individuals are more sensitive to positive information, adopts exploratory information processing method, preference information search and himself, so to promote consumers, comments on the type contains positive interpretation is more persuasive, explain the type information for a positive match, a larger impact on consumer attitudes. For defensive consumers, comments with negative explanations are more persuasive and attract their attention in line with their conservative and cautious personality traits. They adopt alert strategies and prefer to search for information related to losses. In addition, information of negative explanations can be adjusted and matched to have a greater impact on consumers' attitudes. Accordingly, we propose the following hypothesis:

Hypothesis 1 (H1): For promoting consumers, compared with comments containing negative interpretation types, comments containing positive interpretation types have a greater impact on changes in consumer attitudes;

Hypothesis 2 (H2): For defensive consumers, comments that include negative interpretation types have a greater impact on changes in consumer attitudes than comments that include positive interpretation types.

2.3.2 Consider different product types

Nelson divided the products into two categories, search-type commodities and experience-type commodities, according to whether consumers can make a judgment on the value of products based on their existing knowledge before purchase. Search-type commodities refer to that consumers can obtain information related to product attributes before purchase by virtue of their own knowledge or third-party channels, such as laptop computers. Experiential goods must be experienced in order to evaluate their attributes, such as clothing ^[21]. As the nature of the product itself is different, consumers' search time and effort before purchase are also different. Huang et al. point out that consumers' purchase of search-type goods involves more extensive search, while consumers' purchase of experience-type goods involves more in-depth search ^[22]. The search product attributes (such as price, color, etc.) are objective and easy to diagnose, while the experience product attributes (such as camera usage difficulty) are subjective and difficult to evaluate. Differences in product attributes result in different information processing methods ^[23].

When consumers choose and buy search products, they pay more attention to whether the characteristics of the product itself can provide practical value for themselves, and the practical value is expected to be measured by the objective attributes described after others purchase and use. When consumers purchase experience products, they pay more attention to whether the products can satisfy their own enjoyment experience, and the enjoyment value they expect to obtain is measured by subjective evaluation, such as the reaction described by others after using. Studies on the usefulness of comments have also confirmed that comments that explain behavior are more useful for search items, and comments that explain reactions are more useful for experience items ^[4]. Therefore, we speculate that comments that explain behavior have a greater impact on consumers' attitudes for search products; For experiences, comments that explain reactions have a greater impact on consumer attitudes. Face information for promotion people when the choice has higher cognitive ability, good at active search for relevant information and explore the relationship between things, so when the face expression of emotion to explain reaction comment, no matter in the face of positive or negative view, tend to attribute the advantages or disadvantages to reviewers subjective factors rather than the product itself. In combination with the influence of H1 and H2 on consumers' regulation of orientation, when consumers are promotive personality traits, we propose the following hypothesis:

Hypothesis 1a (H1a): For search items, comments that include positive explanatory behaviors have a

greater impact on changes in consumer attitudes than comments that include negative explanatory behaviors;

Hypothesis 1b (H1b): For experiential products, there is no difference in the impact of changes in consumer attitudes on comments containing positive explanatory responses and comments containing negative explanatory responses.

When consumers are defensive personality traits, we make assumptions:

Hypothesis 2a (H2a): For search items, comments containing negative explanatory behaviors have a greater impact on changes in consumer attitudes than comments containing positive explanatory behaviors;

Hypothesis 2b (H2b): For experiential products, comments containing negative explanatory responses have a greater impact on changes in consumer attitudes than comments containing positive explanatory responses.

The research model is shown in Figure 1.

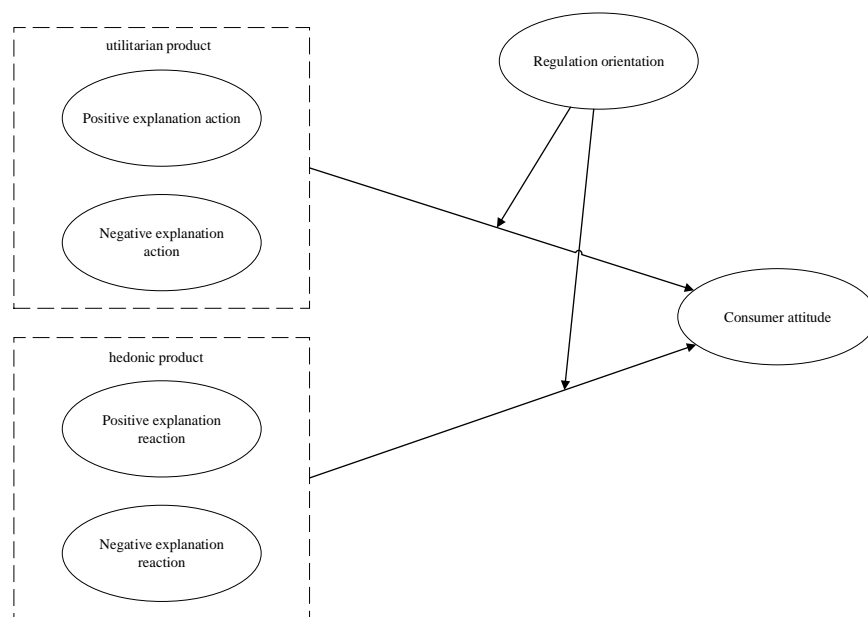


Figure 1. Research Model

3. EXPERIMENTAL STUDY

3.1 Experimental Materials

As the main force of online shopping, college students can reduce the influence of age, educational background and other demographic variables on the experiment, and they are familiar with search engines and online shopping. This study selects college students as the experimental subjects. In the selection of experimental objects, because college students know more about computers and have certain needs, they choose computers as search objects. In order to avoid the influence of gender factors on the selection of goods, the experience products choose neutral running shoes. At the same time, in order to prevent the subjects' preference or bias towards a certain product, the real name of the experimental object was concealed in the experiment, and only the picture, price, parameters and other information of the commodity were given.

In the measurement of variables, both the initial attitude and the final attitude refer to Stayman and Bartra's likert7-point scale^[24], including 9 items. Trait Yao Qi and adjust directional questionnaire reference guo-an yue modified questionnaire^[25], according to the consumer itself characteristics were divided into promote directional and defensive orientation, each topic adopt 5 points, including six topics used to measure the promotion orientation, the questionnaire also included age, sex, whether to have online shopping experience, and whether the reference review information such as online shopping.

In order to investigate the change of consumers' attitude, the experiment was divided into two parts: pre-test and post-test. Pretest according to different types of products, measured search product (computer) group and experience (running shoes) of the initial attitude, after the test, according to the different types of groups for further comment, which is divided into four groups, followed by interpretation of positive behavior group (computer) and positive reaction group (running shoes), negative explain behavior (computer), negative interpretation reaction group (running shoes), one and two groups, three groups and four groups explain content part are exactly the same, reviews the difference of expression is limited to explain different types. Participants were randomly assigned to one of the four groups, read the different comments, and then filled out the attitude scale. In addition to measuring the initial attitude, the pretest also distinguished the trait adjustment tendency of each group.

This study with the method of laboratory experiment, a total of 352 college students as subjects, invited by the time interval of two weeks of two orientation attitude scale before and after the complete measurement, to measure the attitude of the subjects to change. The experimental design of before and after test can effectively control the interference of product and other relevant information on the experimental results, and ensure that the difference in consumers' attitude towards products is entirely caused by the difference in comments. Finally, 319 valid questionnaires were used for user measurement. Among them, 153 were male, accounting for 48%. The average age of the subjects was 20.41 years old. In addition, the pretest attitudes of each group were worth 4.14, indicating that the subjects had a neutral attitude towards the commodities at the beginning.

3.2 Data processing and analysis

3.2.1 Reliability and validity test

The alpha value and KMO value of the front and back attitudes are above 0.9, the alpha value and KMO value of the adjusted vector table are also greater than 0.7, and the sig value of the Bartlett sphere test is 0.000, indicating that the data is suitable for factor analysis. The degree of interpretation is high, and the data has a good level of validity.

3.2.2 Hypothesis test results

Table 2. Test results of experimental data

		Explanation type	Explanation action	Explanation reaction
Promote orientation	Positive review	M=0.42,SD=0.76	M=0.35,SD=0.57	M=0.49,SD=0.90
	Negative review	M=0.69,SD=1.10	M=0.80,SD=1.30	M=0.57,SD=0.85
	ANOVA analysis	F=3.347,p=0.069	F=4.236,p=0.043	F=0.097,p=0.756
Defensive orientation	Positive review	M=0.20,SD=1.16	M=0.27,SD=1.07	M=0.13,SD=1.23
	Negative review	M=0.98,SD=1.28	M=0.85,SD=1.29	M=1.11,SD=1.26
	ANOVA analysis	F=15.859,p=0.000	F=4.483,p=0.038	F=11.666,p=0.001

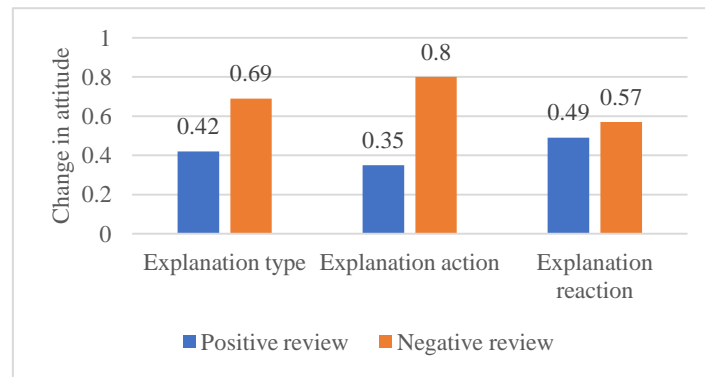


Figure 2. Amount of change in attitude of promoting consumers under different conditions

Univariate analysis of variance was used to test whether the difference in attitudes between groups was significant. The specific test results are shown in Table 2.

As shown in Figure 2, for promoting consumers, there is no significant difference in the amount of attitude change between positive interpretation type groups and negative interpretation type groups ($F = 3.347$, $p = 0.069$). For promoted consumers, when the product is a search product (computer), there is a significant difference in the amount of consumer attitude change between the positive and negative interpretation behavior groups ($F = 4.236$, $p = 0.043$). The amount of change in attitude is greater than the positive interpretation behavior group, which is contrary to our hypothesis that -H1a holds; when the product is an experience product (running shoes), there is no difference in the amount of change in consumer attitude between the positive interpretation reaction group and the negative interpretation reaction group. Significantly ($F = 0.097$, $p = 0.756$), H1b holds.

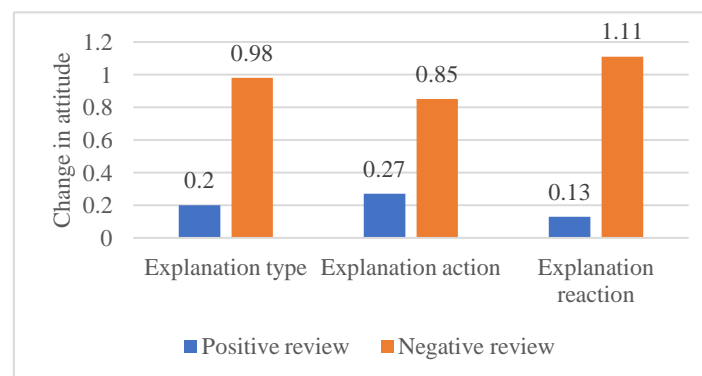


Figure 3. Defensive consumers' attitude change under different conditions

As shown in Figure 3, for defensive consumers, there is a significant difference in the amount of consumer attitude change between the positive interpretation type group and the negative interpretation type group ($F = 15.859$, $p = 0.000$), that is, H2 holds. For defensive consumers, when the product is a search product (computer), there is a significant difference in the amount of consumer attitude change between the positive and negative interpretative behavior groups ($F = 4.483$, $p = 0.038$), and the attitude of the negative interpretative behavior group is different. The amount of change is greater than the positive interpretation behavior group, H2a is established; when the product is an experience product (running shoes), there is a significant difference in consumer attitude change between the positive interpretation reaction group and the negative interpretation reaction group ($F = 11.666$, $p = 0.001$), and The amount of attitude change in the negative interpretation response group was greater than that in the positive interpretation response group, and H2b was established.

3.2.3 Interactive analysis based on product type

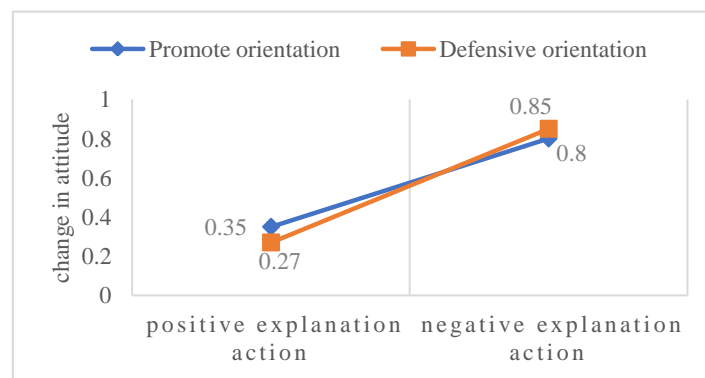


Figure 4. Interaction Diagram of Search Group Regulation Orientation and Interpretation Behavior

An ANOVA analysis of 2 (regulated orientation: promotion / defense) \times 2 (explanatory behavior: positive behavior / negative behavior) was performed on the data of the search item (computer) group, as shown in Figure 4. The results show that: (1) the main effect of regulating orientation is not significant, that is, when consumers choose search products, the difference in the attitude of consumers who promote orientation and defense orientation is not significant ($F(1,81) = 0.008$, $\eta^2 = 0.000$, $p = 0.929$) (2) The main effect of interpretive behavior is significant, that is, when consumers choose search items, there is a significant difference in the amount of attitude change between reading reviews that contain positive interpretive behavior and reading reviews that contain negative interpretive behavior, and reading contains negative. The amount of attitude change was higher when interpreting behavioral comments ($F(1,81) = 8.727$, $\eta^2 = 0.053$, $p = 0.004$) (3) The interaction between regulation orientation and explanatory behavior was not significant ($F(1,81) = 0.135$, $\eta^2 = 0.001$, $p = 0.713$), that is, for search products, the interaction between the adjustment of orientation and explanatory behavior has no significant effect on the amount of change in consumer attitudes.

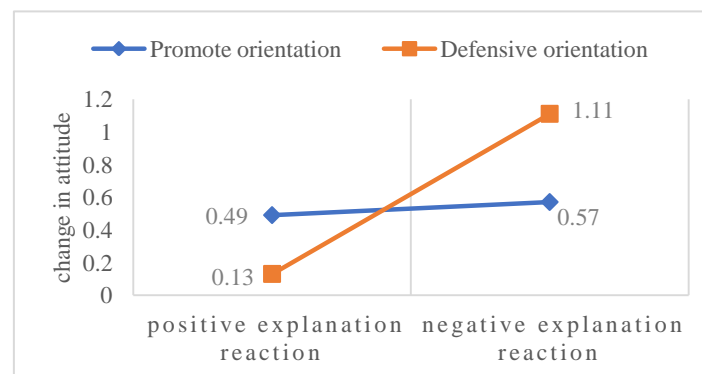


Figure 5. Interaction diagram of experiential group regulation orientation and interpretation response

The ANOVA analysis of the data of the experience product (running shoes) group is 2 (regulation orientation: promotion / defense) \times 2 (explanation response: positive response / negative response), as shown in Figure 5. The results show that: (1) the main effect of regulating orientation is not significant, that is, when consumers choose experiential products, there is no significant difference in the amount of changes in consumer attitudes that promote orientation and defense orientation ($F(1,83) = 0.266$, $\eta^2 = 0.002$, $p = 0.607$) (2) The main effect of interpretation response is significant, that is, when consumers choose experience products, there is a significant difference in attitude change between reading reviews with positive explanation reactions and reading reviews with negative explanation reactions, and reading contains negative. The amount of change in

attitude was higher when interpreting response comments ($F(1,83) = 9.459$, $\eta^2 = 0.057$, $p = 0.002$) (3) Significant interaction between modulating orientation and interpretive response ($F(1,83) = 6.721$, $\eta^2 = 0.041$, $p = 0.010$), that is, when consumers choose experiential products, the attitude change of defensively oriented individuals when reading negative review comments is significantly higher than when they read positive explanation response comments The amount of change in attitudes between individuals who read comments with positive and negative comments was not significantly different for individuals who promoted orientation.

4. RESEARCH CONCLUSIONS AND DISCUSSIONS

4.1 Research conclusions

The experimental results show that, for potential consumers, there is no significant difference in the impact of positive explanatory comments and negative explanatory comments on the amount of change in consumers' attitudes. To be specific, when promoting consumers choose search items, the impact of negative explanatory behavior in comments on the amount of change in consumers' attitude is significantly higher than that of positive explanatory behavior, which is contrary to our hypothesis. Although promote the personality of the individual information more open and inclusive, and preference income characteristics make them more sensitive to positive information, but when selecting the search product, negative comments objectively explain behavior, strong show the disadvantages of the product, product search properties make it easier for individuals to these shortcomings, lack of due to the product itself, even if the individual shortcomings more tolerance, also cannot ignore after choose products is expected to bring their losses. There was no significant difference in the impact of positive and negative explanatory comments on the amount of change in consumers' attitudes when they chose the experience. Consumer experience product itself ambiguous characteristics make it difficult to make objective evaluation, promoting consumption individuals with higher cognitive ability, is good at through own efforts to take the initiative to find the deep relationship between things, in the face of negative interpretation reaction comment because of the experience of product attributes are more inclined to the subjective attributes these deficiencies to reviewers itself. For defensive consumers, whether they choose the search product or the experience product, the cautious and conservative thinking characteristics and the low cognitive processing mode of information will make the negative interpretation comments have a greater impact on their attitude.

4.2 Research contribution and prospect

The theoretical contribution of this paper is mainly reflected in the following aspects: first, existing studies generally regard online comment expression as a whole, mainly focusing on the textual and quantitative characteristics of comments. Firstly, this paper divides the comment expression into two parts: explanation type and explanation content, explores the influence of explanation type on consumers' attitude under different conditions, and enriches the research on online comment. Secondly, consumers have heterogeneity, that is, individuals with different personality traits will adopt different ways of information processing when faced with the same information, thus resulting in different attitudes. Based on this, the adjustment orientation theory is introduced in the experiment, and the attitude change differences between the corresponding comment interpretation types to the promoting and defensive individuals are explored respectively for different commodity types. Research on interpretation types has found that defensive individuals still maintain their negative preferences, while the cognitive focus of promotive individuals varies with the processing of different information. This paper not only expands the research of regulation orientation theory in the field of consumer behavior, but also deepens the exploration of consumer attitude from the perspective of comment interpretation type.

In practice, different measures should be taken according to the type of products sold. For search product

sellers, needed to pay attention to the potential consumer groups is to promote personality or defensive personality, just need to know the negative comments to explain behavior of consumer attitudes influence is very big, this may be because contain explain behavior made the credibility of the review itself more and more convincing, more evident objective attributes, just can make huge consumer attitudes change. Therefore, search product e-commerce enterprises should always pay attention to the appearance of negative explanation behavior comments, and communicate with the reviewers in time to understand the reasons and properly deal with them. Otherwise, potential consumers will have a strong negative attitude and affect their purchase behavior. For sellers of experience products, the personality traits of potential consumers need to be distinguished. There was no difference in the impact of positive and negative explanatory comments on the attitude of individuals promoting orientation. For defense-oriented individuals, comments with negative explanatory reactions had a greater impact on consumer attitudes than comments with positive explanatory reactions. Therefore, the experience product sellers should pay more attention to the defensive potential consumer groups and take active measures to curb the impact of previous negative comments on subsequent consumer attitudes.

According to the theory of three ingredients attitude, attitude can be further divided into cognition, emotion and behavior intention, this paper studies the results showed that under different conditions explain types will have different effects on consumer attitudes, but did not explore the specific happens is a change in the attitude of what kind of ingredients, can be in the future from this perspective, explore the role of different explanation attitude to each component. Second in this study, overall positive attitude change quantity less than the change of the negative attitude, suggesting that some of the consumer is in after reading the positive explanation type of comment form compared to the attitude of the initial attitude instead of reduced, we explore the reasons for this phenomenon is nothing, future research can be perfect, and to explain the causes of the formation of different attitude.

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Sentiment Diffusion of Social Inequality in Microblogs: A Case Study of “Migrant Worker” in Sina Weibo

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Abstract: Migrant workers constitute the main city workforce in China. However, they are the victims of social inequality. Sina Weibo is one of the most important channels for people to share information and public opinions. In order to study into the sentiment diffusion of social inequality over Sina Weibo, we collected a huge number of root microblogs and reposts based on the search query “Migrant Worker”. With applying the sentiment tendency analysis tool provided by Baidu AI, we were able to capture the sentiment flipping process. We found that most microblog users tended to follow the previous users’ sentiment polarity. But the intensity of the sentiment polarity would always get weaken.

Keywords: Sentiment Diffusion, Migrant Worker, Sina Weibo

1. INTRODUCTION

In recent years, social inequality about migrant worker in China has attracted researchers’ attention, for most migrant workers in China have been excluded from the benefit of social welfare systems [1]. Meanwhile, as we can see, topics related to migrant workers are rather concerned over microblogging platforms. And microblog user’s sentiment varies about such kind of topic and the sentiment tends to flip during the information diffusion process.

Our study would just focus on the sentiment flipping process of posts related to “migrant worker” through online social network. We used the reposting relation to build the online social network and modeled the information diffusion process since the reposting process brought about the rapidest and widest diffusion of hot topics over microblogging networks [2]. Then we did the sentiment analysis using sentiment tendency analysis tool provided by Baidu AI [3]. The research questions could be concluded as follows:

- 1) *To what extent does sentiment flip during microblog reposting?*
- 2) *What are the influential factors leading to such flips?*

Through the study on the sentiment flipping rules and influential factors, we could find the factors related to people's attitude towards migrant workers to some extent, which could provide some guidance for improving the social image of migrant workers, eliminating people's discrimination and solving the inequality faced by migrant workers.

2. DATA AND METHOD

We obtained 51,926 root microblogs and 31,384 reposting microblogs from Sina weibo with the search query “migrant worker”. For further study, comment and reply contents of those microblogs were also collected. Then social network could be built during the information diffusion process. Every root microblog was seen as a root node. And reposting behavior brought a directed edge from the original post to the reposting one. For microblog M , we got the overall content $M_{overall}$ and the reposting content M_{repost} which could be shown as Figure 1.

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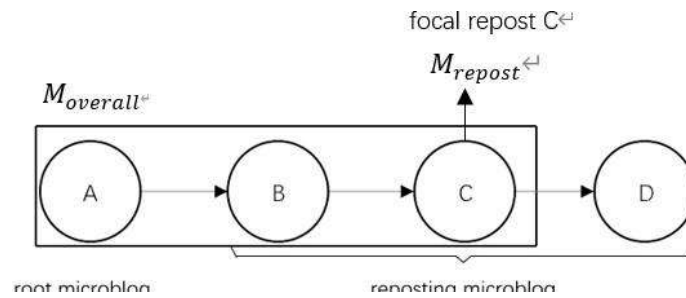


Figure 1. Overall content and reposting content

We randomly selected 100 posts from the 31384 reposting microblogs. After calculating the sentiment polarity of each reposting microblog and the overall content, we made a preliminary table as Table 1. Then we calculated the difference between the overall content and the reposting content shown as Table 2 to describe the sentiment flipping process.

Table 1. Sentiment distribution of overall content and reposting content

	Positive reposting content	negative reposting content	Total
Positive overall content	50%	4%	54%
Negative overall content	12%	34%	46%
Total	62%	38%	100%

Table 2. Sentiment change of reposting content

	Reposting microblog getting positive	Reposting microblog getting negative	Total
Positive overall content	17%	37%	54%
Negative overall content	35%	11%	46%
Total	52%	48%	100%

3. PRELIMINARY DISCUSSION

First, the sentiment inclination tended to be consistent during the reposting path. As shown in Table 1, most reposting microblogs had the same polarity as the overall content. That is, a positive root microblog about migrant worker would be likely to influence more users to hold positive sentiment through reposting. Second, according to Table 2, we can find that the intensity of sentiment in the reposts tended to get weakening along the reposting path.

To conclude, during the information diffusion process, sentiment following is commonplace, but the intensity tends to get weakening. The outcomes have implications to the design of the online social media.

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Mobile O2O Commerce Platform Quality: Scale Development and Validation

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Abstract: The *Drainage effect* of mobile O2O commerce is closely related to the platform quality. However, to date there has been no measure specifically designed to measure mobile O2O commerce platform quality (MCPQ). The purpose of this study is to develop a scale for measuring MCPQ based on the IS success model. Exploratory factor analysis (study 1) and confirmatory factor analysis (study 2) were performed on 613 samples. Results showed that the scale of MCPQ is a reliable and valid instrument, and that mobile O2O commerce platform quality is a multi-dimensional construct composed of five dimensions, i.e., interface design, operational efficiency, content quality, demand responsiveness, and privacy protection.

Keywords: mobile O2O commerce, platform quality, service quality, IS success model, scale development

1. INTRODUCTION

Mobile devices have radically changed people's daily communication, learning, working and social intercourse models. The new business model represented by mobile commerce has imperceptibly enabled people to have a chance to enjoy different life experiences. Among several different business platforms, mobile O2O commerce is a new e-commerce model emerging after B2B, B2C and C2C^[1], which has been developing vigorously in China and the world in recent years. O2O commerce attracts online users by providing information, services, and booking discounts, afterward, users receive products or experience services through the traditional offline approach. The key to this model is how to turn online users into offline consumers of cooperative merchants through the display of mobile commerce platforms, thus achieving the *drainage* effect^[1]. Therefore, users' perception of service quality of mobile commerce is crucial. However, according to a survey by the Chinese Internet Data and Information Center, among mobile O2O commerce users, 43.0% of them think the responsiveness is too slow; 40.2% of them complain about the inaccurate communication; 37.4% of them are obsessed by system errors. This unpleasant user experience reflects the service quality problems in mobile commerce^[2-4]. The improvement of quality cannot be separated from the scale of evaluation. Hence it is very necessary to explore the measurement system of mobile O2O commerce service quality from a theoretical perspective. Given the particularity of the research situation, mobile O2O commerce service quality normally considers from two aspects: online and offline, but after the practical investigation, we realized that some offline businesses only act as O2O operators cooperation units, not all of those business regulated by O2O operators. Therefore, this study will focus on online service quality, namely the mobile O2O commerce platform quality.

Existing researches is lack of the research results of developing and testing the quality scale of mobile O2O commerce platform through standardized procedures, which leads to people's confusion about the platform quality, impedes the development of theoretical research and management practice. The purpose of this study is to compile the mobile O2O commerce platform quality (MCPQ) scale through standardized programs. After sorting out and integrating relevant studies, we found that no comprehensive theoretical framework has been

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developed to measure mobile O2O commerce platform quality, and scholars have a significantly different understanding on the dimensions and levels of mobile or e-commerce service quality^[3, 5-7]. In this regard, based on the IS success model, this study attempts to identify the theoretical structure of MCPQ and develop a scale for assessing MCPQ.

2 THEORETICAL BACKGROUND

2.1 Mobile O2O commerce

By cooperating with offline merchants, O2O operators provide mobile users with information, discounts, orders, and other services, thus transforming online users into offline consumers. Mobile O2O commerce has specific advantages, including accurate positioning of consumer groups, traceable transaction processes, reduced logistics costs and promotion of localized industry development; Achieve sustainable revenue growth by providing value-added services to attract long-term customers^[1]. O2O commerce usually focuses on the life service field, and the inherent location correlation in the life service field determines that mobile terminals are more suitable for the development of O2O commerce. The portability of mobile phones is consistent with the real-time demands of users' daily life. The smartphone has characteristics combined portability, location traceability and identity uniqueness of mobile terminals; they are utilized to facilitate users to search and find the required services at any time.

2.2 Mobile commerce service quality

Service quality of mobile commerce is defined as the overall performance that reflects various service links and final service effect in the process of mobile e-commerce. It is the comprehensive perception and direct experience of customers. Based on the SERVQUAL model, Kar et al. applied these five dimensions (reliability, responsiveness, user interface, trust, and customization) to assess the quality of service in unstable mobile environments, and then puts forward some design methods of service quality to solve the unstable environment problem^[8]. Huang proposed a multidimensional model of M-S-QUAL^[3], the construction concluded with five factors (contact, responsiveness, fulfillment, privacy, and efficiency) for the supporting services in the process of virtual product shopping and four factors (contact, responsiveness, fulfillment, and efficiency) for the supporting services in the process of physical product shopping. Based on the uniqueness of mobile commerce, Zhang et al.^[9] proposed a three-tier model for measuring mobile service quality, which has three main dimensions: (interaction quality, environmental quality, and result quality) and ten sub-dimensions (attitude, expertise, problem-solving, information, equipment, design, location, punctuality, visibility, and rejection values). Choi extracted six factors concerning mobile service quality: network coverage, mobile device, value-added services, billing system, convenience, and price structure. Lu et al.^[10] used mobile brokerage services as an example and proposed an instrument for mobile service quality measurement. These researchers identified three mobile service quality factors that customers perceive when making use of such brokerage services, namely interaction quality, environmental quality, and outcome quality. With the continuous development of information technology, the service contents and methods of all walks of life have changed a lot, website interface design, operational efficiency, privacy protection, information content, and system quality have also become high-frequency terms in the field of information system service quality measurement^[5-7]. It can be found that the multi-dimensional and multi-level measurement method could better describe the complexity of users' perceived behavior process. It also reflects the service quality measurement standards of different industries. In summary, researchers have not reached a consensus on the dimensions contained in the service quality of mobile commerce. This study believes that the academic community ignores the difference between mobile service quality and mobile platform quality. Therefore, this study focuses on the quality of mobile O2O commerce platforms. Based on the IS success model, we start from the three dimensions (i.e.,

system quality, information quality, and service quality), and develop the mobile commerce platform quality scale in the O2O context.

2.3 IS-Success Model

The IS success model was first proposed by DeLone and McLean. In 2003, DeLone and Mclean revised the existing successful model of information systems, with the core of the modification being the inclusion of quality of service in the important reference dimension of information systems themselves^[11]. Since users are also consumers, they believe that the quality of service is exceeding important in the e-commerce environment, providing high-quality service could bring more consumers and higher sales. Since then, the information system (IS) success model^[11] considers three dimensions of system quality, information quality, and service quality has been widely used and extended to measure the success of e-commerce systems^[12]. O2O mobile commerce is a typical mobile commerce information system. This study takes three dimensions, namely system quality, information quality, and service quality, as the theoretical framework to develop the MCPQ scale.

3 SCALE DEVELOPMENT

3.1 Conceptualization and developing a preliminary scale

Mobile O2O commerce is carried out around the transaction platform, and a well-designed trading platform can not only facilitate users to obtain information about products and services they need, reduce searching time, but also establish their preference for the platform^[13]. In this study, platform quality is defined as users' perceived efficiency and convenience of O2O application, as well as their satisfaction with APP visual experience and content presentation. Based on the theoretical framework of the IS success model, the initial scale was determined according to the frequency of key indicators and the characteristics of MCPQ. In this study, interface design and operational efficiency are two dimensions for reflecting system quality; information quality usually appears as content quality; responsiveness and privacy protection occur most frequently in service quality dimension. The following sections will respectively elaborate on the subscales of each structural dimension and its measure items in this study.

3.1.1 Subscale of information quality

Information quality refers to the applicability of the information to users and the degree to which it meets their specific needs. Based on a large number of informational system research literature, usefulness is considered as one of the important antecedents for the adoption of information technology. It refers to the extent to which information is useful to users and meets their needs, reflected in the reliability, accuracy, relevance, and matching of information. In the Internet era, the value of information is closely related to its timeliness, and no matter information is updated in time is also an important indicator to consider the quality of information. With the development of content recommendation technology in the era of big data, it is also crucial for mobile O2O commerce to accurately match personalized information for users. This study uses six items to measure content quality according to Zhou's scale^[7], for example, "The information provided by the mobile APP is easy to understand".

3.1.2 Subscale of system quality

Zhou pointed out in his study that a high level of system quality should have a reliable system, effective navigation and a clear layout of the interface^[14]. Applications with easy-to-navigate interfaces are seen by users as highly efficient and help users build trust in the process. Chow (2004) et al. believed that higher response speed, a scientific navigation design system and a friendly user terminal experience would help promote the ordering process of users. In this study, we selected interface design and operational efficiency as attribute dimensions of system quality, both of which have been highly cited in the literature on mobile commerce and have been verified to be highly correlated with information system quality^[3, 15]. Adapted from Huang^[3] and

Hoehle ^[15], six items were used to assess interface design, for example, "the display effect of the mobile APP interface is very good". The operational efficiency was measured with four items, for example, "this mobile APP allows me to load the web page quickly".

3.1.3 Subscale of service quality

This study focuses on the measurement of service quality indicators in terms of the E-S-QUAL, E-RECS-QUAL, and mobile-service-quality model ^[3]. Three dimensions of demand responsiveness, contact and privacy protection were determined. In this study, three items were used to assess demand responsiveness, for example, "the service provider provides convenient options for my return and exchange". Contact was measured with five items, for example, "the service provider arranges the personnel of the service to help solve the problem". The privacy protection assessed with three items, for example, "the service provider can effectively protect my personal privacy information".

3.2 Pretesting

A pretest questionnaire survey was administered to ensure the quality of our scale instrument. During the test, a total of 60 questionnaires were issued, and 54 valid questionnaires were recovered. Statistical analysis was conducted on the questionnaire results, and the test results were basically in line with expectations. Ten randomly selected subjects were interviewed by our researchers. During the interview, most of the subjects expressed that the questionnaire was readable and could be completed smoothly, but some of them could not understand a few nouns clearly. Combined with questionnaire analysis and interview results, in this study, some measurement items were modified to ensure the content validity of the measurement scale, and the expressions of some items were adjusted slightly to minimize ambiguity, ensure the readability and accuracy of the questionnaire. After repeated discussion, trial filling and modification, a total of 27 measurement scales were finally compiled in the officially released questionnaire, including two dimensions of system quality (operation efficiency and interface design). Three dimensions of quality of service (contact, demand responsiveness, and privacy protection) and one dimension of information quality (content quality). Exploratory factor analysis and confirmatory factor analysis are performed on the collected data in two studies.

3.3 Study 1: Initial Administration

3.3.1 Descriptive statistics of the sample

Through a professional online questionnaire survey platform (www.wjx.cn), we conducted an electronic survey. To study questionnaire for college students and a dissemination group centered on this group, it took one week to collect 235 questionnaires, excluding 23 invalid ones and 212 valid ones left. Among the effective samples, male students account for 53.3%. The age distribution was mainly concentrated in 20~29 years old (80.66%). The disposable monthly income of the sample population was distributed at different consumption levels, with less than 1000 yuan accounting for 41.04%, occupations are found in all walks of life, students account for 48.58% of the total. The samples in this stage are used for exploratory factor analysis.

3.3.2 Exploratory factor analysis

SPSS17.0 software was used to conduct exploratory factor analysis on 27 questions, and the statistical results showed that the KMO value was 0.897. Bartlett's sphericity test ($P < 0.001$) showed that exploratory factor analysis was appropriate. Then, the Principal component analysis and Promax oblique rotation method was used to obtain the factor loading matrix. In the process of analysis, items that meet one of the following conditions were deleted: (1) the common degree is less than 0.5; (2) factor loading is less than 0.6; (3) a span loading exceeds 0.3^[16]. After several iterations of principal component analysis, it has been found that there are five factors with the eigenvalue greater than 1. Since the two-actor loadings of "demand responsiveness" and "connection" are close to each other, they belong to one dimension in terms of a theoretical construct, so the two factors are combined and represented by "demand responsiveness". The factor loadings of two other items were

Table 1 Exploratory factor analysis results

Items	Communalities	Interface Design	Demand Responsiveness	Content Quality	Privacy Protection	Operational Efficiency
The service provider handles customer complaints in a friendly manner.	0.551	-0.049	0.73	0.063	0.117	-0.1
The service provider will arrange customer service representatives to solve problems.	0.581	-0.199	0.779	0.202	-0.087	0.021
The service provider can ensure consistent advice from customer service representatives.	0.522	-0.21	0.771	0.153	-0.122	0.035
The service provider provides me with convenient options for returning items.	0.591	0.141	0.71	-0.107	-0.008	0.055
The service provider handles product returns well.	0.697	0.205	0.77	-0.166	0.012	0.028
The service provider offers a meaningful guarantee.	0.648	0.192	0.655	-0.103	0.13	0.032
The APP loads its pages quickly.	0.651	0.034	0.054	-0.009	0.076	0.729
This APP makes it easy to find what I need.	0.843	-0.006	-0.024	0.006	-0.017	0.938
The APP enables me to complete a transaction quickly.	0.682	-0.034	0.06	0.02	-0.048	0.812
The service provider does not share my personal information with other sites.	0.891	-0.076	-0.005	0.04	0.972	-0.055
The service provider protects information about my web-shopping behavior.	0.858	0.045	-0.053	-0.005	0.952	-0.032
The service provider protects my credit card information.	0.753	-0.052	0.046	0.032	0.798	0.109
In general, the interface of the mobile APP is designed well.	0.662	0.698	0.124	0.078	-0.014	-0.008
I like the graphics displayed on the interface of the mobile APP.	0.773	0.856	0.057	-0.001	-0.013	-0.006
The APP has very good user interface.	0.651	0.823	-0.031	-0.062	-0.02	0.099
I appreciate the overall design of the APP.	0.64	0.859	-0.064	-0.064	0.057	-0.01
I think the APP is well designed.	0.644	0.689	-0.101	0.278	-0.05	-0.086
I am very satisfied with the input mechanisms of the APP.	0.615	0.728	-0.044	0.148	-0.082	-0.02
The information provided by the APP is accurate.	0.671	0.057	-0.009	0.702	0.019	0.134
The information provided by the APP could satisfy my needs.	0.65	0.156	-0.119	0.61	0.042	0.216
There is no out-of-date information on the APP.	0.656	-0.016	0.057	0.791	0.019	-0.006
The information provided by the APP is personalized.	0.5	0.099	0.055	0.672	-0.008	-0.124
This APP provides real-time information.	0.657	0.225	0.122	0.611	0.047	-0.093
Eigenvalue		9.564	2.971	1.733	1.518	1.155
Cumulative % of variance		41.583	54.5	62.036	68.637	73.66

deleted because they were less than 0.6, and the remaining 25 items were factor structures with good discriminability. Next, to further explore the potential factor structure, Principal Axis Factoring and Promax rotation were applied to these 25 questions^[16]. Based on the 0.6/0.3 item retention principle, two more items were deleted. As shown in Table 1, the remaining 23 questions were well distributed among the five factors of demand responsiveness, operation efficiency, privacy protection, interface design, and content quality, explaining a total of 73.66% variance.

3.4 Study 2: Scale Validation

3.4.1 Descriptive statistics of the sample

In the second study, questionnaires were collected for two weeks. To ensure the questionnaires could cover target samples as much as possible, samples were collected by random and snowball methods. A total of 486 samples were collected, of which 401 were valid questionnaires, and the effective rate was 82.5%. The sample distribution was as follows: the ratio of male to female was almost the same (male: 45.89%, female: 54.11%). The age distribution was mainly between 20 and 39 years old (92.27%). The samples have different distributions at different consumption levels; education background is mainly undergraduate (80.8%). The valid samples cover more than a dozen different professions, including IT, government, finance, healthcare, construction, retail, education, advertising, manufacturing, and logistics. Therefore the influence of industry attributes on research results can be minimized.

3.4.2 Confirmatory factor analysis

The 401 samples were used to test the fitting indices of the measurement model obtained by exploratory factor analysis to the actual observed data. The AMOS17.0 software was used to perform confirmatory factor analysis by using maximum likelihood estimation to test the structural validity of the scale. Test the difference between the CFA model after the original item and the deleted item, if the Chi-square Difference is significant

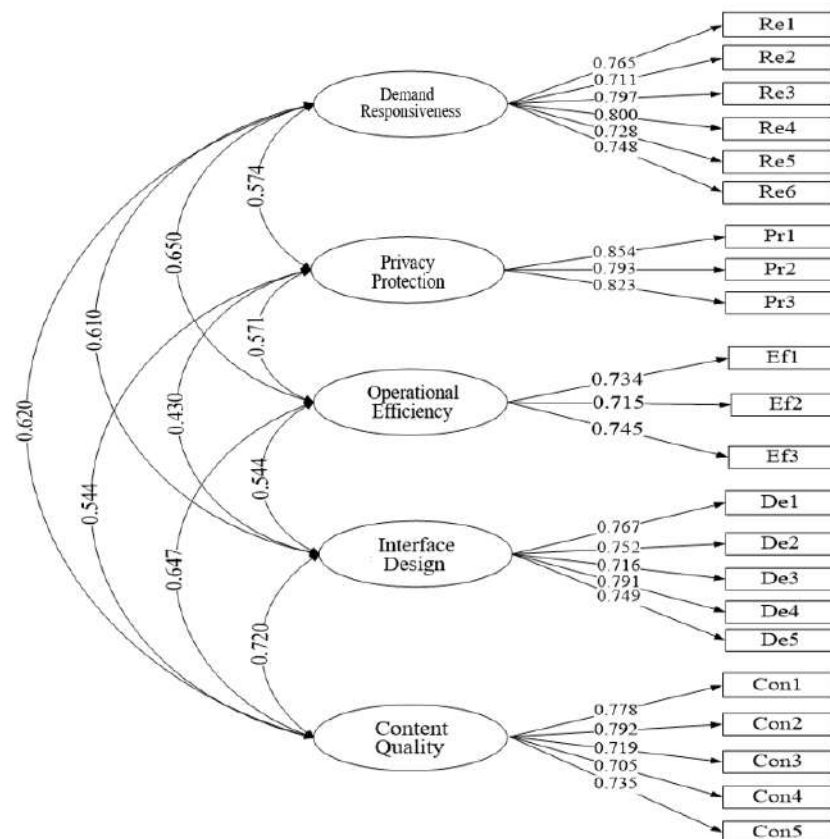


Figure 1 Results for the measurement model.

and the AGFI increases, the deleted item is considered to have a better fitting result. Repeat the process until: (1) the Chi-square test has no significant difference (2) the AGFI does not increase. It was found that the first item of the interface design was deleted and the fitting result was better. Finally, 22 items were retained, the fitting result of the final model is $\chi^2=353.272$ (df=198), approximate root mean square error RMSEA = 0.044, residual root mean square RMR=0.022, the goodness of fit index GFI=0.926, revised standard fitting index IFI=0.970, comparison of fitting index CFI=0.969 (recommended threshold value of GFI, AGFI, NNFI and CFI ≥ 0.90 , the acceptable threshold level of SRMR and RMSEA ≤ 0.08). It indicates that the fitting degree between the data and the measurement model is excellent^[17]. The confirmatory factor analysis results of the model are shown in Figure 1. Besides, Cronbach α was used to measure the reliability of the scale. According to Nunnally^[18], a coefficient greater than 0.7 indicates a high consistency or stability of the evaluation results. The reliability analysis results showed that the Cronbach α coefficient of the five factors was between 0.885 and 0.932, all of which were greater than 0.7, indicating that the scale had high reliability.

3.4.3 Convergent validity

The convergence validity was tested by standardized factor loading and average variance extraction (AVE). According to the results of the first-order five-factor model, as shown in Table 2, the standard factor load values of all observed variables are higher than the threshold value of 0.5, in addition, AVE of all potential variables was greater than 0.5, and composite reliability values were between 0.775 and 0.891, all higher than 0.7^[18]. The above results show that the five subscales of mobile quality of service have preferable convergent validity.

Table 2 Convergence validity test

Factor	Items	Factor Loadings	AVE	C. R
Demand Responsiveness	DR1~DR6	0.711~0.800	0.576	0.891
Operational Efficiency	OE1~OE3	0.715~0.745	0.535	0.775
Privacy Protection	PP1 PP3	0.793 ~0.854	0.679	0.864
Interface Design	ID1~ID5	0.716~0.791	0.571	0.869
Content Quality	CQ1~CQ5	0.705~0.792	0.557	0.863

3.4.4 Discriminant validity

The discriminant validity of the scale was tested by comparing the square root of AVE with the correlation coefficient between variables. The discriminant validity of the scale was tested by comparing the square root of AVE with the correlation coefficient between variables. The results, shown in Table 3, show that the square root of AVE of each factor is greater than the correlation coefficient of corresponding factors, indicating that the scale has a preferable discriminative validity.

Table 3 Discriminant validity test

Variable	Mean	SD					
Demand Responsiveness	3.918	0.770	0.724				
Operational Efficiency	4.067	0.691	0.650**	0.731			
Privacy Protection	4.015	0.792	0.574**	0.571**	0.824		
Interface Design	3.988	0.685	0.610**	0.544**	0.430**	0.756	
Content Quality	4.048	0.674	0.620**	0.647**	0.544**	0.720**	0.746

4 DISCUSSION

This study empirically analyzed the theoretical structure of MCPQ and developed its scales, and found that MCPQ is composed of system quality, service quality, and information quality. System quality is reflected by the interface design and operation efficiency of O2O platform. Service quality is measured by two dimensions: privacy protection and demand responsiveness. Information quality is reflected by content quality. Exploratory factor analysis and confirmatory factor analysis showed that the theoretical structure of the scale fits the actual data well.

Efficiency means the site of APP responds quickly and easy to use. Interface design refers to the user's overall perception of the visual presentation and interactive experience of the mobile APP interface. Zhou^[14] pointed out in his study that the system quality should have a reliable system, effective navigation and clear layout of the interface, applications with easy-to-navigate interfaces are seen as efficient and help users build trust in their use. Obviously, a system that is easy to use and navigate efficiently results in a completely different buyer/seller relationship. The quality of content depends on the availability of timely, accurate, and comprehensive data, and the relevance and usefulness of the information conveyed to the user. Mobile O2O is characterized by real-time, mobility and location correlation; its significant advantage is: it can carry out a series of services to users based on their personal information, such as providing products and pushing personalized services, so as to obtain greater benefits^[19]. The definition of privacy is the degree to which customers perceive the site to be safe and the extent to which their personal information is protected. Mobile O2O service providers can provide users with products and push personalized services based on their personal information. However, for mobile commerce users, they are also faced with problems such as improper collection, processing and use of personal privacy information. Many studies have shown that perceived privacy protection can significantly affect users' attitudes and consumption behaviors^[3]. Responsiveness means the effectiveness of the site's problem-handling process, return policy as well as the availability of telephone assistance and online representatives. Whether service providers can timely feedback and effectively solve users' relevant needs (return, exchange consultation ,and operation) will affect users' satisfaction and loyalty^[20, 21].

Existing researches on the quality measurement of the mobile O2O platform are quite limited. Previous studies mainly focused on the service quality assessment model in the field of mobile commerce^[3]. Discussions on tourism, mobile library, and other situations, as well as the research on the service quality of a certain type of mobile commerce are characterized by functions^[2, 12]. Based on the successful model of the information system, this study established the theoretical structure and measurement system of MCPQ, narrowed the gap between the existing theoretical research and management practice, and provided practical tools for further research of the O2O industry.

This study also has certain limitations. Although the samples cover different ages and occupations, they are all from China. Considering cultural differences, samples from different countries should be collected in the future to further verify the theoretical model to enhance the robustness and universality of the model prediction results. The research on mobile O2O commerce should not only focus on mobile APP, because many users rely on small programs as the platform entrance when using O2O services. There are some differences between the O2O platform and APP itself through small programs, so small programs can be studied in the future.

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SMEs' Entrepreneurship from the Perspective of Social Networks

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Abstract: Companies utilize social networks which don't entail any additional resources to promote their products, services as well as brands, build a brand image and handle customer relationships. Therefore, numerous SMEs are more likely to turn to social media when they launch a business. The current research mainly uses questionnaires or case studies to illustrate the benefits resulted from using social media by SMEs to start up a business. A large amount of information flow in social media has brought a lot of opportunities to SMEs. Still, meantime it also puts more pressure on SMEs that lack funds and technology to use such information. In the end, whether social media brings benefits or disadvantages to entrepreneurship still needs empirical data to confirm. From this perspective, this article looks for empirical data to demonstrate the role of social media in entrepreneurship for SMEs. This study obtains relevant data of sample companies from e-commerce and social media websites and applies the data envelopment model to measure the efficiency of these enterprises using social media entrepreneurship.

Keywords: Social Media, Entrepreneurship, SMEs, Data Envelopment Analysis

1. INTRODUCTION

Entrepreneurship will not be as easy as it is nowadays until the emergence of social media like Weibo, which not only has a strong impact on corporate activities ^[1], but also offers a unique marketing mode ^[2]. Social media, as a many-to-many conversation nowadays, is increasingly becoming a popular choice for business promotion because it allows communication to go beyond private one-on-one conversations ^[3]. To some extent, social commerce's input and output rates far exceed traditional marketing strategy. Modern entrepreneurs who want to sell their products need to introduce themselves and their brand first. People can even gradually build their own brands on social media without having to invest in it, acquiring audiences, fans, customers and popularity with charm ^[4]. Amy Jo Martin, founder and CEO of social media consultancy Digital Royalty, believes that social media, regardless of size, can help showcase the individuals in a personalized company and yield influences. Social media is especially helpful to entrepreneurs with which they are more likely to gain potential customers and partners. Besides, as some previous research pointed out, free marketing, market research and efficient customer service can be facilitated by using social media, which does not require significant financial expenses. Therefore, even small and medium-sized enterprises (SMEs) can use it for everyday customer relationship management out of the low cost and the need for low-level IT skills ^[3].

However, the widespread use of social media in entrepreneurship can also bring about risks. Despite the potential benefits of social media for organizations, companies still face the challenge of managing the adoption and use of social media ^[5]. The platform of social media is built upon the "weak bond" relationship ^[6]. The Internet has helped us to greatly improve the efficiency of developing remote connectivity and has played an unparalleled role in the dissemination of innovative technologies and interdisciplinary collaboration. However, "weak bond" relationship rarely succeeds in organizing high-risk activities. Recent media coverage, e.g., Dwivedi et al. (2018) ^[4], Paniagua&Sapena (2014) ^[7], has highlighted the potential for negative or inappropriate posts that can harm business reputations. This is echoed by Gallaughier & Ransbotham(2010)^[8], who offer

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recommendations on managing risks, including dissent and negative feedback via social media. To date, the majority of social media research exploring business adoption and consumer engagement has focused on medium to large organizations (e.g., Jarvenpaa&Tuunainen,2012^[9]; Han, Xu & Chen, 2018^[10]; Senadheera, Warren & Leitch, 2015^[11]).

There is some research (e.g., Delerue& Hopkins, 2012^[13]; Hills & Cairncross, 2011^[12]), focusing on why and how small businesses are using social media at present, but there is little work exploring what small business perceives as success in terms of social media engagement. Some international work focuses on Return on Investment (ROI) (e.g., Hoffman & Fodor, 2010^[14]; Kaske et al., 2012^[15]; Gilfoi et al., 2015^[16]), business value (e.g., Delerue& Hopkins, 2012^[13]; Hills & Cairncross^[12]) and ‘how-to’ guides exist for businesses wanting to create a social media presence (e.g. Holzner, 2009^[16]). In the end, whether social media brings benefits or disadvantages to entrepreneurship, and it needs empirical data to confirm. From this perspective, this paper attempts to look for empirical data to illustrate the role of social media in entrepreneurship.

It is organized as follows: Section 2 reviews the relevant literature and their efforts; the methodology of the study is presented in Section 3; a description and analysis of the data and variables with their relevant results are introduced in Section 4; we then discuss our findings and finally address the study's limitations and suggestions for future research.

2. LITERATURE REVIEW

2.1 Influence factors of social media adoption behavior

The adoption of information technology has always been a hot issue in the research of information systems. In practice, the usage of information technology has become a common cognition^[18]. With the emergence and development of social networking technologies, the usage of social networks in the context of companies has attracted more and more scholars' attention. Compared to large companies, small businesses have experienced barriers when adopting information technology systems due to a lack of resources, skills, and technologies^[19], but the emergence of social networks has changed the circumstances.

So what is the motivation for SMEs to take social media into account? Many studies have found that compatibility is a significant factor in the usage of social networks by SMEs (e.g., Wang et al., 2010^[20]; Jones et al., 2011^[21]). Cost-benefit factors are also noteworthy for companies to use social networks. Social networking is such a cost-effective technology in information technology that companies can invest directly with many customers at a small cost^[22]. By answering customers' questions about corporate products on social networks, companies can gain their trust^[23], which is why many SMEs choose social networks. Besides, social networking is an interactive product that is good for companies to communicate with customers. However, these studies are based on case studies about a handful of companies, and there is no in-depth study of the underlying driving force to decide whether SMEs use social networks or not. These factors are strategic choices for SMEs in their initial business operations but cannot make social networks become the driving force for the long-term development of enterprises. Therefore, it is necessary to conduct an empirical investigation on the motivations of the social network used by SMEs. The current research mainly focuses on the behaviors of using social media by SMEs through case studies, interviews, or questionnaire surveys on the part of a country or company. These studies' conclusions are barely representative and indirectly lead to the insufficient promotion of results.

2.2 Social media usage behavior and organizational performance improvement

Some scholars have begun to extend their vision to the relationship between social networks and corporate performance. Yong (2012)^[24] found that social networks have a positive impact on the business of SMEs. Öztamur & Karakadılar(2014)^[25] argue that social networks improve business performance by having a significant positive impact on the organization's social capital. Social media also improves sales performance by

positively influencing the customer's customer-oriented process ^[26]. In the current research, there is a relatively small quantity of research on the relationship between the usage of social networks of SMEs and corporate performance. These studies select some enterprises as research objects, while the results are not so representative that it needs further research. The number of objects is expanding on a large scale, so it is necessary to put an emphasis on the universality of the results.

It is undeniable that social networks are very beneficial to business operations. Previous research highlights the value of social networks in enterprise management from different perspectives, but few studies focus on the use of social networks in SMEs, which do not have the knowledge and skills to use social networks properly. The widespread use of social media in SMEs also poses risks. In the end, whether social media brings benefits or disadvantages to SMEs requires a large amount of empirical data to confirm. From this perspective, this study looks for empirical data to illustrate the role of social media in SMEs. Previous research combined technology-enterprise-environment theory with innovation diffusion theory as a theoretical basis to explain how SMEs improve their corporate performance by using social networks. Simply transplanting these theories into performance research brought by social media is not universal and representative enough.

At present, in the study of the application of social media in enterprises, three models are mostly used to explain this phenomenon. The first one is the traditional theory of communication, where a customer's message on social media is more credible than an enterprise's. The second model is the social exchange theory, where individuals decide how to interact with others under the framework of cost-benefit comparison, and social media is considered an ideal platform for social interaction. The third model is the theory of social capital that social costs affect firms' performance and financial capital build-up, while firms increase their social capital by using social networks.

There are two major aspects in the evaluation of entrepreneurial performance: one is associated with financial indicators, including net income, net profit, sales growth rate, sales profit rate, etc., which is the ultimate economic embodiment of organizational activities and the basis for measuring entrepreneurial performance. The other one is about non-financial indicators, including market share, market development capabilities, technological innovation, and other indicators related to operational performance, stakeholder satisfaction, customer loyalty, employee loyalty, etc., which reflects entrepreneurial performance. Aspects have a deeper meaning. Some studies suggest that organizational performance measures can be discussed through multiple layers of ideas. The first layer is the financial performance of the organization, which is the main content of organizational effectiveness. The second layer is the operational performance (or non-financial performance), such as organizational product market share. Non-financial performance ultimately results in organizational financial performances. The last layer considers the interests of all stakeholders, such as customers' satisfaction.

Despite many advantages of using social media, organizational-level research on social media has not grown as rapidly as the research on its impact on organizational performance. Therefore this study investigates the various factors that influence social media usage among organizations and their impact on organizational performances. To investigate the usage of social media among organizations, the effective use of social media must be considered. It is an important indication of technology success, which in turn has an impact on organizations. Based on the IS success model, organizational performance refers to the actual benefits organizations received from using social media in terms of both financial and non-financial performances.

3. METHODOLOGY

3.1 The DEA method

Data Envelopment Analysis (DEA) is a method for evaluating the relative effectiveness of decision-making

units (DMUs) with multiple inputs and multiple outputs using DEA models to obtain corresponding production fronts based on given data. In DEA, the relative efficiency of firms is distributed within the (0, 1) interval, and the efficiency of firms at the efficiency front is 1.

DEA was originally proposed by Charnes, Cooper, and Rhodes (1978), as the first DEA model - the CCR model. Afterward, Banker, Charnes, and Cooper (1984) changed the assumption that the scale returns remain unchanged in the CCR model, but introduced the assumption that the scale returns vary, known as the BCC model.

Suppose that n DMUs have m inputs and s outputs, X_{ij} represents the i -th input of the j th DMU, and Y_{rj} represents the r -th output of the j th DMU, which is respectively recorded as the input vector $(X_{1j}, X_{2j}, \dots, X_{mj})$ $T=X_j$ and the output vector $(Y_{1j}, Y_{2j}, \dots, Y_{sj})$ $T=Y_j$, using the main idea of the DEA method, construct the following linear programming model:

$$\begin{aligned} \text{Min } \theta &= V_D \\ \text{s. t. } \sum_{j=1}^n \lambda_j X_j &\leq \theta X_{j0} \\ \sum_{j=1}^n \lambda_j Y_j &\geq Y_{j0} \\ \lambda_j &\geq 0, j = 1, 2, \dots, n \end{aligned}$$

3.2 Sample and variable selection

Now there are many entrepreneurs in China through online stores. Taobao, China's largest C2C website, where has assembled a large group of entrepreneurs. They have become samples of this study. In the research stage, 46 Taobao stores with microblogs were randomly selected as research objects, and one day in the research period was randomly selected, that is, on April 27, 2016, the sellers' credit and praise number of Taobao stores were observed. Because these Taobao stores are small businesses created by individuals, they are not listed and cannot obtain accurate financial data. However, the seller's credit and praise number are cloud statistics carried out by Taobao. They are only determined by the buyer, while the seller cannot change, which will more objectively reflect the entrepreneurial performance of entrepreneurs. This article uses the DEA approach to measure the impact of social media on entrepreneurial performance. Social media in this article takes Weibo as an example. The input is the number of start-ups' fans and the amount of tweeting. The output variables are divided into financial indicators, that is, the seller's credit of the entrepreneur's shop on Taobao. The higher the seller's credit is, the higher the sales volume of the seller are; the non-sales indicator is the customer satisfaction, that is, the more the number of praises gains, the higher the non-financial entrepreneurial performance the entrepreneurs acquire.

4. EMPIRICAL RESULTS OBTAINED BY THE BCC MODEL

As shown in Table 1, the results of DEA indicate that four entrepreneurs' Weibo's efficiency on entrepreneurial performance is 1, and many entrepreneurs' Weibo's impact on entrepreneurial performance is more than 0.8 in 2015, a relatively high performance. Some other entrepreneurs' Weibo's impact on entrepreneurial performance is between 0.2 and 0.3, which is a very low level of performance. By 2016, four more stores were using social media effectively. But two stores closed in less than a year, which fully used on

social media in 2015. In general, 41 randomly sampled stores were less efficient at using social media.

Next, we used SPSS software to correlate the number of fans and microblogs that measured the input variables, as well as the seller credits and the number of praises who measured the output variables. According to the results shown in Table 2, the number of fans was positively correlated with credit and praise at a significant level of 0.01. That is to say, the more Weibo fans shop owns, the higher the store's credit and praise rating. The number of Weibo posts and credit rating of stores were positively correlated at 0.05 significant levels. That is, the high number of Weibo posts shops, credit rating is better. There is no correlation between the scores and the number of Weibo posts.

Table 1. Results obtained by the BCC model

DMU	2015	2016	DMU	2015	2016
欧美阳光屋	1.000	1.000	植木制	0.528	1.000
蓝色鱼外贸童装	0.159	0.127	luson baby	1.000	1.000
周小熊	0.449	0.538	快乐的芒果	0.081	0.714
安娜贝拉	0.097	0.264	柚子爱 kaka	0.114	0.115
小背包	0.338	0.315	甜旅农特产	0.195	0.154
非妮不可	0.150	0.203	TTT 快乐窝	0.277	0.255
加拿大正品代购	0.019	0.510	sevi 家	0.222	0.475
苹果童装店	0.087	0.167	nanacub	0.880	0.859
邂逅锡兰	0.112	1.000	anna it is amazing	0.380	0.561
小新家	0.008	0.086	mali studios	0.433	0.586
未来总统加国代购	0.012	0.328	lin 限定衣	0.708	0.478
屿路永生花	0.098	1.000	tkstyle	0.848	1.000
又见小夕	1.000	1.000	inking pot	0.309	0.252
Myliteco 童品	0.011	0.171	a-bow studio	0.204	0.622
查摩尔	0.026	0.479	lamps	0.210	0.289
七小格	1.000	0.000	AM 欧美高端定制	0.114	0.200
蜕变蝶小铺	1.000	0.000	XWW	0.009	0.128
陌陌那阁	0.139	0.110	小宜定制	1.000	1.000
juicy cakes	0.070	0.738	fairy wang	0.038	0.399
alu	0.372	0.174	魔幻厨房	0.010	0.048
jilljudith	0.037	0.129			

Table 2 Variables correlation

	fans	credit	praise	posts number
fans	1			
credit	0.428**	1		
praise	0.627***	0.878***	1	
posts number	-0.013ns	0.354*	0.297ns	1

Note: *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$; ns, not significant; N = 39

5. DISCUSSION

From the results of DEA, some entrepreneurs' social media has an impact on entrepreneurial performance, and some have not reached 1. This shows that social media is helpful for entrepreneurs' entrepreneurship, but this is not for all entrepreneurs. From the practical point of view, the usage of social media by small and medium-sized enterprises only stays in the tool stage and does not realize the value of the social network. Although social networks can help small and medium-sized enterprises to start, but it hasn't become an inexhaustible driving force in the development of small and medium-sized enterprises. This is the case, so we must pay attention to the impact of social media on entrepreneurship, but not overestimate the impact of social media. So, what aspects of social media do affect entrepreneurial performance?

Through correlation and dependence, we can know that the number of fans has a major impact on the entrepreneurial performance of entrepreneurs. This shows how the store's sales performance depends entirely on the owner's own fans' full support. This means that if the fans' admiration or support collapsed, the store's sales would run into problems. The influence of entrepreneurs' microblogging on fans and buyers is not very strong. This is the initial stage of entrepreneurship called the personal social network, where personal charisma has a positive impact on their entrepreneurship. On the condition that these companies' operation on Weibo is not frequent, the amount of microblogging has not had a big impact on fans. In terms of correlation analysis, social media is mainly used by small and medium-sized enterprises to communicate with fans and conduct customer relationship services. In fact, the lack of funds and technical training to take full advantage of social media means that the use of social media by small and medium-sized enterprises is no different from that of individual users.

6. CONCLUSION

Through a variety of platforms, social media enables companies to communicate with customers in a more personalized way. The key is not just advertising. The best way to increase your followers is to share valuable content and increase the efficiency of your social media. To maintain a good balance of content is to share education, information, inspiration, exclusive news and entertainment. Storytelling is also a good choice. For example, instead of posting a product photo on Weibo for publicity, it would be better to share a real video of a real customer using the product to demonstrate its usefulness. Plus, we must respond actively to others and contribute to the dialogue and exchange in the community.

This study makes theoretical and empirical contributions to the literature on social media efficiency measurement. Most previous research on the usage of social media in small and medium-sized enterprises is a questionnaire survey, while this study provides a reference framework for objective evaluation. This study confirms from an empirical view that social media can indeed help SMEs start their businesses. It theoretically proves the feasibility of SMEs using social media marketing. Research shows that the current use of social media by SME owners is still in the early stages of attracting fans. Although social networks can help small and medium-sized enterprises to start, they have not become an inexhaustible motive force for the development of small and medium-sized enterprises. That is to say, it is easy for SMEs to use social media for marketing, but sustainable development is difficult. A large amount of information flow in social media has brought a lot of opportunities to SMEs, but it also lacks funds and technology to utilize information. SMEs have put more pressure on them. Although most SMEs use social media for marketing, they also face many problems in actual operation. Therefore, researchers should find out the solution to the social marketing of SMEs different from the marketing of large enterprises. In reality, relevant departments can provide relevant training on social media marketing for small and medium-sized business owners and help them make better use of social media tools. At the same time, it is also important to remind small and medium-sized business owners that they should focus

more on product quality; otherwise, if fans do not support them, their enterprises will face great risks.

The main limitation of this study is its liability for the estimated results, which is not tested by longitudinal studies. This study did not obtain relevant performance data of related companies after a while. Therefore, it can only reflect the social media usage of these sample companies during the research period, and it does not indicate whether the efficiency of the usage of social media has been improved after the development of these sample companies for some time. In future research, it is necessary to collect panel data for some time to study the development of social media use efficiency of SMEs. The two variables used in the study to measure the performance of small and medium-sized enterprises were obtained from the Taobao store statistics. Due to the relevant restrictions, this data cannot be downloaded and can only be recorded by the research team at a certain time, which makes our research data very insufficient. Besides, Taobao's statistics on shop praise and credit data in the research period have changed in different forms, which also caused the later statistics cannot be used to compare. In future research, we will look for a way to combine big data mining with large-scale interviews to make more accurate measurements of social media usage efficiency in small and medium-sized enterprises.

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Does COO Matter in Value Co-creation of Cross-border E-commerce?

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Abstract: The purpose of this paper is to explore the cross-border e-commerce value co-creation mechanism. We believe that the most significant factor affecting consumers' cross-border online shopping is online service quality. And the country of origin effect also plays an important role in the cross-border purchase intention. Therefore, this study built a proposed model of cross-border online purchase intention based on co-create theory and two-side market theory. For the case of online cross-border shopping, perceived value is very important which can directly determine the purchase intention of customers. Based on the related theory, three significant latent variables that can indirectly determine the purchase intention of customers as follows: consumer resource, platform service quality (or ESQ), and country of origin. According to our positive study, platform service quality is the most important factor, COO is the second one, and consumer expertise is the last one. All of the antecedent variables are significant according to statistical results. Then we made the conclusions and implications.

Keywords: COO, two-side market, value co-create, SEM, CMV mediation effect

Introduction

Despite recent trade frictions, those hopes have been borne out, with cross-border e-commerce sales through Amazon now raking in \$10,000 a day on average. Under the background of the rapid development of information technology, e-commerce has become an important driver for the development of the world economy and has drawn great attention from various countries. China's e-commerce has a significant scale advantage in the world. As an important business model and trade method, cross-border e-commerce has become a new engine to promote the stable growth of foreign trade, promote the transformation and upgrading of foreign trade, and promote the overall economic development. Actively participating in and leading the development of international e-commerce rules has become an important strategic task in China's foreign trade field. In the future, digital trade will become the mainstream of international trade commerce, while traditional agriculture and manufacturing will benefit from this. Therefore, how to build a healthy and sustainable cross-border e-commerce value co-creation mechanism is of great significance¹.

In recent years, value co-creation in the two-side market has become the focus of current theoretical and practical research. As the market competition environment changes, the role of customers in value creation has changed. Value is no longer created by the company alone, but is created by the interaction between the company and the customer through the internet platforms. Many domestic companies have achieved strong market competitive advantages through value co-creation. With the development of the network economy, the perspective of value co-creation has shifted from the dual interaction of enterprises and customers to the dynamic network interaction of multiple socio-economic participants.

Value co-creation in the two-side market is a new value creation model, and the influence mechanism of customer resources on the value co-creation ability has gradually attracted the attention of scholars and managers. In the S-D logic, the customer is the main body of value creation, and its role has changed from the passive participant to the dominant creator². But in the two-side market, the platforms also played a significant

role in the value co-created process. And there is less research on the value co-creation ability based on the two-side market, especially in cross border e-commerce market.

Purpose

The aim of this paper is to address the COO(Country of Origin) effect of the value co-creation mechanism in two-side market, particularly when customers buy the imported goods different countries, to verify whether the country origin effect in the two-side market still has a strong effect or not.

Methodology

According to the latest National Economic and Social Development Statistical Bulletin of Wuhan, Beijing, Shanghai, Guangzhou, and Shenzhen, Using those cities' population. According to the method of Sevilla(1992),this study selected 525 samples in Beijing, Shanghai, Guangzhou, Shenzhen, and Wuhan based on sampling techniques in 2019. There were 469 valid samples, and the effective rate was 89.33%. Then we tested the value co-creation model with COO effect developed by us. And the techniques we used are as follows: the test and control of common method variance、exploratory factor analysis、confirmative factor analysis、SEM analysis and mediation effect test. The concept model is as follows:

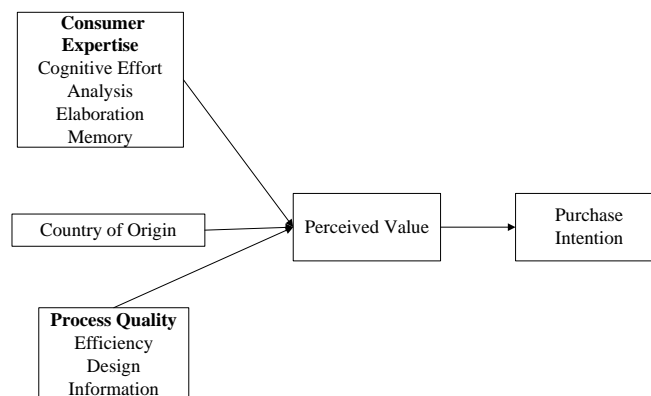


Figure 1. Research framework

Originality

Although there are many literatures focus on the value co-creation mechanism, there are not many literatures focus on the value co-creation mechanism in the bilateral market, and fewer literatures focus on the country of origin effect of the value co-creation mechanism in the bilateral market. Therefore, we built a proposed model of cross-border online purchase intention based on co-create theory and two-side market theory.

This work value consists of trying to explain the mechanism of value co-creation with country origin effect in a theoretical context different from the traditional value co-creation theory, i.e. value co-creation in two-side market with country origin effect.

Findings

Firstly, the empirical results show that platform service quality of the cross-border online websites and apps will significantly affect consumers' perceived value and their willingness to purchase, and both of which are significant at a high level. At the same time, consumers' perceived value has a fully mediating effect on the relationship between online service quality and cross-border online purchase intention. The validity of this conclusion has also been proved by some other scholars.

Nowadays, cross-border online shopping is very hot, and a lot of related cross-border e-commerce

platforms and small and medium-sized cross-border e-commerce companies are emerging one after another. After all, the development of a cross-border online shipping eco-system is too fast to be a mature one. Some cross-border e-commerce platforms and companies lack experience and prospects. Therefore, some customers are not satisfied with some cross-border e-commerce platforms and companies. Some customers maybe give up the shopping on the cross-border e-commerce websites and apps for the sake of low-quality level.

But for young or high-income groups, cross-border online shopping is easy to be accepted because of buying global and high-quality goods. In addition, the group who are pursuing new things feel that cross-border online shopping is a very fashionable shopping method. This group of the population will also perceive the value of cross-border online shopping. According to the above analysis, we found that different people have different perceptions of the value of cross-border e-commerce, which indirectly affects the online shopping intentions of different consumers.

Secondly, the effect of country of origin is crucial to the purchase willingness of cross-border e-commerce users. Through the above data analysis, it can also be found that country of origin has a positive impact on consumers' perceived value and cross-border online purchase intention, and both of which are at a significantly high level. Then consumers' perceived value has a fully mediating effect on the relationship between country of origin and purchase intention.

Finally, consumer expertise is also a very important impact factor to the purchase willingness of cross-border e-commerce customers. We also found that the consumer expertise has a positive impact on consumers' perceived value and online purchase intention, and both of which are at a significantly high level. Then consumers' perceived value has a fully mediating effect on the relationship between consumer expertise and purchase intention.

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Potential Analysis of Chinese Mechanical and Electrical Products Export to France—An Empirical Study Based on the Extended Trade Gravity Model

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Abstract: Under the support and guidance of the Belt and Road initiative, China has welcomed new opportunities for the export of mechanical and electrical products to France. By selecting the SITC Class 7 machinery and transport equipment as the research object, this paper firstly analyzes the current situation of Chinese Mechanical and Electrical Products Export to France. Secondly, this paper analyzes and calculates the influence factors and potentials of Chinese mechanical and electrical products export to France from 1998 to 2017 based on the expanded trade gravity model. The results show that: the main influence factors of China's export of mechanical and electrical products to France are GDP of China's mechanical and electrical products, the GDP of China and France, bilateral distance and trade openness, and the GDP of China's mechanical and electrical products is the most important reason. According to the export trade potential calculated by the regression results, the export trade relationship of mechanical and electrical products between China and France belongs to the potential development type, and the trade potential needs to be further explored. Conclusively, in terms of the outcomes of empirical analysis, some specific suggestions are put forward to further improve Chinese mechanical and electrical products export to France. First, modernizing the national governance system and governance capacity. Second, increasing the investment in scientific research and personnel training in the mechanical and electrical industry. Third, increasing investment in infrastructure along the China Europe train. Fourth, digging the potential of "one belt and one road" cooperation. Fifth, promoting independent brands. Sixth, focusing on cross-border e-commerce of mechanical and electrical products.

Keywords: France, mechanical and electrical products, export potential, influence factor, trade gravity model

1. INTRODUCTION

China's cross-border e-commerce has developed rapidly in recent years, and is increasing at a rate of 30% to 40% per year. By 2020, China's cross-border e-commerce import and export scale is expected to reach 12 trillion yuan. As France's response to the Belt and Road initiative has become more and more active, the scale of trade in mechanical and electrical products between China and France has expanded in general. As the fastest-growing and most popular trade mode in the Internet era, cross-border e-commerce has undoubtedly become a new bright spot in the economic and trade exchanges of mechanical and electrical products between China and France. This paper analyzes and calculates the influencing factors and potentials of Chinese mechanical and electrical products export to France from 1998-2017 based on the expanded trade gravity model, which is of great significance to promote the development of economic and trade relations between China and France. At the same time, it can also provide empirical reference for trade with different countries and products.

The trade gravity model is often used in the field of mechanical and electrical products. Using the trade gravity model, Huang Jie, Yin Xiongyan and Jin Li (2015) analyzed China's export trade of mechanical and electrical products to Germany and found that the economic scale of Germany is the most important factor through the trade gravity model^[1]. Hu Mei, Liu Chunsheng and Wang Yunjie (2015) calculated China's trade potential of mechanical and electrical products to the six ASEAN countries through the trade gravity model, and

believed that the establishment of the ASEAN Free Trade Area promoted the expansion of trade scale^[2]. Che Chunli and Xu an (2016) analyzed and calculated the influencing factors and potentials of Chinese mechanical and electrical products export to central and eastern European countries from 1997-2014 based on the expanded trade gravity model^[3]. Huang Weixin and Lu daofen (2017) estimated the trade potential of China's mechanical and electrical products exported to ASEAN countries through the trade gravity model, the result showed that : generally, the export potential to ASEAN markets was promising in the future, but the export potential of different kinds of China's mechanical and electrical products varied in different ASEAN countries^[4]. According to the trade data of 34 countries along the "one belt and one road" area in the past 2000-2015 years, Zeng Xiaoqiang (2017) built the stochastic frontier gravity model, calculated the export potential of China's mechanical and electrical products, and found that the per ca pita GDP of the importing country and the population of both sides can promote the export trade of China's mechanical and electrical products, while China's per ca pita GDP and bilateral distance play an obstacle role^[5]. At present, few scholars study the trade of mechanical and electrical products between China and France. Under the background of sluggish global trade activities, maintaining the stable growth of the trade of mechanical and electrical products to France is not only conducive to improving the share of China's mechanical and electrical products in the French market, but also conducive to accelerating China's transition from a trading power to a trading power. Therefore, this study has practical significance. At the same time, this paper uses the combination of theoretical analysis and empirical test, and uses the extended trade gravity model to analyze the significance of the factors that affect China's export of mechanical and electrical products to France, and measures the export potential. Therefore, this study has economic significance.

2. THE CURRENT SITUATION OF CHINESE MECHANICAL AND ELECTRICAL PRODUCTS EXPORT TO FRANCE

According to the standard classification of international trade (SITC) formulated by the United Nations Statistical Commission, combined with the characteristics of mechanical and electrical products, this paper selects the 7th category under the SITC Rev. 3 standard to represent the mechanical and electrical products under study. All the data are from the UNCOMTRADE database. The main categories are shown in Table 1.

Table 1. Classification of mechanical and electrical products under SITC Rev. 3 standard

SITC classification	Classification product name
7	Machinery and transportation equipment
71	Power generation machinery and equipment
72	Special industrial machinery
73	Metalworking machinery
74	General industrial machinery and parts
75	Office machinery and automatic data processing equipment
76	Telecommunications and recording and sound equipment and instruments
77	Electric machinery, appliances and electrical parts
78	Land vehicles (including air cushion vehicles)
79	Other transportation equipment

Table 2 shows the export volume of China's mechanical and electrical products to France in 1998-2017 and its proportion in the goods trade between China and France. Although China's exports of mechanical and electrical products to France have experienced negative growth in some years, the overall growth is fluctuating.. The export volume reached the highest point in 2011. China's export of mechanical and electrical products to France needs to inject new vitality and expand the growth space.

Table 2. China's exports of mechanical and electrical products to France in 1998-2017 (US \$100 million)

Year	Exports of mechanical and electrical products	Proportion of export volume of mechanical and electrical products in goods trade (%)
1998	9.58	33.84
1999	10.25	34.98
2000	15.34	41.28
2001	14.36	38.79
2002	16.30	39.88
2003	41.27	56.29
2004	57.46	57.65
2005	59.61	50.99
2006	70.52	50.45
2007	114.66	56.02
2008	120.39	51.23
2009	110.73	51.24
2010	139.50	50.07
2011	139.88	46.25
2012	115.87	42.61
2013	106.49	39.52
2014	114.85	39.64
2015	108.28	40.03
2016	100.07	40.10
2017	118.56	42.40

Source: calculated by UN COMTRADE

It is worth noting that according to the survey report "French industrial manufacturing" issued by the French strategic Bureau under the French Prime Minister's office at the end of 2018, French companies' investment in machinery and equipment is obviously lacking, and the domestic investment in France is showing a significant imbalance, which directly causes the inefficiency of French production sector ^[6]. Therefore, from the perspective of future development trend, China's export of mechanical and electrical products to France still has a large space for cooperation. Therefore, We need to recognize the situation, establish strategic thinking and global vision, use cross-border e-commerce to aggregate the mechanical and electrical industry, and expand the types of mechanical and electrical products with international competitiveness.

3. EMPIRICAL ANALYSIS OF INFLUENCE FACTORS

3.1. Model setting and variable description

3.1.1. Model building

Trade Gravity model is an effective tool to study international trade. The basic expression of trade gravity model is as follows:

$$T_{ij} = A \times Y_i \times \frac{Y_j}{D_{ij}} \quad (1)$$

Its corresponding economic meaning is interpreted as that the trade scale of both sides is positive proportional to their respective economic aggregate and inverse proportional to the distance between them. The trade gravity model is simple and flexible, which enables scholars to add some variables to explain the actual trade phenomenon on the basis of the basic trade gravity model according to the characteristics of the research object. This paper analyzes various factors and its significance of China's export trade of mechanical and electrical products to France. Therefore, the following will combine the actual research content and data availability to introduce relevant variables. Since the space distance between China and France is constant and cannot be directly used for quantitative analysis, but the transportation cost formed by distance is actually constantly changing, Therefore, Based on the method of Jiang Dianchun and Zhang Qingchang (2011), the transportation cost is equal to the product of the bilateral distance between China and France multiplied by the international oil price^[7]. The expanded trade gravity model constructed in this paper is as follows:

$$\ln EXP_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j + \beta_5 \ln TO_i + \beta_6 \ln TO_j + \beta_7 \ln INO_i + \beta_8 \ln DIS_{ij} + \beta_9 REER + B_{10} \ln GDP GDP_{ij} + \varepsilon_{ij} \quad (2)$$

Where, EXP_{ij} is the interpreted variable, which refers to China's exports of mechanical and electrical products to France. β_0 is a constant term, β_k ($k = 1, 2, \dots, 10$) is the regression coefficient of the explanatory variable, and ε_{ij} is the random error term.

3.1.2 Variable description

Before regression analysis of the model, it is necessary to explain the meaning and expected symbols of explanatory variables, as shown in Table 3:

Table 3 Meanings, expected symbols and explanation of explanatory variables in the model

Variable	Meaning	Anticipation symbol	Explain
GDP_i	China's GDP	+	Reflecting China's export capacity, the larger the economic scale is, the greater China's export volume will be.
GDP_j	French GDP	+	Reflecting the import demand of France, the larger the economic scale is, the larger the import volume of France is.
POP_i	China's population	Uncertain	The population reflects the market potential of a country. The more population, the stronger demand. Brada (1985) believed that the export volume was positively correlated with the population of the importing country and negatively correlated with the population of the exporting country ^[8] .
POP_j	Population of France		
TO_i	China's trade openness	+	It reflects the market opening degree of a country. The higher the opening degree is, the higher the level of economic development is, and the overall trade volume will be increased.
TO_j	Trade openness of France		
INO_i	GDP of China's mechanical and electrical products	+	It is expressed in terms of China's industrial added value, reflecting a country's industrial production capacity and development level, as well as the supply capacity of exporting countries.

Variable	Meaning	Anticipation symbol	Explain
DIS_{ij}	Bilateral distance	—	Bilateral distance hinders bilateral trade by affecting trade costs.
$REER$	RMB real effective exchange rate index	+	Excluding the impact of inflation on the change of the value of money itself, it can comprehensively reflect the RMB's external value and relative purchasing power, which can be used to measure the international competitiveness of a country's trade goods. The higher the index, the greater the value of Chinese exports.
$GDPGDP_{ij}$	The gap of per capita income between China and France	—	It is replaced by the per capita GDP gap between the two countries. The closer the per capita GDP gap between the two countries is, the smaller the gap is, the more similar the demand structure is, and the greater the trade volume is.

3.2. Data source

The statistical caliber of mechanical and electrical products is the 7th category of the third edition of international trade standard (SUC Rev. 3). All trade data are from the UN COMTRADE database of the UN statistics agency. China's and France's GDP, per capita GDP and population come from the National Accounts Main Aggregates Database of the United Nations statistics office, in which both GDP and per capita GDP are calculated at the constant price of US dollars in 2010. The trade openness of China and France is calculated according to the formula $TO = (EX - IM)/GDP$. EX represents a country's total export and IM represents a country's total import. The data comes from the UN COMTRADE database. The data of China's industrial added value comes from the National Bureau of statistics. The distance between China and France, that is, the space distance between Beijing and Paris, comes from www.gpsppg.com, and the international oil price comes from EIA. The real effective exchange rate index of RMB comes from the website of the bank for International Settlements (BIS).

3.3. Regression results and analysis

3.3.1 Unit root test

In order to avoid the phenomenon of "pseudo regression" caused by non-stationary time series, unit root test is carried out for variables before co integration analysis. In this paper, ADF test is used to determine whether the variables are stable. From the results of unit root test, the ADF test statistical value of the original sequence of all variables is greater than the critical value under the level of 10% significance, that is, the variable fails to pass the stationery test and has unit root. After the first-order difference of each variable, it is still not stable. In the second-order difference, it is found that $Lnpop_i$ and $Lnpop_j$ still fail to pass the stationery test, while the ADF test values of other variables are less than the critical value under the 1% significance level, that is, passing the stationery test. Therefore, in the following analysis, the population of China and France are excluded, and other sequences are second-order single integration, which can be used for co integration test.

3.3.2 Co integration test

Before establishing the regression model, EG two-step method is used to do co integration test and quantitative analysis between variables. The test results are as follows: the residual sequence of the per capita GDP difference between China and France is not stable at the significance level of 10%, therefore, we exclude this variable. The residual sequence of the other seven variables is stable at the significance level of 5%, which shows that the GDP of China and France, the openness of trade between China and France, the GDP of China's mechanical and electrical products, the bilateral distance, and the real effective exchange rate index of RMB have a long-term stable equilibrium relationship with China's exports of mechanical and electrical products to France.

3.3.3 Regression analysis

Through a series of tests mentioned above, after removing relevant variables, the new model is as follows:

$$\text{Ln}T_{ij} = \beta_0 + \beta_1 \text{LnGDP}_i + \beta_2 \text{LnGDP}_j + \beta_3 \text{LnTO}_i + \beta_4 \text{LnTO}_j + \beta_5 \text{LnINO}_i + \beta_6 \text{LnDIS}_{is} + \beta_7 \text{REER} + \varepsilon_{ij} \quad (3)$$

Using Eviews8.0 and ordinary least squares (OLS) for multiple linear regression, the results are shown in Table 4:

Table 4. Regression results of multiple linear models

Variable	Coefficient	Standard error	T Statistics	P value
C	-13.68631	27.8653	-0.49116	0.6315
LnGDP _i	1.08365	0.45939	2.35889	0.0398
LnGDP _j	0.90535	0.35726	2.53418	0.0256
LnTO _i	0.82361	0.32082	2.56722	0.0234
LnTO _j	0.64135	0.30722	2.08756	0.0713
LnINO _i	2.68035	0.48637	5.51099	0.0068
LnDIS _{ij}	-0.38754	0.13003	-2.98038	0.0106
REER	0.01461	0.00543	2.69058	0.0185
$R^2 = 0.99284$ Adjusted $R^2 = 0.98954$				
F=300.5545 P VALUE=0.000000 D.W. =2.01599				

The estimated equation from OLS is:

$$\text{Ln}T_{ij} = -13.68631 + 1.08365 \text{LnGDP}_i + 0.90535 \text{LnGDP}_j + 0.82361 \text{LnTO}_i + 0.64135 \text{LnTO}_j + 2.68035 \text{LnINO}_i - 0.38754 \text{LnDIS}_{ij} + 0.01461 \text{REER}$$

(4) According to the regression results, the if $R^2 = 0.99284$, and the adjusted $R^2 = 0.98954$, indicating that the goodness of fit of the model is high. The F statistic is 300.5545, and the corresponding p value is 0, indicating that the model is significant. D. W. value is 2.015987, it can be seen from the table that the upper critical value of D.W. is 2.01599, then D.W. value is in the range of 1.838-2.162, indicating that there is no sequence auto correlation in the model. France's trade openness has passed the t-test at the significance level of 10%, and the rest of the variables have passed the t-test at the significance level of 5%, so each variable has significance.

First, the coefficient signs of China's and France's GDP are all positive, passing the test at the significance level of 5%. It shows that China's export of mechanical and electrical products to France depends on the economic scale of the two countries, that is, the larger the economic scale of the two countries is, the larger the export volume is, and there is a long-term stable equilibrium relationship between them. Given the situations that other conditions remain unchanged, for every 1% increase in China's and France's GDP, the export volume will increase by 1.0836% and 0.9053% respectively. It can be seen that the export volume created by China's GDP growth is greater than the import demand generated by France's GDP growth for the export volume of mechanical and electrical products.

Second, trade openness has a positive effect on export volume, and its coefficient has passed the significance test. China's trade openness was only 16.9% in 1998, and increased to 54.5% in 2011. Although it declined, it still maintained a high level. At the same time, France's trade openness has also increased, from 27% in 1998 to 39.5% in 2017. Generally speaking, the trend of trade openness between the two countries is basically consistent with the export volume, and the promotion effect of China's trade openness is greater than that of France. In the future, China's mechanical and electrical industry needs to make full use of various preferential policies and international resources under the Belt and Road Initiative, so as to continuously push ahead with a new round of high-level opening to the outside world and expand exports.

Third, from the results of empirical test, GDP of China's mechanical and electrical products is positively correlated with the export volume, which is consistent with the expectation. Its t-statistic is 5.510968, P-value is 0.0068, which passes the test at the significance level of 1%. Given the situations that other conditions remain unchanged, For every

1% increase in China's GDP of mechanical and electrical products, the export volume will increase by 2.6804%. Because of the advantage of large output and price, China has created favorable conditions for the export trade of mechanical and electrical products, thus promoting the increase of export volume. By comparing the data, we can also find that the GDP of China's mechanical and electrical products is the most important factor affecting the export volume of mechanical and electrical products.

Fourth, from the results of empirical test, the coefficient of bilateral distance is negative. The bilateral distance reflects the transport cost between trading countries. According to the new trade theory, geographical location is an important factor affecting the trade between the two countries. For the two countries with a long distance, the transportation cost of products is too high, and there are many uncertain factors in the long-distance transportation, which will hinder the export trade. The coefficient of bilateral distance shows that for every 1% increase in transportation cost represented by bilateral distance, the export volume will decrease by 0.3875%, that is to say, the distance between France and China will increase the transportation cost between the two sides of trade, compress the profit space, and restrict the export trade of China's mechanical and electrical products to France.

Fifth, From the results of empirical test, under the condition that other conditions remain unchanged, the RMB real effective exchange rate index has a relatively small positive impact on the export volume of mechanical and electrical products. For every 1% increase of RMB real effective exchange rate index, that is, 1% depreciation of RMB, the export volume will increase by 0.0146%. Exchange rate is an important adjustment lever of international trade. Although the exchange rate of RMB has little impact on the export of mechanical and electrical products from China and France, the mechanical and electrical industry in China should also improve the risk awareness of exchange rate fluctuations.

4. EXPORT TRADE POTENTIAL ANALYSIS

For the calculation of export trade potential, this paper brings the data of explanatory variables into the extended trade gravity model, so as to obtain the predicted value of export volume under the theoretical state, and then divide the actual export volume by the predicted export volume, and the ratio obtained is the export trade potential value. If the ratio is greater than or equal to 1.20, it is a "potential reshape", indicating that the existing trade potential has been exhausted; if the ratio is between 0.80 and 1.20, it is a "potential development type", indicating that the potential of both sides of trade has not been fully exploited, and there is still room for further expansion of bilateral trade relations. If the ratio is less than or equal to 0.80, it is a "huge potential", indicating that there is a huge trade potential, and the possible factors that hinder the growth of export trade need to be excluded.

According to this, this paper calculates the export trade potential value of China's mechanical and electrical products to France in 1998-2017, as shown in Table 5.

Table 5 Export trade potential value of China's mechanical and electrical products to France in 1998-2017

Year	Export potential	Year	Export potential
1998	0.961343	2008	1.229330
1999	1.033353	2009	1.282156
2000	1.037308	2010	1.262565
2001	1.017934	2011	1.098224
2002	0.870049	2012	0.944374
2003	1.072659	2013	0.921970
2004	1.029486	2014	1.087451
2005	0.956858	2015	1.070576
2006	0.973070	2016	0.964181
2007	1.137407	2017	0.988661

According to the calculation results in the above table, export trade potential value of China's mechanical and electrical products to France can be divided into three stages.

(1).Potential development type (1998-2007) .The type indicates that the export potential of China's mechanical and electrical products to France has not been fully exploited, and there is still room for further expansion.

(2).Potential reshape type(2008-2010) .The type indicates that there is excessive trade. On the basis of existing positive factors, it is necessary to cultivate a new growth mode of export trade of China's mechanical and electrical products to France.

(3).Potential development type(since 2011). The export trade of China's mechanical and electrical products to France has returned to the potential development type.

In recent years, France has greatly improved the understanding and depth of the Belt and Road initiative, it has brought new opportunities to explore the multidimensional and three-dimensional cooperation between China and France, and is also conducive to enhancing the core competitiveness of China's mechanical and electrical products in the French market. At the same time, specialized cross-border e-commerce services in various regions of China have become a new engine leading the growth of export trade in mechanical and electrical products. Furthermore, China has opened a number of China EU trains, which facilitates the export of mechanical and electrical products between China and France, greatly reduces transportation costs, reduces the impact of severe weather and uncertain factors on transportation, and expands the export trade potential of mechanical and electrical products from China to France, In general, the export trade relationship of mechanical and electrical products between China and France belongs to the potential development type, and the trade potential needs to be further explored.

5.CONCLUSIONS AND SUGGESTION

This paper analyzes the trade volume and export volume of mechanical and electrical products between China and France from 1998 to 2017. According to the basic principle of trade gravitation model, the paper empirically tests the significance of each influencing factor and measures the potential of export trade. The results shows:

First, since the 21st century, the bilateral trade volume of mechanical and electrical products between China and France has been expanding in general. The empirical results of the extended trade gravity model show that the GDP of China's mechanical and electrical products is the most significant factor affecting the export trade of China's mechanical and electrical products to France, which has a significant positive effect on it. It shows that the optimization and upgrading of industrial structure and the upgrading of production and manufacturing capacity provide favorable conditions for the export of mechanical and electrical products. The economic scale and trade openness of China and France also play a positive role in promoting export trade, while the transport cost represented by bilateral distance will hinder the development of export trade. The real effective exchange rate index of RMB has little influence on the export volume of mechanical and electrical products, but it is also necessary to improve the risk awareness. In addition, there is no long-term stable equilibrium relationship between the population of China and France and the export volume of China's mechanical and electrical products to France, and the per capita GDP gap is also.

Second, the calculation results of export trade potential show that the overall trade relationship between China and France in mechanical and electrical products belongs to the potential development type. Although the potential reshape type has appeared in the development process, China's export trade of mechanical and electrical products to France still has a large development space, and the trade potential needs to be further explored.

Therefore, based on the above research results, in order to tap the potential of China's export trade of mechanical and electrical products to France, specific suggestions include:

The government should increase its support. Firstly, we will make greater efforts to promote the reform of

"deregulation services", focus on the concerns of market players and weaknesses, and continue to promote the construction of a market-oriented, legal and international business environment, in particular, based on the smooth development of general export business of cross-border e-commerce in the machinery and electronic industry, the customs should implement data exchange and mutual recognition of supervision, provide specialized customs clearance services based on the whole link of the supply chain, and realize the full coverage of all cross-border e-commerce customs supervision modes so as to promote the development of the machinery and electronic industry. Secondly, the government should increase the investment in scientific research and personnel training in the machinery and electronic industry, improve the level of intellectual property protection, encourage enterprises to strengthen their independent research and development capabilities, and focus on improving the production capacity of mechanical and electrical products with high technology content and high added value. Thirdly, the government should also increase investment in infrastructure along the China Europe train, build an efficient, flexible and low-cost global distribution system, and speed up China Europe train to reduce logistics costs.

Enterprises should pay attention to their own construction Firstly, According to the characteristics of French market and consumer demand preference, Chinese enterprises can develop marketable products, and realize differentiation in terms of product grade, trademark, style and color, or in terms of sales links, packaging and after-sales service, so as to improve the market share of mechanical and electrical products in France. Secondly, enterprises should actively promote independent brands. China's machinery and electronic enterprises should fully understand the manufacturing standards, technical standards, safety and environmental protection requirements of French mechanical and electrical products, adhere to innovation driven, and create independent brands with high technical level, so as to further improve the international competitiveness of China's mechanical and electrical products. Thirdly, focus on cross-border e-commerce of mechanical and electrical products. Cross-border e-commerce is a new channel for enterprises to expand exports. Cross border e-commerce should be committed to providing intelligent and efficient service system, so as to make China Manufacture go further with fast and efficient customs clearance logistics service.

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Research on the Application of Blockchain Technology in the Field of Cross-border Logistics for Small and Medium-sized Enterprises

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Abstract: With the continuous development of the current economic globalization, coupled with the continuous maturity of Internet technology, e-commerce, as a new industry, has been developing rapidly. Cross-border e-commerce has become the mainstream of development in the current economic era. In the process of cross-border e-commerce development, logistics plays an important role. The success or failure of small and medium-sized enterprises also depends on the efficiency and quality of logistics to a great extent. If some cross-border e-commerce enterprises want to get a place in the current fierce market competition, they must choose appropriate logistics channels to effectively promote their own development. This study explores the typical application mode of Blockchain technology in the field of cross-border logistics, and proposes specific implementation path to improve the performance of cross-border logistics management. This study combines the selection of cross-border logistics drive of small and medium-sized enterprises, analyzes the structural framework, core technology and main advantages of Blockchain, and then analyzes the combination of Blockchain technology advantages and cross-border logistics management needs. On this basis, the application mode of Blockchain technology in cross-border supply chain logistics is proposed; the application mode of Blockchain technology in cross-border trade logistics is proposed with information, documents and containers as typical objects; the application mode of Blockchain technology in cross-border customs clearance is proposed with customs declaration as typical carrier. Finally, the paper puts forward the specific implementation path, main success factors and implementation steps of the application of Blockchain technology in cross-border logistics.

Keywords: Small and Medium-sized Enterprises, Blockchain Technology, Cross-border Logistics, Application Mode

1. SELECTION OF CROSS-BORDER LOGISTICS CHANNELS FOR SMES

1.1 Postal parcels and international express

Postal parcels and international express delivery are a kind of logistics mode with high proportion of cross-border e-commerce logistics channel selection for some small and medium-sized enterprises. Goods transacted online are sent to the postal delivery platform by personal mail to complete the delivery of goods. Due to the long history of the development of postal parcels in China, the logistics channels of postal parcels are particularly mature, and the logistics of postal parcels are widely distributed in some countries and regions, which to a certain extent brings a lot of convenience to the recipients. In addition, the way of sending postal parcels is relatively simple. The cross-border e-commerce only needs to post the number of the bill number on the express mail in the process of mailing, so that the goods can be mailed to the buyer. For a series of procedures required after the delivery of the goods, the postal company will handle the cross-border e-commerce of small and medium-sized enterprises, which saves the work pressure and reduction of the cross-border e-commerce of small and medium-sized enterprises to a certain extent. Due to the convenience of postal parcels, most of the current cross-border e-commerce of small and medium-sized enterprises in China will use postal parcels to complete delivery when choosing logistics. However, the logistics mode of postal

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parcels is not perfect. Due to the large number of items delivered, the delivery time of postal parcels is longer than that of other express delivery. If they are delivered to western countries, it usually takes about 25 days. The express delivery mode of postal parcels only uses some electronic accessories, clothes and hats and other light industrial logistics distribution. In addition, if the managers of cross-border e-commerce of small enterprises deliver the goods, they do not register the goods. As long as the goods leave the country, they will lose contact and cannot get the buyer's receiving status, which brings many problems to the follow-up after-sale of cross-border e-commerce of small and medium enterprises. Therefore, when choosing logistics channels, small and medium-sized cross-border e-commerce must choose logistics channels reasonably according to the type of products they are engaged in.

1.2 Special line logistics

With the continuous development of cross-border e-commerce, special line logistics is a new type of logistics mode. It mainly transports logistics through a third party. Compared with postal parcels, special line logistics is not only fast, but also has a relatively favorable delivery price. With the help of professional third-party cross-border logistics services, the service level of cross-border logistics can be improved and the initial investment cost of enterprises' cross-border logistics can be rapidly reduced^[1].

In addition, special line logistics also has a higher advantage in customs clearance. The special line logistics is mainly to effectively decompose the goods in the warehouse of the export city, then organize the goods through strict packaging, and adopt a unified logistics transportation mode to carry out the export operation of logistics for the goods. Because of the advantages of special line logistics, some small and medium-sized cross-border e-commerce enterprises in China begin to try special line logistics one after another, and special line logistics is highly praised by most small and medium-sized cross-border e-commerce enterprises because of its high professionalism. However, special line logistics also has its limitations, the region where special line logistics is located has a certain restriction on the delivery scope.

1.3 Overseas warehouse

Some small and medium-sized cross-border e-commerce enterprises choose logistics channels in order to save logistics costs. Some buyers choose to transport products to the warehouse in the sales place first, and then in the e-commerce platform, as long as customers place an order, they immediately carry out the packaging and delivery of goods. In terms of logistics mode, the logistics mode of overseas warehouse is a more efficient logistics distribution mode. For some small and medium-sized enterprises with high strength, cross-border e-commerce can establish a separate warehouse overseas to transport products. Of course, for some small and medium-sized enterprises in the development process of cross-border e-commerce, only by cooperating with some logistics enterprises can independent warehouses be established overseas. Hybrid cross-border logistics is suitable for complex and changeable cross-border markets, which has the advantages of flexibility, such as special logistics line (International Express) + overseas warehouse, special logistics line + overseas warehouse + border warehouse, etc. ^[2]. With the development of small and medium-sized enterprises' cross-border e-commerce, building overseas warehouse is an advanced way of logistics and transportation, and its management system still has many shortcomings.

2. WHY DO SMES CHOOSE BLOCKCHAIN FOR CROSS-BORDER LOGISTICS?

The concept of Blockchain is believed to originate from the digital currency, which is a kind of combination of block and a data structure composed of chains. At present, the generally accepted definition of Blockchain has not been formed. The narrow sense of Blockchain refers to the decentralized sharing general ledger that combines data blocks into specific data structures in the form of chain and in order of time, and prevents forgery and tampering guaranteed by cryptography; the broad sense of Blockchain refers to the

generation and update of data with the distributed node consensus algorithm, and the encryption chain block structure a distributed computing paradigm and decentralized framework for data verification and storage, data operation and programming using automated script code (smart contract).

The technological revolution and the multitude of data collection components have highlighted the issue of the level of data security, and the reliability of communications. Blockchain's ability, reliability, traceability, and authenticity of information, as well as intelligent contractual relationships for a trustless environment, foreshadow a major overhaul of supply chains and chain management.^[3]

The core technologies and main advantages of Blockchain are as follows^[4].

2.1 Distributed ledger technology - decentralized, permanent data storage

Based on the distributed structure and ledger technology, the process of data accounting, verification, storage, maintenance and transmission is completed. Instead of relying on the central organization, the mathematical method is adopted to establish the trust relationship between distributed nodes and form a trusted decentralized distributed system. Transaction bookkeeping is completed by multiple nodes distributed in different places. Unlike traditional database technology, which records and stores data by central administrators, many nodes in a peer-to-peer network can copy each other's copies of real ledgers. Data is backed up by each other among nodes. Each node maintains the system functions in an equal position. Therefore, the damage or abnormality of the point affects the operation of the system and the recording of information, so as to realize the permanent storage of transaction records and data.

2.2 Consensus mechanism: security, authenticity and credibility

In order to effectively verify the effectiveness of transaction information and ensure the authenticity and reliability of data, the Blockchain does not rely on the central organization of traditional database technology, but relies on all nodes in the network to form a consensus on the authentication principle, and ensures the participation of many nodes in the distributed system with a special economic incentive mechanism. In the verification process of data blocks (bitcoin's "mining" is a typical example), only when the number of agreed node members exceeds 51%, can the transaction data be recognized as true and effective.

2.3 Asymmetric encryption algorithm security and tamper proof

The asymmetric cryptography principle is applied to encrypt the data, and the powerful computing power formed by consensus algorithm is used to resist external attacks, so as to ensure that the Blockchain data cannot be forged and tampered; the public key, private key and digital signature are used to ensure the security and accuracy of the stored information and control the access right of the account book, so as to ensure the security of transaction records and information data rely on. For example, IoT devices safety and pricing is an area of concern for IoT industry. Blockchain can help in improving the privacy and safety of IoT devices^[5].

2.4 Time series data: traceable and verifiable

The Blockchain stores data through the chain block structure with time stamp inside to generate time sequence for data, and any two blocks are associated with each other through cryptography method, which can trace the data information of any block, so it has strong traceability and verifiability.

2.5 Smart contract: automatic and efficient transaction completion.

The Blockchain provides a flexible script code system for users to build advanced smart contracts, which is equivalent to the digital contracts of business rules, and automatically execute pre-defined rules and procedures when the transaction is in progress; the transparent script code of smart contracts is automatically executed under the supervision of each node and when the conditions are met, the performance process of the transaction cannot be interfered, manipulated or tampered with, ensure the reliability of the results in automatic predefined programs operation.

3. APPLICATION MODE OF BLOCKCHAIN TECHNOLOGY IN CROSS-BORDER LOGISTICS

3.1 For cross-border supply chain logistics

The cross-border supply chain logistics information platform based on the Blockchain can collect the important information of the supply chain logistics process such as the source of goods, manufacturing, distribution and retail completely and accurately, and store it permanently in the Blockchain information platform for sharing and not tampering, which can significantly enhance the convenience of each member (including the end user) in the supply chain to query and track products, and improve traceable function and information transparency. For example, the platform information can be used to prove the legitimacy of the drugs transported, and high-value commodity manufacturers can provide authentic proof, which is also conducive to the effective identification of consumers whether the goods are authentic.

3.2 Application mode of Blockchain technology in cross-border trade logistics

3.2.1 Simplify and accelerate trade order fulfillment

Cross border logistics is considered as the core support of cross-border trade, while orders for large quantities of goods under business models such as B2B and B2C mainly rely on international shipping or air logistics to fulfill the contract. However, the process of cross-border logistics is more complex, involving a large number of stakeholders. There are often conflicts in the priority of interests. The information management systems for tracking and querying goods are different, resulting in many logistics obstacles, low efficiency of logistics, and even fraud. The management of cross-border logistics based on Blockchain can help ease the friction in the purchase, transportation management, customs cooperation, information tracking query and trade financing of goods, optimize the cross-border logistics documents and information processing, save operating costs and processing time, so as to simplify and speed up the order fulfillment process.

3.2.2 Improve the efficiency of cross-border trade logistics

Trade participants can transfer and exchange electronic data point-to-point, efficiently and safely in the decentralized Blockchain information system. The business records of all Blockchain information systems are authentic, permanent and tamper proof. The operation information of all parties can be traced and verified to prevent fraud to the greatest extent. Participating members can query the logistics progress at any time, track the location of goods in real time, master the continuously updated data in time, understand the customs clearance dynamics in detail, take remedial measures for unexpected events in time, greatly reduce the delivery delay, so as to improve the efficiency of cross-border trade logistics. In addition, they will improve business processes by simplifying the process of acquiring products and services by exceeding currency constraints and transfer charges. As well as encouraging customers and improving their demands^[6].

3.2.3 Minimize document costs and errors

In the process of cross-border trade of bulk commodity orders, documents such as Bill of lading and waybill are the core logistics documents, which can effectively promote the digitalization of bill of lading and waybill by using Blockchain technology. Ocean bill of lading is one of the most important documents. As the real right certificate, transportation contract and receipt of trade goods, the information stored in the bill of lading is very important. Like the bill of lading, air bill of lading contains all important details such as the consignee and consignor, loading and unloading place, specific name and quantity of goods, goods handling and expense settlement. In the cross-border logistics management based on the Blockchain, the decentralized Blockchain information system enables the relevant parties of bill of lading and waybill to directly communicate with each other and eliminate the dependence on the central entity or intermediary organization. The core organizations (such as small and medium-sized cross-border logistics enterprises) and participants send, transmit and receive digital documents point-to-point, efficiently and safely through the decentralized network, realize the safe and efficient transmission of documents, minimize the cost of documents and document errors, and

provide a strong guarantee for the accurate delivery of goods to the consignee.

3.2.4 Achieve automatic performance

B2B or B2C is the main mode of cross-border trade of large quantities of products. In the process of cross-border logistics in which the seller enterprise delivers large quantities of products to the buyer enterprise (non-individual), the container is the key logistics equipment. Container delivery involves multiple participants, which is a typical scenario applicable to Blockchain. The Blockchain smart contract technology can be applied to develop smart containers to improve the performance efficiency of cross-border trade orders. The container based on the Blockchain smart contract technology can realize many important functions: first, confirm the authenticity and effectiveness of the smart contract execution through the visual process tracking of the physical chain of the smart container; second, automatically confirm the fulfillment of the smart contract through the visual result tracking of the physical chain of the smart container, so that the contract can be automatically closed; third, through the visual process tracking of the physical chain of the smart container, and verify the goods documents and complete the automatic settlement of the smart contract. A smart contract is therefore like a bunch of codes and commands to make a transaction (or an action), so long as the permissions or the rules written in the associated codes dictates how that's going to happen. A smart contract once created can be imagined as an object with a code instructing it how to behave in an object-oriented environment^[7].

3.2.5 Application in cross-border customs clearance

Customs clearance is one of the core links of cross-border logistics. In the process of customs clearance, we should not only strictly manage the customs, but also improve the speed of customs clearance to promote trade facilitation. These two aspects have always been the dilemma for customs agencies. Among them, the key and difficult point is to ensure the reliability of information data of inbound and outbound goods. Generally, enterprises need to provide complete documents and materials to verify whether the information is accurate, including on-site inspection of goods, which makes it difficult to improve the speed and experience of customs clearance. The blockchain technology and cross-border customs clearance field are integrated to achieve the effect.

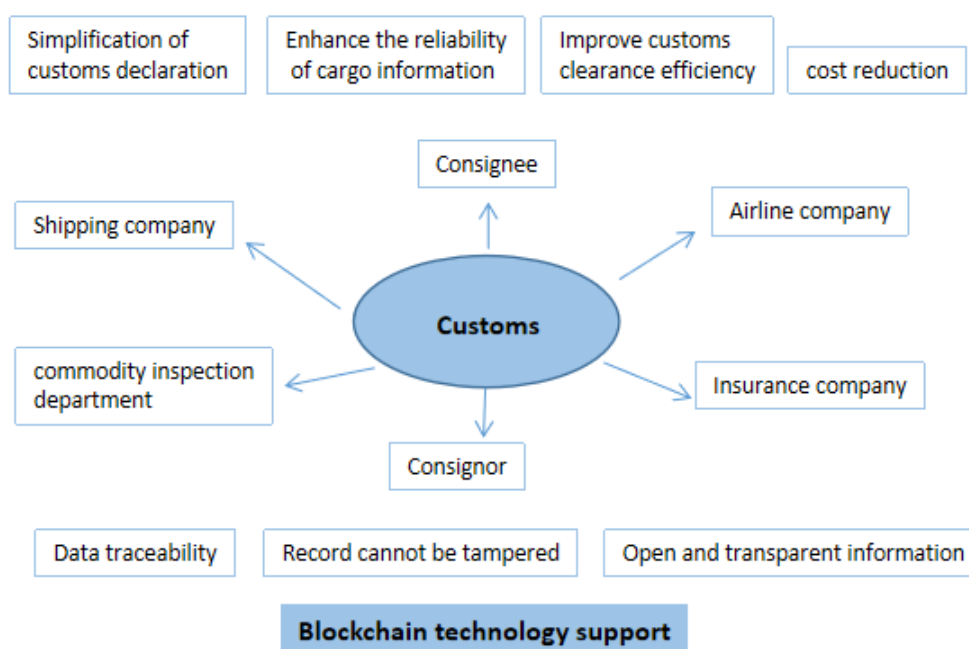


Figure1. Blockchain support in cross-border customs clearance.

4. HOW CAN BLOCKCHAIN TECHNOLOGY BE IMPEMENTED IN CROSS-BORDER LOGISTICS?

4.1 Create a cooperative relationship and win-win vision

It is very important to construct the path of cross-border e-commerce and cross-border logistics collaborative development for the integration and symbiosis of the two systems. The collaborative path of the two systems can be founded through strategic, functional and business level^[8].

When cross-border logistics enterprises or trade enterprises decide to apply Blockchain in logistics management, they should first create close cooperative relationship and win-win vision. Because it will involve multilateral trust and in-depth cooperation, including various partners, industry organizations, customs inspection agencies, and cooperation between legal entities and public institutions such as other relevant departments even competitors. Take the financial service industry with fierce competition as an example. Competitors have built a cooperation platform to jointly study the application of Blockchain technology. Although the cooperation between competitors is contrary to common sense, when more cooperative members are willing to use the same Blockchain solution, all parties can obtain higher value and achieve greater goals. Therefore, in the field of cross-border logistics, logistics blocks can also be built in alliance. However, current data privacy is not applied to the transaction data. Partners are permitted to use such information without any specific data protection. Therefore, it is very important to create certain boundaries to potential applications of blockchain technology. Also, certain parts of shipment details may be referred from Blockchain to an external system link^[9].

4.2 Improve the application level of Blockchain technology

New technology is the key support for the organization to realize the value of new operation mode. The cross-border logistics departments and participants of cross-border logistics enterprises and trade enterprises must invest enough resources and time, adopt effective personnel training and technical training methods and establish effective incentive mechanism. The member organizations simultaneously improve the application level of Blockchain technology of employees at all levels, ensure that they fully master relevant knowledge and professional ability, and make due contributions to the implementation of each Blockchain application project.

4.3 Scientific decision-making of Blockchain technology application

The application value and potential of Blockchain technology are immeasurable and need to be explored, which has formed a consensus at home and abroad. However, the current Blockchain technology has not been widely used, and it is still in the early stage of the technology life cycle. The goal and value expectation should be realistic, and the application decision of Blockchain technology should follow scientific and reasonable principles and ideas, which can be completed by decision-making^[10].

Questions included:

- (1) Is a shared public database required?
- (2) Is multi-party participation required?
- (3) Are there common interests among participants?
- (4) Is it necessary to keep authentic and tamper proof business information records?
- (5) Is it necessary to change the business transaction rules in the update cycle?

In addition, in the process of decision-making, SMEs should also consider the cost of applying blockchain technology. Currently, each party creates a partial copy of the product data suitable for their own needs. As a consequence, each party is also responsible for its own costs of creating the imperfect copy and for the failures resulting from inaccurate and obsolete product data^[11].

5. CONCLUSION

Also, the use of Blockchain technology in the field of smart logistics remains rare, following its new

appearance, its low popularity, and its complexity for the majority of people and organizations. The first real application in the logistics field was announced in April 2015: Everledger startup uses Blockchain to fight fraud in diamond supply chains^[12].

At present, the cross-border logistics industry is speeding up transformation and upgrading, and technological innovation and application have become the core support for improving quality and efficiency. There is a close relationship between the main advantages of Blockchain core technology and the cross-border logistics management needs of SMEs. In the field of cross-border supply chain logistics, Blockchain technology is applied to improve the anti-counterfeiting function of commodities, ensure the safety of logistics process and enhance the transparency of information. In the field of cross-border trade logistics, information, documents and containers are taken as typical objects, Blockchain technology is applied to simplify and speed up the order fulfillment, improve the efficiency of cross-border logistics, and realize the automation of performance. In the field of customs clearance, SEMs shall take the customs declaration as a typical carrier, the Blockchain technology is applied to simplify the customs clearance process and improve the speed of customs clearance. To establish the implementation path of applying Blockchain technology in cross-border logistics, we should first analyze the main success factors, follow scientific principles and ideas to make application decisions, and then formulate corresponding implementation steps. Although the specific application mode and implementation path are put forward, this paper still focuses on theoretical exploration. The successful application of Blockchain technology in the field of cross-border logistics practice cases and empirical analysis are the desirable directions for follow-up research; at the same time, the application research scope for other related fields of logistics needs to be further expanded. The technical characteristics and core advantages determine that Blockchain technology has a broad application prospect in the field of logistics. Looking forward to the future, Blockchain technology will be deeply integrated with new technologies such as artificial intelligence, cloud computing, Internet, big data, etc., so as to promote the sustainable development of intelligent logistics.

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Review of Cross-border Electronic Retail Logistics Research in the Last Five Years

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Abstract: Nearly five years, retail in cross-border e-commerce (CBER) has gradually attracted more attention with the expansion of domestic e-commerce in several retail major economies. Scholars both here and abroad have become increasingly interested in CBER. As the important supporting services, logistics services of CBER have also be deeply concerned. However, compared with the rich practice, the theoretical outputs of logistics services in CBER are still less. Previous studies have focused on the relationship between cross-border e-commerce and logistics services , and international distribution network. So far, there is little research on content-based logistics services concerning CBER. Based on the literature review, this paper has determined a series of possible research directions, including strategic significance of cooperation in forming CBER distribution structure and how to implement customer-driven logistics service improvement. Finally, some future research directions are proposed.

Keywords: Internationalization, cross-border retail e-commerce, logistics services, development trends

1. INTRODUCTION

It has been 34 years since the word "economic globalization" was put forward in 1985. With the emergence of the revolution in information technology in the 21st century, economic globalization has further developed. Since 2008, the trend of globalization at the consumer end has become much more obvious, although the growth of global trade slowing down. Especially under the impetus of online e-commerce, cross-border e-commerce has brought new vitality to the international consumer market. CBER is permeating people's lives with greater breadth and depth, and has become an important fulcrum to create growth during the new period all over the world, a series of policies to support cross-border electronic commerce being issued. According to relevant OECD reports, the vast majority of member countries have formulated their own national digital economic strategies or related policies.

This topic has attracted more and more attention from scholars because it requires specific knowledge and ability to meet all the challenges behind the development of cross-border electronic commerce which include language and cultural differences, regulatory issues, compatibility and interoperability between online payment systems. However, one of the most complicated problems is logistics. The intangible nature of online transactions should not allow underestimation of problems in the actual distribution of products. For many years, scholars have been discussing the importance of logistics in e-commerce, where logistics is often regarded as the source of competitive advantage. Especially with the international market competition becoming extremely fierce, the requirements for logistics services in e-commerce are becoming much higher. However, the relationship between logistics and e-commerce is mainly analyzed from the perspective of different countries. So far, there has been little research on content-based e-commerce logistics. On the other hand, logistics in

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CBER is different from logistics in e-commerce. At the same time, the logistics in developing countries is at a stage of rapid development recently, and the summary of new practices and research on logistics in CBER is also urgently needed academically.

In order to determine the key issues and research processes, a literature review was conducted. This review allows authors to identify and classify existing content-based logistics literature contributions in CBER. The thesis is divided into four main parts. Section 2 describes the methods used in this study. Section 3 introduces the results of literature review, discusses the main problems arising from the analysis. Section 4 determines the focus of future research. Section 5 draws a conclusion.

2. METHOD

This review covers scientific contributions in the past five years. This timetable looks natural, as CBER has gradually shown its advantages in economic development since 2014. This paper makes contributions to logistics in CBER in the form of literature analysis, because the system method is most suitable for verifying its content or repeated analysis, which should follow a series of precise steps, from selecting defined review topics and searching related literature to selection, analysis and critical description.

2.1 Literature search

2.1.1 Definition of cross-border electronic retail logistics

British finidi Research Ltd. pointed out that cross-border electronic commerce involves purchasing goods online in a country or region and shipping them overseas ^[1]. In China, "Cross-border E-commerce Retail Imports" refers to the consumption behavior of domestic consumers in China who purchase goods from overseas through third-party platform operators of cross-border e-commerce by special supervision mode ^[2]. In this article, we define logistics in CBER is a variety of logistics activities that span different countries or regions and mainly serve CBER, being accompanied by domestic consumers in a country purchasing goods from abroad through the operators of cross-border e-commerce third-party platforms. It has the characteristics of special customs supervision, strong timeliness, wider service space and longer supply chain.

2.1.2 Search process

First of all, identify research areas, which are mainly as follows: Cross-border e-commerce, International Express Services, Cross-Border Logistics Services. Then make sure the keywords, which are: cross-border e-commerce, cross border, logistics service. And search time is from 2014 to 2019. The search platforms are "WOS", "CNKI" and the search tool platform "EndNote". Finally, the search results are obtained which is a total of 81 search terms. After reading the summary and conclusion, we select and retain 65 key documents describing both the cross-border e-commerce field and the logistics development.

2.2 Literature analysis

2.2.1 Main features of the article

In terms of publishing time, this sequence helps to highlight how new people's interest in this topic is. About 77% of the papers were published from 2016. The increase in academic interest can be mainly explained as a reflection of the growth of B2C e-commerce in developing countries like China.

In terms of author's location, there are more authors in mainland China, followed by Taiwan, Europe, America and Australia, and finally by Japan, Korea and India. This result is related to the development stage of cross-border e-commerce retail logistics in various countries. China has just promulgated laws for cross-border e-commerce to support the industry in recent years, so the research is on the rise. Most of its research focuses on the macro-research of cross-border logistics, such as: the belt and road initiative with strong policies. Other countries, such as Europe and India, are affected by the strategic investment of neighboring countries, and their international logistics research is also gradually increasing. Similarly, there are more researches on

macro-political situation. .

Table 1 Main References

Year	Author	Document type	Location	Article
2013	EUROPEAN COMMISSION	conference	EUROPEAN	A roadmap for completing the single market for parcel delivery Build trust in delivery services and encourage online sales
2016	Maria G	journal	Italy	Cross Border B2C E-Commerce to Greater China and the role of logistics: a literature review
2016	Kim T Y	journal	EU	The value of express delivery services for cross-border e-commerce in European Union markets
2017	Guo Y	journal	China	To sell or not to sell: Exploring sellers' trust and risk of chargeback fraud in cross-border electronic commerce
2017	Paul Tae-Woo Lee	journal	China	Research trends and agenda on the Belt and Road(B&R) initiative with a focus on maritime transport
2017	Hsiao Y H	journal	Taiwan	Logistics service design for cross-border E-commerce using Kansei engineering with text-mining-based online content analysis
2018	Wu P J	journal	Taiwan	Unstructured big data analytics for retrieving e-commerce logistics Knowledge
2018	Liu X T	journal	China	Analysis of logistics service supply chain for the One Belt and One Road initiative of China
2018	Ángel V	journal	Spain	Drivers and barriers to cross-border e-commerce: evidence from Spanish individual behavior
2018	Ying Wang	journal	China	Supply Chain-Based Business Model Innovation: The Case of a Cross-Border E-Commerce Company

3. REVIEW OF LITERATURE

3.1 Research on the relationship between cross-border e-commerce and retail logistics services

The development of cross-border retail logistics cannot be separated from the continuous expansion of cross-border e-commerce. From the perspective of logistics service as an important factor affecting the development of CBER, the Accenture European Retail Roundtable in cross-border electronic commerce (Europe) proposed that delivery and product return are currently the most concerned issues for e-shoppers and e-retailers in EU ^[3]. However, Estrella finds that package payment costs and foreign attributes of commodities have no significant impact on the development of CBER in the EU, but the language, foreign nationality and payment from the macro perspective of national industrial ^[4]. A similar conclusion was reached by Ángel Valarezoa , he proposes developing online skills training and enhancing the integrity of online shopping, such as rational use of post-purchase reviews of goods from a micro perspective through Spain's 2016 domestic census data ^[5]. Zhang X X measures the seller competition strategy on the sales volume of CBER from the aspects of cost leadership, reputation priority and logistics service, found that the above three factors have positive impact ^[6].

3.2 Development mode, cost and risk analysis of cross-border electronic retail logistics

The research on the development mode of logistics in cross-border electronic commerce generally selects the appropriate logistics mode through comprehensive cost, risk, customer demand and other factors, which is a key decision for the implementation of cross-border logistics. Maria quantified the logistics costs of three logistics solutions from the perspective of a European clothing industry enterprise. The model returns the distributed solution related to the lowest logistics cost by inputting some specific data (such as the weight and volume of clothes) ^[7]. Lu studied the price competition strategy of two adjacent cross-border e-commerce

comprehensive experimental areas in China. Empirical research showed that enterprises in regions with competitive significance should charge different fees according to the competitive areas ^[8]. Another cost risk study for CBER is based on independent cost or risk analysis under a specific scenario. Li studied the cost assessment of the downstream supply chain. The study shows that facility improvement and related ICT have proved to be the most valuable. The author emphasizes that this is the basis for the wide application of supply chain in CBER and will improve transparency, thus creating a more complex supply chain ^[9]. Zhang analyze the risks of logistics operation under CBER based on the five steps of SCCOM. The empirical research on Taobao between Taiwan and the mainland shows that cross-border logistics is most affected by "information system instability" and "abnormal customs clearance at sea" ^[10]. Guo Y and others studied the whole process of sellers' trust in buyers in CBER transactions. This study provides useful insights for third-party online trading platforms and online trade policy makers ^[11].

3.3 Cross-border electronic retail logistics service quality discussion

From a macro perspective that affects the quality of logistics services, Weina studied the application of high-tech technologies and payment methods have a significant impact on logistics in CBER, while laws and regulations and customs clearance services have no significant impact on cross-border e-commerce logistics in the manufacturing industry ^[12]. From the perspective of improving the quality of logistics services, there are currently many logistics demand studies for B-end consumers from the perspective of third-party logistics service providers. Ding found that different business models had very different requirements for logistics services, which were embodied in logistics timeliness, transportation safety, freight affordability and other additional services. Specifically, the economic evaluation of service was relatively low in the aircraft transportation business in China ^[13]. LI proposed an information aggregation platform for businesses to reasonably select logistics service providers is necessary, and suggested that cross-border e-commerce platforms can provide more logistics services ^[14]. Fu proposed the logistics capability evaluation index of the third-party logistics service provider in CBER including quality assurance, rapid response, cost control, value-added service and information management ^[15]. There is also a research on logistics demand directly facing C-end consumers. Kim found that the sales data of consumer on online stores verified that express delivery has a positive impact on financial performance in cross-border e-commerce market in the EU where the demand for express delivery service increases with higher income of users, higher lead-time income of express delivery and lower logistics cost ^[16]. EU has proposed implementation strategies to encourage the establishment of a single package delivery market to promotion online sales from the transparency of information exchange in the supply chain, the quality and affordability of the delivery plan, and the mechanism of customer complaints ^[17]. Hsiao found the services that "the logistics service is available 24 hours a day", "the logistics freight is not paid by the buyer alone", etc. had greater impact on customer satisfaction ^[18].

3.4. Cross-border electronic retail logistics supply chain innovation research

The research of supply chain in CBER is extensive, including the innovation of business model, cost allocation research, supply chain network layout research, etc. Qu took "internet plus" as the entry point, and puts forward the connotation of logistics development in the context of e-commerce. The connotation elaboration focuses on the integration of logistics value, value chain reconstruction and non-intermediary function, and explains the importance of logistics value chain analysis ^[19]. Liu found the profit of integrators decreased with the increase of cost sharing ratio, regardless of whether integrators or providers dominated the logistics service supply chain. In addition, compared with the value in decentralized channels, when integrators and suppliers cooperated in price negotiation, the profit of logistics service supply chain will be higher in the coordination of the supply chain under the Belt and Road Initiative ^[20]. Maria found that Taiwan and Hong Kong, had strategic positions in the development of distribution networks in CBER in China, and emphasized the

establishment of cross-border logistics distribution networks and the decision-making of enterprise outsourcing as two research hotspots^[21]. Shi put forward the factors affecting the responsiveness of third-party logistics suppliers in CBER from the perspective of global value chain, which were the level of specialization in the logistics field, the degree of target consistency of partners and cultural differences^[22]. Wang found that the mode of “overseas warehouse plus supply chain finance” has set up an innovative business model for its supply chain in a logistics enterprise in CBER from China^[23].

3.5. Cross-border electronic retail logistics development trend tracking

Wu crawled 2370 data from professional logistics websites in several countries from 2010 to 2016, and pointed out the 10 mainstream hot topics, such as “E-commerce logistics payment in Southeast Asia”, “E-commerce order management”, etc^[24]. Qu proposed that there is another meaning of “cross-border” mode in the path of logistics, which are: function cross-border mode, industry integration mode, industry linkage mode and industry cross-border mode^[19]. Maria concluded in the role of China's B2C cross-border e-commerce logistics that the design of cross-border logistics distribution networks should be focused on. Meanwhile, the time of delivery is the key service attribute, and it directly limits the applicable logistics solutions^[21]. Paul studied the impact of the belt and road initiative's policies. The article analyzed the impact of policies on the industries of corresponding regions in China from the key factors involved in economic and transportation corridors, urban agglomerations, etc. It also emphasized that the implementation of the project has had a great impact, and would be no longer just a policy call, and corresponding foreign studies will continue to emerge^[25].

4. HINTS FOR FUTURE RESEARCH

4.1 Supporting CBER's value-added logistics service for customers

In CBER, the logistics needs of customers are very basic, such as the need for affordable delivery costs and convenient return logistics services. However, the matching degree of logistics demand in CBER is much more focused on delivering goods as quickly as possible, lacking of flexibility, unable to meet the customer's return needs. This is a common phenomenon in the initial stage of market development which exists in the European Union, China, etc. Although bonded logistics and overseas warehouses can meet the customer's return and exchange requirements to a certain extent, there are still some problems such as insufficient variety of goods, high warehouse management cost, circulation of goods, etc. Another existent solution is to provide logistics insurance, such as return insurance and premium insurance, etc. This is a very conventional value-added service in the domestic e-commerce logistics field, while absent in CBER. Therefore, in-depth research can be conducted that logistics services should cooperate deeply with cross-border e-commerce platforms or sellers on the basis of comprehensive consideration of cost and demand to provide sustainable cross-border logistics service optimization. Because of the cultural differences in different countries, it is more practical to combine in-depth studies of different industries in different regions.

4.2 Research on supply chain organization cooperation supporting CBER

The research of supply chain has local characteristics. China's logistics research tends to the facility planning and service network selection. Under the background of longer service chain and more complicated political culture of logistics in CBER, the overall output based on supply chain research is more important, which is more studied by developed countries. At present, some cross-border e-commerce platforms in developing countries, like China, whose classic practices are worth learning from by international peers, have gone out to sea one after another, making use of their platform flow advantages to find logistics service providers overseas as partners. Big enterprises build their own storage outlets or take shares in foreign logistics service providers to strengthen their control over logistics. Small and micro e-commerce sellers signed contracts with supply chain service providers to access to services. At present, there are few researches on the cost-benefit

distribution of supply chain in CBER, especially the recently popular "Belt and Road" strategy. Future research can combine specific industries to systematically study how to promote efficient supply chain cooperation from the perspectives of cost, risk and benefit. Another trend of supply chain development is to consider establishing a comprehensive platform for cross-border logistics information. Research in China focuses on the construction of bonded comprehensive zones, but the construction has the strong characteristics of regional and administrative nature. Future research can discuss how to build an efficient logistics alliance and the mechanism of information technology in it, where transparency and interoperability of the system are crucial.

4.3 Need to carry out more "inclusive" research, combined with other research and analysis of logistics

It is crucial to consider the relationship between logistics and other functions such as marketing and law by considering the views of foreign companies willing to accept the CBER plan. Among them, legal issues play a prominent role because coordination between different legal systems affects several procedures, including electronic customs procedures. This in turn will affect logistics performance. In addition, the foreign legal framework related to electronic commerce and cross-border electronic commerce is undergoing major changes in recent years. Understanding how legal and policy interventions affect logistics management in such an evolving environment is a key factor to be investigated. Although there are more extensive methods to analyze the relationship between logistics and legal issues in some articles related to foreign countries, there is little research on emerging markets. This gap should not be underestimated, because although foreign retailers may think that Asian countries have similar legal systems, this is not the case, and differences should be correctly pointed out in future studies.

5. CONCLUSION

This research uses systematic literature review method to sort out the research status of cross-border retail logistics worldwide in the past five years. It involves the core set of the international document platform "web of science", the popular document platform "CNKI" in China and the document search tool "Endnote", with a total of 161 search items. After sorting out documents, 65 key documents were finally determined. The contribution of this paper is mainly reflected in two aspects. First, the relevant domestic and foreign documents are classified and expounded five themes in the past five years. Secondly, according to the current research situation, it puts forward possible research directions in the future. There are also deficiencies in the article. Considering that the literature collection channels cover only a few active markets such as Asia, Europe and Oceania, there may be deficiencies in summarizing the global cross-border electronic retail market. In addition, cross-border electronic retail logistics is a relatively new topic in recent years. New research is still emerging one after another. It is necessary to update the latest research situation in time.

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Transnational Entrepreneurship Education System Based On Cross-Border E-Commerce In The Context Of Belt And Road

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Abstract: This article analyzes the significance of Chinese colleges and universities in carrying out entrepreneurship education for international students from the Belt and Road Initiative, and puts forward the idea of constructing an education system centered on the establishment of a Belt and Road: Innovation Farm transnational entrepreneurship network platform. Based on this idea, Huazhong Agricultural University has carried out three aspects of transnational entrepreneurship education practice namely the Belt and Road student team training, Belt and Road transnational entrepreneurship education practice system, and the establishment of an innovation farm in Pakistan.

Keywords: Belt and Road initiative, transnational entrepreneurship, entrepreneurship education, Cross-Border E-Commerce

1. INTRODUCTION

The "Belt and Road" initiative puts China and the countries along the route into a community of mutual prosperity, interests and responsibilities. The construction of such a community requires a large number of professionals with cross-cultural communication capabilities. In the past few years, the number of overseas students from the countries along the Belt and Road has increased rapidly and has become the main force to achieve the development goal of "building China the largest country for studying abroad in Asia by 2020". Some scholars believe that this is actually individual behavior of Belt and Road countries, and has not yet been systematically planned and designed from the national macro strategy^[1].

According to the Push-Pull theory put forwarded by American comparative higher education expert Altbach, international students from countries along the Belt and Road studying in China are relatively more attracted to China's development potential. Carrying out entrepreneurship education for international students from the Belt and Road countries will disseminate the tide of "double innovation" to these students and they will have a more systematic understanding of the Chinese model, making them the best promoters of the "Belt and Road" initiative and the best carrier for capital exchange and intellectual support.

How to carry out entrepreneurship education for international students from the Belt and Road countries? Major part of the existing research on entrepreneurship education is focused on Chinese students, and most of the entrepreneurial perspectives are limited to China. This article starts with cross-border e-commerce as the basis of the Belt and Road transnational entrepreneurship education and attempts to explore a feasible way for the entrepreneurship education for international students from Belt and Road countries.

2. REVIEW OF RELATED RESEARCH

The literature related to this research can be roughly divided into two aspects. One is the research on the Belt and Road initiative and the "double innovation" talent training: Zhou Guping and Jian Yue first analyzed the importance of "Belt and Road" initiative and pointed out the talent support needed to implement the "Belt

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and Road” initiative, including non-universal language talents and overseas high-end talents. On this basis, five paths were given to cultivate the talent needed to implement the Belt and Road: strengthening international awareness and capabilities, deepening curriculum reform, encouraging overseas practice, strengthening education for studying in China, and launching multilevel overseas schools^[2]. Yu Xiaozhong and Gao Qingxin believed that through the cooperative mechanism of collaborative innovation, the establishment of a new Belt and Road cooperation mechanism, the most important is the collaborative innovation of talents. Only when talent training meets the requirements, can it play a role in supporting the Belt and Road initiative^[3]. Yang Hongyun and Su Shibin, drawing on the "three plus one" model, which are putting forward the development of general courses related to the Belt and Road countries, and strengthening the guidance of cultural creative entrepreneurship, interacting with the innovation and entrepreneurship education of the countries along the route through "Send out, bring in"^[4] activities.

Second aspect is the research on transnational entrepreneurship education. Hou Honghong believed that transnational innovation and entrepreneurship can be mainly divided into three models: research project incubation, original project derivation, and cultural project transplantation. He proposed three promotion models, first is optimizing the curriculum setting for the cultivation of innovation and entrepreneurship culture, second is providing the perceptual experience of innovation and entrepreneurship practice, third is creation of an entrepreneurial environment that encourages innovation and tolerance for failure^[5]. Chen Yinfei and Chen Haibo believed that they can teach international students the basic principles and practical knowledge of international finance, cultivate students' ability to analyze the balance of payments of various countries, engage in foreign exchange transactions, prevent foreign exchange risks, and capture international investment opportunities, and help students to develop rational thinking, cultivate teamwork awareness, honesty and trustworthiness and innovative entrepreneurship^[6]. Yang Xiu and Xianghua Xiang analyzed the impact of the “Belt and Road” initiative on the education of universities in Guangxi. They initially designed the Guangxi-ASEAN transnational entrepreneurship curriculum system and gave three suggestions for application^[7].

Existing research generally believe that the Belt and Road initiative has put forward new requirements for entrepreneurship education and has achieved certain results, but there are still some shortcomings: (1) Treat Chinese students and international students differently and carry out different entrepreneurial education separately. In addition to the repeated deployment of entrepreneurial faculty, it has not fully tapped the potential of Chinese and foreign students. (2) Although some literature has designed a multinational entrepreneurship curriculum system based on regional characteristics, it only laid out the design but lack the practice and cannot test the feasibility and effectiveness of the system design.

3. THOUGHTS ON BELT AND ROAD TRANSNATIONAL ENTREPRENEURSHIP EDUCATION SYSTEM

3.1 Belt and Road transnational entrepreneurship types and educational demand analysis

Through interviews with existing “Belt and Road” transnational entrepreneurs in Hubei Province, the specific manifestations of entrepreneurship can be roughly divided into the following types: (1) Cross-border e-commerce based on the four parks of Wuhan Comprehensive Experimental Zone. This is a relatively large-scale and universal cross-border entrepreneurship project. For a period of time, it is also the most likely place for entrepreneurs in the province after receiving cross-border entrepreneurship education. (2) China-foreign two-way traditional foreign trade. Such projects have relatively high capital requirements and high business thresholds. Generally they are not the first choice for college students to start a business, and they are currently few. But if combined with local elites (international students in China and their families), it is still commercially viable. (3) International students from the Belt and Road countries attracting Chinese investment,

return home and start business. These international students are studying in China, and they have experienced the thriving Chinese e-commerce business. They have a strong curiosity about e-commerce entrepreneurship. They want to learn from China's business model and copy it to their own countries. There are currently few such entrepreneurial projects, but they have the most potential. If it takes shape, it is not only the best way to export capital overseas, but because the core personnel are international students, it can reduce friction in a cross-cultural environment, strive for more local recognition, and be able to share growth dividends within a certain period of time.

According to the results of the interviews, the three types of entrepreneurial knowledge and skills commonly required by Belt and Road multinational entrepreneurs are: (1) Internet entrepreneurship and cross-border e-commerce knowledge; (2) International trade and international relations knowledge; (3) Cross-cultural communication skills. The above three types of knowledge and skills are important to the three types of entrepreneurship, but according to the different types of entrepreneurship, the first type of entrepreneurship focuses more on internet entrepreneurship and cross-border e-commerce related knowledge, and the second type of entrepreneurship focuses on international trade and knowledge of international relations. The third type of entrepreneur needs to have strong cross-cultural communication skills.

The knowledge and skills required by the Belt and Road transnational entrepreneurship are the goal and also the most important basis of the Belt and Road transnational entrepreneurship education system. With the further development of practical teaching, the demand for knowledge will become more specific and detailed.

3.2 Thoughts on the Belt and Road transnational entrepreneurship education system

3.2.1 Establish a Belt and Road national "innovation farm" transnational entrepreneurship network platform

Based on the establishment of friendly cooperation memorandums with colleges and universities in Pakistan, Bangladesh, Egypt, and Thailand, the "innovation farms" have been gradually established in China, Pakistan, Bangladesh, Egypt, and Thailand to build a network platform for students from all over the world to innovate and start their own businesses. Based on the principles of friendship, mutual benefit, and win-win cooperation, China-Pakistan, China-Bangladesh, China-Egypt and China-Thailand cross-border innovation and entrepreneurship talent exchange projects have been reached.

The "innovation farms" of the above countries will serve as incubation bases for cross-border innovation and entrepreneurship projects. At the same time, they will collect innovation and entrepreneurship projects for their own countries and partner countries, and recruit project partners and project members in the partner countries in the form of project cooperation. Jointly complete half-year to one-year cross-border entrepreneurship practice projects.

At the same time, countries need to carry out in-depth integration with domestic companies and entrepreneurial mentors to provide all-round support such as funding, policies and communication platforms for entrepreneurial projects and teams from partner countries. During the practice of cross-border exchanges, each country needs to provide effective and reasonable logistic support, follow-up guidance and process management for the players participating in the cooperative country.

Cross-border practice projects include but are not limited to the following categories:

- ① Cross-border trade: cross-border e-commerce with various categories and traditional cross-border trade;
- ② Agricultural production: including special agriculture such as poultry farming, rice plantation, flower plantation, and coffee plantation;
- ③ Elementary and secondary education: various primary and secondary education programs including

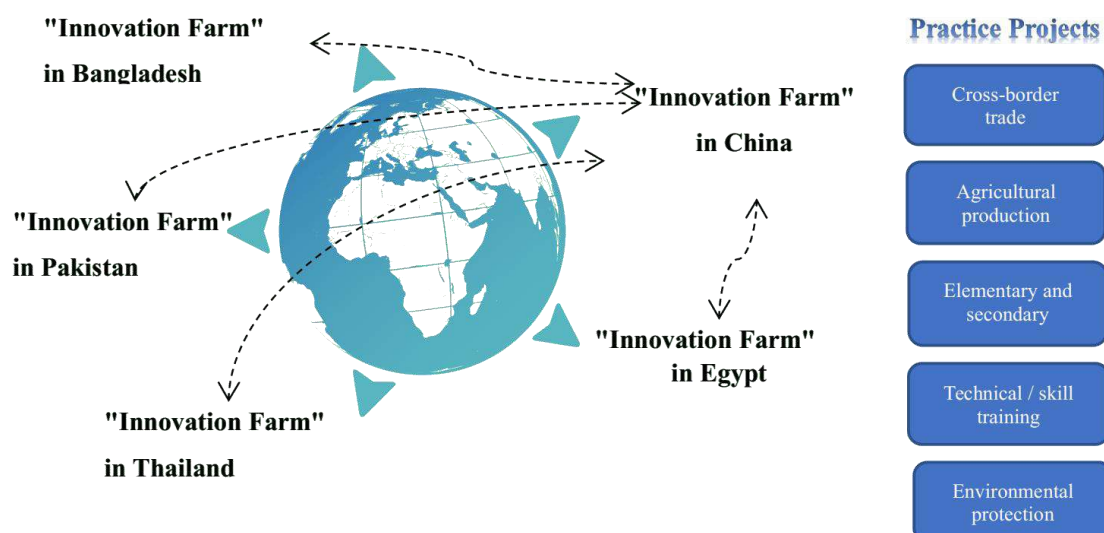


Figure 1. Belt and Road national "innovation farm" transnational entrepreneurship network platform

arts, sports and entertainment;

④ Technical / skill training: including cross-border e-commerce platforms, data mining, graphical programming, and various technical / skill training such as agricultural technology and biotechnology;

⑤ Environmental protection: including degradation of plastic products, water purification, soil improvement, etc.

Cross-border practice projects can be innovative research topics, practical service/ production projects, or entrepreneurial projects. The cross-border practice projects generated by "innovation farms" in various countries would be funded by countries and supported by local cooperative enterprises with funding and project guidance

3.2.2 "1 + 1 + 1" practical courses

① Campus training: Interested students will be organized to focus on practical business English, cross-border e-commerce ERP simulation, entrepreneurship simulation training, cross-border e-commerce operation practice, product selection and design, etc., to accumulate skills required during later internship practices.

② Practice internship: Outstanding students would enter the "innovation farm" in each country. They will conduct a month-long inspection and research, apply the skills learned in campus training, find innovative research topics or entrepreneurial projects in the "innovation farm". The most innovative and feasible projects will be selected into the "project pool" for further incubation;

③ Transnational entrepreneurship practice: Project leaders in "project pool" would select students who have the potential for innovation and entrepreneurship from various countries to participate their projects by organizing written tests, interviews, project recruitment, commercial road shows, etc.. After that, selected students will carry out a multinational entrepreneurship practice with their project team.

3.2.3 Project management system

The practice content of "1 + 1 + 1" practical courses adopts a project management system, from project collection to member recruitment, from process management to schedule control, to build as much as possible a practical environment for entrepreneurial projects. Forcing students to break away from the "challenges" of the campus and the care of their teachers, truly enter the practical state and establish a good psychological quality and working ability for future employment and entrepreneurship.

4. PRACTICAL EXPLORATION OF "BELT AND ROAD" TRANSNATIONAL ENTREPRENEURSHIP EDUCATION BASED ON CROSS-BORDER E-COMMERCE

4.1 Exploration of the Belt and Road team training of Chinese and foreign students

After multiple rounds of cross-border e-commerce training, a multinational entrepreneurial atmosphere have been set up and interested and capable students are gathered. Through school-enterprise cooperation, a total of more than ten cross-border e-commerce training and entrepreneurial lectures were conducted, and the number of participating students was nearly two hundred, of which nearly half were foreign students from Belt and Road countries. Interest is the best teacher, under the voluntary registration recruitment mechanism, a group of Chinese and foreign students who have strong interests in multinational entrepreneurship have been recruited. These students have become the backbone of various entrepreneurial competitions and entrepreneurial projects.

A mixed Chinese and foreign team is formed to conduct corporate training and participate in cross-border e-commerce entrepreneurship competitions. Chinese and foreign students have their own strengths and weaknesses, and forming a mixed team can make up for each other. Chinese students are all undergraduate students majoring in economics and management. They are familiar with e-commerce business processes, and can quickly get started with various operations of cross-border e-commerce platforms. Language is their disadvantage. Foreign students are mostly master and doctoral students. Although they only know a little about e-commerce, they can define English keywords and description terms of products from the perspective of consumers. Organizing Chinese and foreign mixed teams to run cross-border platform account for enterprises and participating in various cross-border e-commerce entrepreneurship competitions, all achieved good results. Practice has proved that the growth of Chinese and foreign students in mixed teams is much larger than that of similar student teams. Chinese students can gain international perspective and cultural self-confidence, and foreign students can quickly master business Chinese and e-commerce operation methods.

Core students are screened to integrate resource advantages and personal interests and incubate multinational entrepreneurial projects. The key to incubating an entrepreneurial project is to form an excellent team. The core members of the team are all excellent students from previous internships and competitions. Chinese and foreign students brainstormed together, combined market research and corporate interviews to form a preliminary project idea, and divided labor and collaboration according to the characteristics of Chinese and foreign students: Chinese students are responsible for the overall planning and daily operation of the project, and foreign students are responsible for integrating overseas social capital and developing markets .

4.2 Belt and Road transnational entrepreneurship education practice system based on cross-border e-commerce

The establishment of a comprehensive and integrated entrepreneurial practice system from module to system and from basic to comprehensive is shown as below.

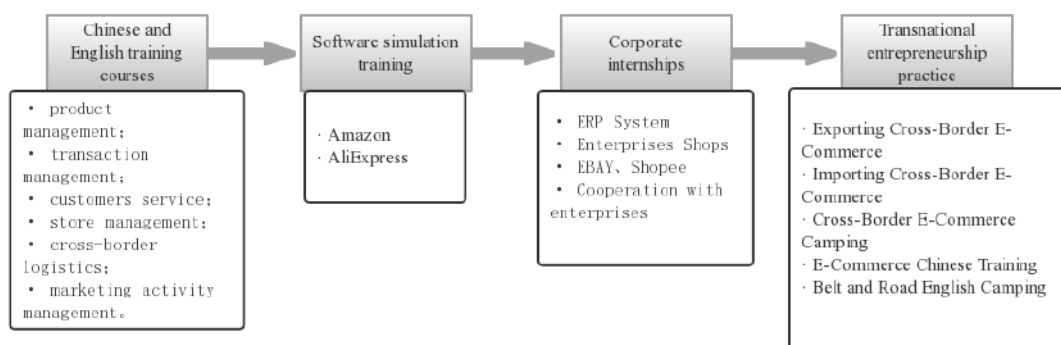


Figure 2 Schematic diagram of entrepreneurial practice

The Chinese and English training courses include a full-English practical elective course "Cross-Border E-Commerce Training" for students majoring in economics and management, and a creative and entrepreneurial general course for cross-border students, "Cross-Border E-commerce Practice", Teaching students in Chinese and English the six operational links of product management, transaction management, customers service, store management, cross-border logistics and marketing activity management in cross-border e-commerce.

Software simulation training is closely integrated with the teaching content of the training courses. In the dynamically changing e-commerce environment provided by the software, students act as enterprises and individuals and independently operate service items provided by cross-border e-commerce platforms to develop cross-border e-commerce business. The simulation training platform is mainly selected from the largest overseas cross-border e-commerce platform Amazon and the cross-border e-commerce platform of China Alibaba Group AliExpress. Students can master the entire flow of cross-border e-commerce business operations in simulation software, effectively preventing operational risks.

In terms of corporate internships, professional teachers in the school have conducted in-depth cooperation with cross-border e-commerce enterprises, and they have jointly organized third-year students from economics and management to carry out professional internships with corporate trainers outside the school. In that internships, students work in teams of three and operate a real online store as a team. They are responsible for the operation of product selection, product listing and delivery. The student team can obtain 30-50% of the profit during the operation. The company is responsible for providing cross-border e-commerce online store account and training and guidance in the operation link. It also bears all the operational risks while obtaining most of the profits. Teaching internships are conducted in the cross-border e-commerce experience hall in the university's entrepreneurial incubator. The hall has an operating area, a shipping area, and a photo studio.

The ultimate goal of entrepreneurship education is to provide students with a certain degree of employment or entrepreneurship. Transnational entrepreneurship practice is part of the implementation of the Belt and Road transnational entrepreneurship education practice system. Most students will choose to work in the cross-border e-commerce industry after they have accumulated sufficient employment skills. Some students start their business ideas after learning cross-border e-commerce. At present, four Belt and Road multinational entrepreneurship projects and one foreign company have been hatched.

4.3 Exploration of Building Pakistan's "Innovation Farm"

The completion of Pakistan's "Innovation Farm" has verified the effectiveness of the "Belt and Road" multinational entrepreneurship education practice system based on cross-border e-commerce.

Growth of the founder: The core member of Pakistan's "Innovation Farm" is a Pakistani student who completed the cross-border e-commerce English training course in February 2019; he also learned AliExpress in simulation software in April of the same year and participated in the first national new retail buyer entrepreneurship skills competition held by Alibaba; entered a cross-border e-commerce internship in May, systematically learned the Amazon platform, and continued to operate Amazon stores for 8 months, earning thousands yuan in the first month. In July, we cooperated with cross-border e-commerce enterprises to carry out a 10-day cross-border e-commerce online training for 35 students in Pakistan, and then provided 15 outstanding trainees with two-month cross-border e-commerce part-time jobs; in December we have completed company registration and started further planning for systematic and continuous cross-border cross-border e-commerce training to provide more Pakistani students with employment or entrepreneurial opportunities.

Promotion of cross-border e-commerce forum: On December 3-5, 2019, the entrepreneurial instructor of the school visited Faisalabad Agricultural University in Pakistan with several Pakistani students to participate in the second cross-border e-commerce international exchange forum. During the forum, the two entrepreneurial teams reached a cooperation agreement and formally established the "China-Pakistan Cross-Border E-Commerce

Association".

Innovation Farm in Pakistan: Gilgit NGO AKRSP (Agha Khan Rural Support Program) and Faisalabad Agricultural University Institute of Agriculture and Resource Economics have become Pakistan's "Innovation Farm", which will work with the entrepreneurial team in China to cultivate more multinational entrepreneurial projects.

5. CONCLUSION

This article first analyzes the significance of Chinese colleges and universities in carrying out entrepreneurship education for Belt and Road countries, and puts forward the idea of Belt and Road transnational entrepreneurship education based on cross-border e-commerce. Based on the summary of three existing types of Belt and Road transnational entrepreneurship and entrepreneurship education needs, this paper puts forward the idea of an education system centered on the Belt and Road countries: "innovation farm" transnational entrepreneurship network platform. Based on this idea, Huazhong Agricultural University has carried out three aspects of transnational entrepreneurship education practice namely the Belt and Road student team training, Belt and Road transnational entrepreneurship education practice system, and the establishment of an innovation farm in Pakistan.

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Investment Risk Analysis of Southeast Asian Countries along the "Belt and Road" and Countermeasure by Analytic Hierarchy Process

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Abstract: Proposal of "Belt and Road" initiative, along with Framework Agreement on Comprehensive Economic Cooperation between China and ASEAN has had far-reaching and positive impacts on promoting social and economic development of Southeast Asian countries. Nevertheless, there are numerous failure examples of overseas investments and cooperation. Therefore, main factors of investment risks are urgent for Chinese investors to analyze and explore further. To reasonably rank and evaluate investment risk, five typical countries are analyzed by the analytical hierarchy process based on economic condition, debt ability, social environment, legal system, political factors. To improve investment efficiency, investment risks of these countries were ranked. Due to complementary effect between host country and China, Southeast Asian countries are generally suitable for overseas investment. Singapore and Malaysia have lower risk level, Laos and Philippines have moderate risk levels since infrastructure construction level in the two countries is not high, Thailand has slightly higher investment risk. In order to reduce investment risk, some countermeasures should be taken. RMB internationalization should be promoted in order to facilitate overseas trade and investment. To strengthen policy communication, role of multilateral trade agreements can be consolidated and expanded. Learning from advanced international experience, financing insurance system should be constructed.

Keywords: Belt and Road; Investment; Risk Analysis; Southeast Asia; Analytic Hierarchy Process

1. INTRODUCTION

In 2013, general secretary Xi Jinping introduced the idea to construct the project "one belt and one road". Adjoining China, Southeast Asian countries are on priority direction of the "one belt and one road" construction.^[1] In the process of Chinese global overseas investment, countries in Southeast Asia have gradually become the focus in the world. Southeast Asia is a very unique region, which is a key hub for communicating the two oceans and connecting the three continents. It contains 11 countries, such as Singapore, Vietnam and Laos, with a population of more than 600 million. According to the latest data released by the International Monetary Fund, the total GDP of 11 countries in Southeast Asia has exceeded US\$247 trillion in 2015, making them the top 10 economies in the world.^[2] Southeast Asian countries have gradually become the key area of cross-border investment for Chinese enterprises.

The initiative of "one belt and one road" has provided great opportunities for Chinese enterprises to carry out foreign trade and overseas investment in Southeast Asia. However, at present, the international macro political and economic situation are grim and complicated. Enormous risks, such as poor political stability and immaturity should not be overlooked in Southeast Asian countries. At present, it is necessary and urgent to accurately identify and quantify the investment risks in Southeast Asian countries.

A significant part of FDI in services flows into segments that are connected to the development of digital economy (AIR 2018), including financial services, wholesale and retail, and logistics. New start-ups have emerged in retail industry, using technology to venture into the e-commerce space, contributing to the increase in retail activities. The 50 most funded e-commerce start-ups in ASEAN had raised \$12.6 billion as of July 2019,

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with most of the funding raised in the last two years. Many have raised venture capital to scale up operations and invest in other ASEAN Member States. E-commerce has been the most dynamic segment of the Internet economy in ASEAN over the past three years. The value of e-commerce rose four-fold, from \$5.5 billion in 2015 to more than \$23 billion in 2018.²⁵ Indonesia accounted for the most (\$12 billion), and Thailand and Viet Nam each accounted for about \$3 billion. E-commerce transactions in the region are expected to exceed \$100 billion by 2025. The affordability of mobile internet, greater consumer trust in e-commerce and growth of logistics industry to handle e-commerce deliveries have been among the main drivers of this rapid growth.

2. LITERATURE REVIEW

2.1 Research on Risk Assessment and Risk Control of Foreign Investment

1. Research Methods of Risk Assessment of Foreign Investment.

Framework and index selection of quantitative analysis are developing continuously. At present, U.S. National Risk International Guidelines Index is the most widely used among them. First-level index system is political risk, financial risk and economic risk. Empowering 50%, 25% and 25% respectively, the higher the score, the better the investment security. Professional institutions attach great importance to risk quantification and have established a relatively perfect system. S&P, Moody's and Fitch also regularly issue authoritative reports on sovereign credit rating, accounting for about 90% of the world's sovereign credit rating market. In recent years, Economist Information Agency, Transparency International and World Bank have also carried out quantitative risk assessment with different methods and different emphasis.^[3] But index system is built around economic risk, political risk, social risk and other first-level indicators. Among them, economic risk reflects the macro level of a country's economic development, such as growth rate of GNP, level of per capita income, employment situation, openness, foreign debt solvency and other indicators. Political risk is usually regarded as the willingness of a government to repay its debts. It mostly uses indicators such as social stability, residents' freedom of speech, government governance efficiency and government corruption. Social risks mostly reflect the ability of FDI to operate independently. The degree of social flexibility, the perfection of the legal system, religious issues, racial issues, openness and cultural acceptance are all taken into account to varying degrees.

2. Research on Risk Control of Foreign Investment.

Kenneth and others believe that we should pay attention to the whole process of the source and flow of funds in order to reduce risks in all aspects. Project declaration, approval, contract signing, legal protection and supervision of overseas direct investment involve both sides of the investment. It is recognized that docking of relevant laws and regulations and keeping perfect data for reference are necessary means of risk reduction.^[4] Jensen et al. (2011) argued that normative management could reduce risk. Firstly, it designs the overall risk management strategy according to the main purpose and mode of investment; secondly, it standardizes the pre-investigation, pays attention to the social and cultural environment; thirdly, it uses financial instruments to intervene in the diversification of investment risks.^[5] Risk of overseas direct investment is concentrated in the financial field, and a complete and standardized risk early warning system is the necessary basis for risk diversification. Disperse political risks, first, we should strictly monitor the implementation of laws and regulations; second, we should build up the system. Special databases and databases for foreign investment can reduce the risks brought by information asymmetry. Third, we should focus on standardizing the compatibility of specific standards.

2.2 Research on OFDI investment risk of "one belt and one road"

The "one belt and one road" initiative has strong compatibility, involving a large number of countries and a

large amount of investment.^[6] The identification and prevention of related risks is one of the focuses of the study.^[7] In terms of political and social risks, Irshad (2015) believes that "one belt and one road" helps to promote coordinated regional development, and that the unity of regional standards and the compatibility of laws and regulations are the basis for effective cooperation.^[8] According to the empirical results, Han and Jiang (2017) put forward that a good political environment can effectively promote the development of foreign investment.^[9] In terms of economic risk, Lee et al. (2016) believes that the promotion of the "one belt and one road" initiative has promoted the public-private partnership among various countries.^[10] However, due to the unequal power, economic risks and accounting risks may be derived, Hali et al. (2015) argued that in addition to improving the compatibility of laws and regulations, it is also necessary to establish unified accounting standards and interfaces. To clarify the audit norms and strengthen the audit norms.^[11] Political risks of Central Asian countries are particularly prominent, and that top-level design should be strengthened at the national level to ensure equal dialogue between the investing countries and the host countries in order to create a good environment for foreign direct investment.

3. THEORETICAL ANALYSIS AND CONSTRUCTION OF ANALYTIC HIERARCHY MODEL

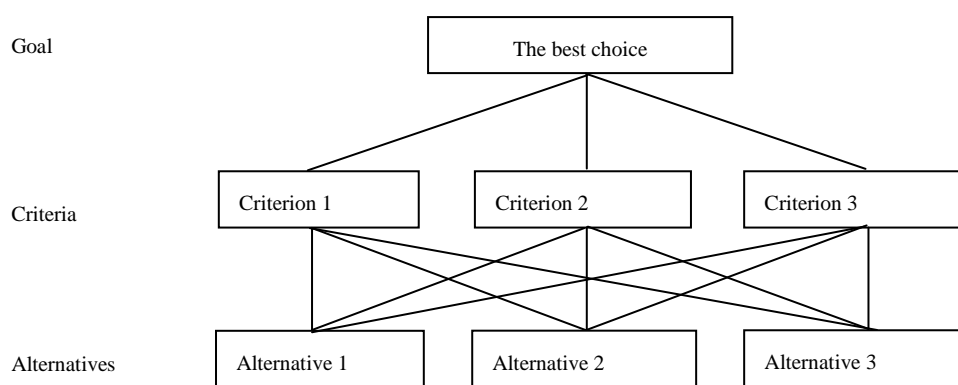
3.1 Operating Principle of Analytic Hierarchy Process

The analytic hierarchy process is a structured technique for organizing and analyzing complex decisions. Based on mathematics and psychology, it was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then. It has particular application in group decision making, and is used around the world in a wide variety of decision situations, in fields such as government, business, industry, healthcare, and education. Rather than prescribing a "correct" decision, the analytic hierarchy process helps decision makers find one that best suits their goal and their understanding of the problem. It provides a comprehensive and rational framework for structuring a decision problem.^[12]

Users of the analytic hierarchy process first decompose their decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The elements of the hierarchy can relate to any aspect of the decision problem—tangible or intangible, carefully measured or roughly estimated, well- or poorly-understood—anything at all that applies to the decision at hand. Once the hierarchy is built, the decision makers systematically evaluate its various elements by comparing them to one another two at a time, with respect to their impact on an element above them in the hierarchy. In making the comparisons, the decision makers can use concrete data about the elements, but they typically use their judgments about the elements' relative meaning and importance. It is the essence of the analytic hierarchy process that human judgments, and not just the underlying information, can be used in performing the evaluations.

The analytic hierarchy process converts these evaluations to numerical values that can be processed and compared over the entire range of the problem. A numerical weight or priority is derived for each element of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way. This capability distinguishes the analytic hierarchy process from other decision-making techniques. In the final step of the process, numerical priorities are calculated for each of the decision alternatives. These numbers represent the alternatives' relative ability to achieve the decision goal, so they allow a straightforward consideration of the various courses of action.

The analytic hierarchy model can be shown in the following diagram:



As can be seen from this diagram, the model is composed by goal layer, criterion layer and alternative layer. Each evaluation factor should be applicable to the alternatives, but the effects and importance are different.

3.2 Setting criteria to countries

The feasibility analysis refers to the reasonable application of analytic hierarchy process (AHP) to analyze the investment risks of Southeast Asian countries under the background of one belt and one road. Analyzing the operation principle of analytic hierarchy process, we can easily find that the establishment of structural model is the basis and key to the operation of this method, which can be called the core and soul of this analysis method. The structural model consists of target layer, criterion layer and selection scheme. The evaluation factors at the criteria level should be applicable to the alternatives, but the impact and importance are different. Based on this, the author explores the feasibility from the perspective of the construction of the analytic hierarchy process (AHP) model. The key to building the structural model is to determine the evaluation criteria and set the criteria layer. In order to comprehensively quantify the risk of investment in the countries along the belt and road, five factors are included in the national risk rating analysis: economic condition, debt ability, social environment, legal system, political factors.^[13]

1. Economic Condition

As a standard to measure the level of economic growth and fluctuation of a country, economic condition is the basis to determine whether the region and the country have a superior investment and financing environment. Better economic conditions always bring higher investment reward and investment security level. GDP gross, per capita GDP and Gini coefficient are used to measure the scale and degree of development of a country's economy; GDP growth rate, consumer price index and unemployment rate are used to explain the economic benefits of development; and the stability of economic growth is measured by the five-year fluctuation coefficient of GDP growth published by the World Bank. In addition, in order to highlight the extent of a country's participation in international trade, this paper also measures the openness of a country's participation in international trade from three aspects: trade, investment and capital. Among them, trade openness is the ratio of a country's total import and export to GDP. The degree of openness of investment is the ratio of total FDI to GDP. Bloomberg's annual Chin-Ito index is used to reflect a country's capital account control level.

2. Debt Ability

Debt ability refers to a country's total dynamic debt level of the public and private sectors and the external debt capacity that economic conditions can bear. For the host countries participating in international trade, once the debt crisis breaks out, the direct and financial investment and other types of investment security of the investing countries will be affected. Therefore, it is necessary to determine the appropriate debt level according to the financial affordability of the country. Liability includes eight sub-indicators. Public debt refers to the total debt of governments at all levels, which can be used to measure the debt level of the domestic public and private sectors by its share of GDP and non-performing assets of the banking industry; the proportion of foreign debt to

GDP and short-term foreign debt to total foreign debt can be used to measure the scale of a country's foreign debt and the risk of a short-term debt crisis. In terms of debt potential, the proportion of fiscal balance to GDP measures a country's financial strength; the proportion of foreign debt to foreign exchange reserves measures the adequacy of a country's foreign exchange reserves; and the current account balance refers to the sum of a country's net exports of goods and services, net income and net current transfer.^[14] Its share of GDP is mainly used to measure the terms of trade transactions.

3. Social Environment

It mainly covers the social risk factors affecting Chinese enterprises' overseas investment. On the premise that a good social order can ensure the orderly operation of investment enterprises, the factors affecting social stability mainly come from internal conflicts, the implementation of environmental policies, the regulation of business conditions, the regulation of labor market and the educational level of social implementation. Social stability includes eight sub-indicators, among which the level of education work measures the basic quality of a country's labor force.^[15] Internal conflicts are mainly manifested in extreme conflicts of society, race and religion. Crime rate measures the degree of internal conflicts and social security of a country. Environmental policies, capital and personnel mobility restrictions, labor market regulation and commercial regulation reflect the business environment in which a country allows domestic and foreign investment enterprises to operate. According to the evaluation criteria established by international financial organizations, the higher the education level of labor force, the lower the degree of internal conflict; the better the social security and business environment, the smaller the investment risk of foreign enterprises.

4. Legal System

It examines the stability and efficiency of a government, as well as the legal environment and external conflicts. Lower legal risk is one of the prerequisites for foreign enterprises to invest safely. It is mainly reflected in six aspects as follows.^[16] The control of corruption reflects the government's awareness and control of the degree of public power for private profit. The effectiveness of the government reflects the public's views on the quality of public services, the quality of civil servants and their independence from political pressure, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The index of political stability measures the impact of violence and terrorism on a country's political stability. The quality of regulation reflects the government's ability to formulate and implement sound policies and regulations that allow and promote private sector development. Legal rules reflect the degree of trust and compliance of agents with social rules, especially the quality of contract enforcement, property rights, police and courts, as well as the possibility of crime and violence. Democracy and accountability reflect the extent to which citizens of a country can participate in the choice of their government, as well as the views of freedom of expression, freedom of association and free media. The higher the stability and governance quality of a government, the better the legal environment and the smaller the external conflicts, the lower the risk of foreign enterprises investing in it.

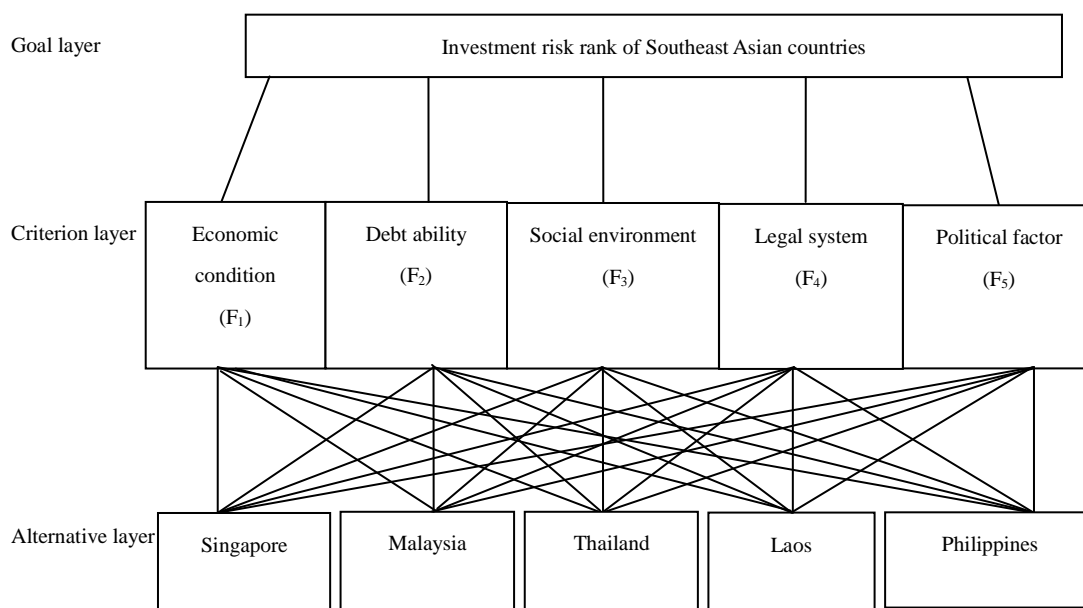
5. Political Factors

It is mainly used to measure the important factors affecting the investment risk of Chinese enterprises in the host country, such as investment policy, investment smoothness and investment and trade dependence.^[17] It is generally believed that a better bilateral relationship is an important buffer to reduce the risk of Chinese enterprises' overseas investment. The bilateral relationship contains five sub-indicators. Among them, trade (investment) dependence measures the proportion of bilateral trade (investment) between China and a country in its trade (investment). The higher the proportion, the stronger the dependence on trade (investment). This article uses the visa exemption situation of foreign countries published by the Ministry of Commerce to make an analysis. To some extent, the exemption shows that bilateral relations are harmonious and political mutual trust

is high. The degree of investment hindrance and bilateral political links refer to the results of Delphi method used in the report of National Risk Rating of Overseas Investment in China, International Investment Research Department, Institute of World Economy and Politics, Chinese Academy of Social Sciences. This index measures the degree of investment hindrance and bilateral political relations. Lower degree of investment hindrance and better bilateral political relations help to reduce the risk of Chinese enterprises investing in the host country.

6. Constructing Analytic Hierarchy Process Model

In this model, the goal layer is investment risk rank of Southeast Asian countries. Criterion layer is: economic condition, debt ability, social environment, legal system, and political factors. The alternatives are seven typical countries in Southeast Asia. By identifying and quantifying risks, it can provide reference for overseas investment of Chinese enterprises and improve the success rate of investment.



This paper refers to the method of National Risk Rating for Overseas Investment of China, Institute of World Economy and Politics, Chinese Academy of Social Sciences. The data indicators selected in the whole evaluation system come from the open data information of authoritative institutions at home and abroad, such as the World Bank WORLD GOVERNANCE INDEX database, the Economist, the World Bank, the global economy, the official websites of the United Nations and China Customs. Others are annual reports issued by the above-mentioned institutions, such as the Statistical Bulletin on China's Foreign Direct Investment of the National Statistical Bureau, the Human Development Report of the United Nations Development Programme and the Business Environment Report of the World Bank.^[18]

The hierarchy has been constructed. It can be analyzed through a series of pair-wise comparisons that derive numerical scales of estimation for the nodes. The criteria are pair-wise compared against the goal for importance. The alternatives are pair-wise compared against each of the criteria for preference. The comparisons are processed mathematically, and priorities are derived for each node. An important task is to determine the weight to be given each criterion in investment risk rank of Southeast Asian countries. Another important task is to determine the weight to be given to each alternative with regard to each of the criteria. In the analytic hierarchy process, a meaningful and objective numerical value should be put on each of the five criteria.

3.3 Constructing Judgment Matrix and Assigning Value

To make comparisons, we need a scale of numbers that indicates how many times more important or dominant one element is over another element with respect to the criterion or property with respect to which

they are compared.^[19] Table 1 exhibits the nine scales. The comparison judgment matrix is formed. All the criteria are the same importance to each other with respect to investment risk rank of Southeast Asian countries. Criterion layer judgment matrices of alternatives are shown respectively in table 4, table 5, table 6, table 7 and table 8, which includes economic condition (F_1), debt ability (F_2), social environment (F_3), legal system (F_4), and political factors (F_5).

Table 1. Fundamental scale of absolute numbers

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another
8	Very, very strong	
9	Extreme importance	Evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If i has number when compared with j, j has reciprocal value compared with i.	A reasonable assumption

Hierarchical single ranking is the criterion of evaluating the relative weight of each factor according to the relative weight of the criterion layer. According to matrix theory, the characteristic vector of the judgment matrix is obtained through mathematical calculation. The feature vector represents the influence degree of some elements (or all) in this layer on the elements in upper layer, that is, the weight value. In this way, the results of the single ranking of this layer form. Therefore, the matrix feature vector determination is very critical in hierarchical single ranking. Calculation method of the characteristic vector includes square root, sum product, and power method, etc. For different calculation methods, the results are very similar, can meet the accuracy requirements. Computer can be used to automatically calculate the maximum eigen-value λ_{\max} and the corresponding feature vector. By Matlab (Laboratory Matrix) or Scilab (Laboratory Scientific), entered the data, the computer will quickly calculate the results.

In the layers ranking, the consistency should be checked in judgment matrix. That is, whether the judgment is consistent or not. From the human understanding law, a correct importance ranking of judgment matrix must be logical. Such as, if A is important than B, B is important than C, logically, A should be more important than C. By the pair-wise comparison, if C is more important than A, the judgment matrix violations against the consistency criterion. It is not reasonable. Therefore, in order to ensure the conclusion of the analytic hierarchy process is basically reasonable, it is necessary to test the consistency of the judgment matrix. Only through the test, in order to explain the judgment matrix is reasonable, can we continue to analyze the results. The consistency check can be carried out according to the following three steps. Only passing the test, the judgment matrix is logically reasonable. After that, the results can be continuously analyzed. The consistency check can be carried out according to the following three steps:

The first step is to calculate the maximum eigen-value of the judgment matrix, and then get the consistency index CI (consistency index)

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

If $CI=0$, judgment matrix has complete consistency, and the test is over. If $CI \neq 0$, the random consistency ratio ($CR=CI/RI$) should be calculated.

The second step is to determine the average consistency random index (RI). According to the judgment matrix order, the random index (RI) can be obtained from table 2. This table was firstly presented by professor Saaty, who is the founder of analytic hierarchy process.

Table 2 Random Consistency Index (RI)

Matrix order	1	2	3	4	5	6	7	8	9
RI	0	0	0.5149	0.8931	1.1185	1.2494	1.3450	1.4200	1.4616

The third step is to calculate the consistency ratio (CR)

$$CR = \frac{CI}{RI}$$

If $CR < 0.1$, it is acceptable that the consistency of judgment matrix and single ranking results. Otherwise, if $CR > 0.1$, judgment matrix does not meet the requirements of consistency, need to adjust the element values. Single ranking and consistency test were carried on the criteria layer and 5 alternatives which include Singapore, Malaysia, Thailand, Laos, and Philippines. The results are shown in table 3, table 4, table 5, table 6, and table 7. The evaluation results show that they all pass the consistency test.

Table 3 Judgment matrix and hierarchical single ranking of economic condition (F_1) in criterion layer

Weight ratio to F_1	Singapore	Malaysia	Thailand	Laos	Philippines	Ranking result
Singapore	1	6	8	4	7	0.5903
Malaysia	1/6	1	2	1	1	0.1147
Thailand	1/8	1/2	1	1/2	1	0.0706
Laos	1/4	1	2	1	2	0.1412
Philippines	1/7	1	1	1/2	1	0.0833
$\lambda_{\max}=5.0844$		CI=0.0211		CR= 0.0189<0.1		

Table 4 Judgment matrix and hierarchical single ranking of debt ability (F_2) in criterion layer

Weight ratio to F_2	Singapore	Malaysia	Thailand	Laos	Philippines	Ranking result
Singapore	1	1/3	1/5	1	1/8	0.0550
Malaysia	3	1	1/2	3	1/3	0.1560
Thailand	5	2	1	5	1/2	0.2733
Laos	1	1/3	1/5	1	1/7	0.0567
Philippines	8	3	2	7	1	0.4590
$\lambda_{\max}=5.0115$		CI=0.0028		CR= 0.0026<0.1		

Table 5 Judgment matrix and hierarchical single ranking of social environment (F₃) in criterion layer

Weight ratio to F ₃	Singapore	Malaysia	Thailand	Laos	Philippines	Ranking result
Singapore	1	2	5	9	7	0.4457
Malaysia	1/2	1	7	9	9	0.3837
Thailand	1/5	1/7	1	2	1	0.0715
Laos	1/9	1/9	1/2	1	1	0.0445
Philippines	1/7	1/9	1	1	1	0.0546
$\lambda_{\max}=5.2801$		CI=0.0700		CR=0.0626<0.1		

Table 6 Judgment matrix and hierarchical single ranking of legal system (F₄) in criterion layer

Weight ratio to F ₄	Singapore	Malaysia	Thailand	Laos	Philippines	Ranking result
Singapore	1	2	5	9	6	0.5102
Malaysia	1/2	1	2	4	3	0.2387
Thailand	1/5	1/2	1	2	1	0.1060
Laos	1/9	1/4	1/2	1	1	0.0624
Philippines	1/6	1/3	1	1	1	0.0827
$\lambda_{\max}=5.0475$		CI=0.0119		CR=0.0106<0.1		

Table 7 Judgment matrix and hierarchical single ranking of political factors (F₅) in criterion layer

Weight ratio to F ₅	Singapore	Malaysia	Thailand	Laos	Philippines	Ranking result
Singapore	1	1/2	1	2	1/4	0.2224
Malaysia	2	1	1	3	1/2	0.1337
Thailand	1	1	1	3	1/2	0.1548
Laos	1/2	1/3	1/3	1	1/6	0.4222
Philippines	4	2	2	6	1	0.0669
$\lambda_{\max}=5.0504$		CI=0.0126		CR=0.0113<0.1		

3.4 Hierarchical total ranking and conclusion

Total ranking is the relative weight of each element in every judgment matrix, which aims at the goal layer (top layer). The weight is calculated by the top-down approach, layer by layer synthesis. Calculating total ranking of certain layer, it must be used that total ranking of the higher layer and single ranking of this layer. Yet the single ranking of second layer to first layer is total ranking of the second layer. In this way, the total ranking is obtained layer by layer from the highest to the lowest one. In addition, consistency test should be carried on the hierarchical total ranking, the process of which is also obtained layer by layer from the higher to lower one.

$$CI = \left(\begin{matrix} 0.0211 & 0.0028 & 0.07 & 0.0119 & 0.0126 \end{matrix} \right) \begin{pmatrix} 0.2 \\ 0.2 \\ 0.2 \\ 0.2 \\ 0.2 \end{pmatrix} = 0.0237$$

$$CR = \frac{0.0237}{1.1185} = 0.0212 < 0.1$$

Table 8 gives the results of the hierarchical total ranking. It can be seen that the comprehensive evaluation of Singapore is the best, the value is 0.3647, Malaysia is slightly lower, Laos and Philippines are ranking in the middle. Thailand is the lowest one.

Table 8 Hierarchical total ranking

Criteria	F ₁	F ₂	F ₃	F ₄	F ₅	Comprehensive evaluation of total ranking
Weight	0.2	0.2	0.2	0.2	0.2	
Singapore	0.5903	0.0550	0.4457	0.5102	0.2224	0.3647
Malaysia	0.1147	0.1560	0.3837	0.2387	0.1337	0.2054
Thailand	0.0706	0.2733	0.0715	0.1060	0.1548	0.1352
Laos	0.1412	0.0567	0.0445	0.0624	0.4222	0.1454
Philippines	0.0833	0.4590	0.0546	0.0827	0.0669	0.1493

From the final ranking score of investment risk, two following conclusions can be drawn. First, Southeast Asian countries are generally suitable for overseas investment. This is due to the complementary effect of industrial structure between the host country and China, and its own governance level is in a relatively superior position in the country. China have signed the Framework Agreement on Comprehensive Economic Cooperation with ASEAN, which jointly initiated the construction of China-ASEAN Free Trade Area.^[20] Therefore, investment in these countries will face relatively small risks. Secondly, different countries have slightly different risk levels. Among them, Singapore has the lowest risk level, regardless of the economic condition, social environment, legal system, and political factors. Malaysia also has a lower risk level and signed "Avoiding Double Taxation Agreement", "Trade Agreement", "Investment Protection Agreement" and "Sea Agreement" with China. There are more than 10 economic and trade cooperation agreements such as the Transport Agreement and the Civil Aviation Transport Agreement. But on 2 November 2018, Malaysia's central bank said that Malaysia's national debt reached 1,065 billion ringgits (equivalent to RMB1746.6 billion), which had soared to 80% of GDP. Due to the huge financial burden, Malaysia has a very high degree of enthusiasm in attracting Chinese investment. Laos and Philippines have moderate risk levels, and the infrastructure construction level in these two countries is not high.^[21] In recent years, they have attracted a lot of Chinese investment in infrastructure area. Chinese investment in the Philippines is noteworthy. In the first 11 months of 2018, it reached 48.7 billion yuan which is much higher than 576 million yuan in 2017, an increase of more than 80 times. Chinese investment in Laos accounts for half of Laos's GDP. Because of Chinese strong participation in local investment and construction, Southeast Asia has become one of the fastest growing regions in the world. Thailand has a slightly higher investment risk. In recent years, the growth rate of Chinese investment in Thailand was lower than that in other countries, mainly due to its single industrial structure, low added value of products, unstable political situation and serious trade barriers.

4. COUNTERMEASURE TO INVESTMENT RISK

In 2018, China successfully held the "one belt and one road" International Cooperation Summit Forum. Used to aim at promoting exchanges among countries in the world, the initiative of "one belt and one road" transformed to a consensus reached by all countries. However, the "one belt and one road" initiative involves a large number of countries with obvious differences in political, economic, social and cultural environment, resulting in heterogeneity in debt, governance and risks. Therefore, Chinese enterprises also have different investment preferences, and need different early risk warning mechanisms according to different countries.^[22] This paper tries to optimize the top-level design of the "one belt and one road" initiative, and provides policy

basis to effectively reduce Chinese investment risks in Southeast Asian countries.

We shall promote internationalization of RMB in order to facilitate financially overseas trade and investment. With increasing recognition of the "one belt and one road" initiative, China formally accessed to the SDR basket of currencies, RMB begins to multi-lateralize and internationalize. RMB internationalization gradually expands to Southeast Asian countries. The wide currency of RMB shows not only improvement recognition of China's comprehensive national power, but also conducive to both sides cooperation so as to reduce settlement and investment risks caused by trade uncertainty. Currently, RMB is mainly used for loan, liquidation, settlement and other services of infrastructure construction projects. The internationalization of RMB is mainly manifested in four aspects: China has begun to try to establish an RMB clearing system; RMB has gradually realized its settlement function in international trade and investment; it supports the establishment of multilateral financial institutions such as the Asian Investment Bank and Silk Road Fund; functions have also become increasingly prominent. Gold, crude oil and iron ore futures denominated and settled in RMB have come out Southeast Asian countries. Relevant institutions around the world have also begun to explore the feasibility of RMB for petroleum and iron ore, laying the foundation for RMB settlement of commodity transactions. Therefore, promoting the internationalization of RMB can effectively reduce the settlement risk of trade and investment, and will also effectively promote the common development of China's trade and financial markets along the "one belt and one road".

To avoid investment risk, we should strengthen policy communication, consolidate and expand the role of multilateral trade agreements.^[23] Southeast Asian countries have strong economic strength and solid political foundation. From the perspective of comparative advantage, China and Southeast Asian countries are mostly similar in geographical location. The industrial structure also shows relatively broad basis for industrial complementary cooperation, and strong demand for economic and trade cooperation with China. Based on international experience, China can actively sign bilateral or multilateral investment agreements with Southeast Asian countries. A stable political foundation and strong economic capacity will provide the basis for Southeast Asian countries to abide by and implement the signed agreements, which can significantly and effectively reduce the political and economic risks that Chinese enterprises may face in overseas investment. At present, China's trade with Southeast Asian countries has shown a more obvious linkage effect. Our government should further deepen its economic and trade cooperation with Southeast Asian countries on the basis of the Framework Agreement on Comprehensive Economic Cooperation between China and ASEAN. China should use the advantages of Chinese and overseas Chinese to spread Chinese culture by organizing cultural themed activities and setting up cultural exchange non-governmental organizations, correctly promote China's "Belt and Road" initiative, and establish a peaceful and friendly international image.

Learning from advanced international experience, we should improve our overseas investment and financing insurance system.^[24] An important function of financial products is to transfer and disperse risks. At present, China Export Credit Insurance Company has designed a guarantee system for overseas investment risk and carried out relevant business. However, nowadays the unilateral model is not distinguished for specific national condition. Absent investment protection agreements, it is difficult for China's export credit insurance companies to obtain subrogation rights. It increases the operating costs and risks of insurance companies. China's insurance industry needs to be improved in terms of the scale and types of overseas investment products. Improving the overseas investment insurance system will effectively improve the risk control system of Chinese enterprises' overseas investment. One hand, investment insurance systems under a bilateral model have been further established with Southeast Asian countries that have signed trade protection agreements with China. On the other hand, for countries that have not signed a trade protection agreement, they should focus on early warning of risks in investment cooperation and work to urge both parties to sign a trade protection agreement.^[25]

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Understanding Continuance Intention to Use Mobile Fitness Services: The Roles of Technological Characteristics and Network Effects

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Abstract: Mobile fitness platforms are effective in promoting healthy behaviors but these platforms generally suffer from low retention rates. It is necessary to study how to retain users of mobile fitness platforms. Based on customer value theory and Socio-technical approach, this study proposed a theoretical model to study the factors that affect users' continuance intention to use mobile fitness platforms from a holistic perspective. A total of 320 valid questionnaires were collected to verify the model. The results indicate that utilitarian value and hedonic value are positively related to continuance intention. Social ties are negatively related to continuance intention. Meanwhile, it is found that technological characteristics have significant positive influences on utilitarian value, hedonic value and social ties. Network effects have significant positive influences on hedonic value and social ties. These findings extend our understanding of users' continued usage of mobile fitness platforms and provide practical implications for mobile fitness service providers.

Keywords: mobile fitness, continuance intention, customer value, technological characteristics, network effects

1. INTRODUCTION

With the development of mobile internet, mobile fitness platforms are playing important roles in encouraging regular exercise. In recent years, many mobile fitness platforms have emerged, such as Keep, Joyrun and so on. However, lots of mobile fitness platforms suffer from low retention rates ^[1]. For example, 26% of fitness apps are used only once by each user and that 74% of these apps are abandoned after their tenth use ^[1]. Therefore, it is necessary to study how to promote the continued use of mobile fitness users.

Although traditional information systems were mostly oriented by utilitarianism, it appears that today's systems not only provide instrumental services to users, but also create affective and social experiences for users ^[2]. More specifically, in the field of mobile fitness, quantified-self, gamification and social networking are the three popular system design classes ^[2]. Utilitarian, hedonic and social components should all be noted when evaluating the value of mobile fitness platforms. Therefore, this study integrated utilitarian value, hedonic value and social ties to explain the continued use of the mobile fitness platforms.

Since the customer value focus on constructs in terms of subjective feelings from user perspective ^[3], this study aims to further provide insights about which specific system characteristics lead to users' behavioral decisions. Previous studies in the context of online health communities emphasized the impact of technical and social factors ^[4]. Similarly, mobile fitness platforms not only provide users with a series of technological functions, but also exist network externalities due to its social network service ^{[5], [6]}. Hence, it is necessary to consider both technological and network effect factors. The socio - technical approach is a method to analyze technology use from technical and social factors ^[4]. Thus, this study adopted the socio - technical approach to identify the technological characteristics and network effects.

Specifically, this study explored the impacts of utilitarian value, hedonic value and social ties on users' continuance intention of mobile fitness platforms and the impacts of technological characteristics and network effects on utilitarian value, hedonic value and social ties.

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2. THEORETICAL BACKGROUND

2.1 Mobile fitness use

Present studies on the use behavior of mobile fitness platforms have been mostly based on TAM, UTAUT and Motivation Theory^{[1]-[3]}. Many factors that directly impact users' behavior have been found such as perceived ease of use, perceived usefulness and so on^{[1]-[3]}. These factors can fully predict the continued use of mobile fitness platforms, but they cannot give specific recommendations to mobile fitness service providers. Although several studies have addressed the technological characteristics or network effects of mobile fitness platforms, these variables often appear as a single ambiguous variable. That is to say, there is still a lack of concern that the impact of system characteristics of the mobile fitness platforms on user's continuance.

2.2 Customer value theory

Customer value reflects the user's overall assessment of the utility of the product or service^[7]. Users' behavioral intentions for products and services may be driven by multiple dimensional values^[7]. Utilitarian, hedonic and social components should also be highlighted in the realm of mobile fitness^[8]. Utilitarian value reflects the task-oriented, cognitive, and non-emotional outcome of using the mobile fitness platform^[9]. Hedonic value refers to the fun or pleasure derived from using the mobile fitness platform^[9]. Social ties refers to the strength of the relationships between users of mobile fitness platform^[10].

2.3 Technological characteristics and network effects of mobile fitness platforms

The socio - technical approach is a method to analyze technology use from technological and social factors^[4]. The technological factors refer to the attributes related to technologies and the social factors focus on the relationship between users. Some scholars described the mobile fitness platform as a social - technical system, where users interact not just with technology but also other users^[11]. In this research, we considered the effects of technological dimension and network effect dimension on users' behavior, which were both considered to be able to cover the major characteristics of mobile fitness platforms^{[3], [6]}.

Studies have identified discrete technological characteristics of mobile fitness platforms such as personalization, recordability, networkability and information quality^{[12], [13]}. Personalization, sociability and informativeness are important characteristics of mobile fitness platforms. Personalization refers to the extent to which the mobile fitness platform can understand and meet users' needs and preferences^[12]. Sociability refers to the extent to which the mobile fitness platform facilitates social interaction by providing social context support^[14]. Informativeness reflects the quality of information provided by the mobile fitness platform^[13].

Network effects occur when the benefits of using services depend on the number of other users^[15]. It has been found that network effects significantly affect users' attitude and behavior in the context of mobile fitness^[6]. Network effects in mobile fitness platform include number of users and number of peers^[15]. The number of users refers to users' perception of the overall user size within the mobile fitness platform and the number of peers refers to users' perception of the size of the relevant network within the platform^{[6], [15]}.

3. RESEARCH MODEL AND HYPOTHESE

The present study explored the drivers of users' continuance intention to use mobile fitness platforms by integrating customer value theory and socio-technical approach. The research model established in this paper is shown in Figure 1. The hypotheses are demonstrated as follows.

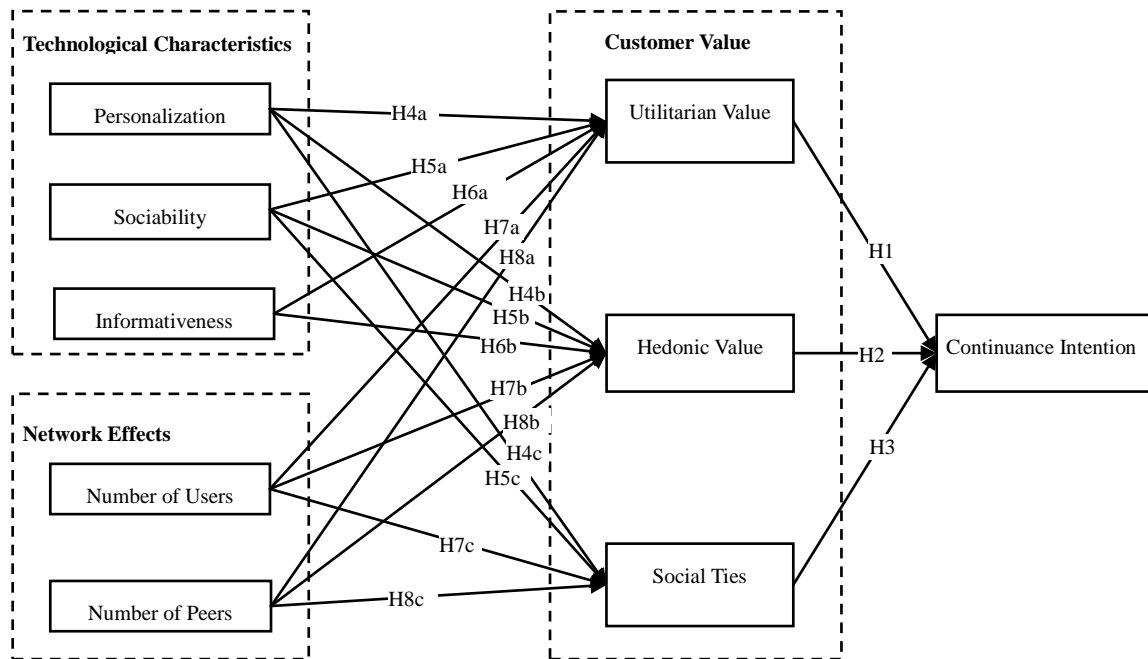


Figure 1. Research model

3.1 Customer value and continuance intention

The research model of traditional information system is mainly based on the viewpoint of utilitarianism. In the following research on the user behavior of continuous use, the utilitarian variable is also considered to play an important role^[3]. In addition to utilitarian functions such as recording data and self-monitoring, the gamification also makes mobile fitness platforms become more attractive. The important predictive role of hedonic value in use behavior has also been studied before^[3]. In addition, strong social relationships provide users with opportunities to recommend services to others. In this case, these relationships largely determine the users' willingness to continue using the mobile fitness platform^[7]. Thus, the following hypotheses are proposed:

H1: Utilitarian value positively affects continuance intention.

H2: Hedonic value positively affects continuance intention.

H3: Social ties positively affects continuance intention.

3.2 Technological characteristics and customer value

Personalization can provide users with customized content in line with their preferences, which reduces users' search costs and enhances the perceived utilitarian value^[12]. Personalization can also promote user participation, making them actively invest time and energy. This focused engagement enhances their sense of control and naturally enhances their perception of hedonic value^[17]. In addition, personalization can increase the matching degree between media content and users' preferences. Therefore, a high level of personalization will enhance the user's perception of being valued by the service provider and affect the social ties in the online environment^[17]. Thus, the following hypotheses are proposed:

H4a: Personalization positively affects utilitarian value.

H4b: Personalization positively affects hedonic value.

H4c: Personalization positively affects social ties.

The sociability enhances the possibility that users can jointly dig out the required information and related services, which enables users to better realize their utilitarian expectation^[13]. Second, human are naturally happy in the process of social interaction. As the platform more encourages social interaction between users,

their interactions are more likely to create hedonic value^[18]. In addition, previous studies have shown that high sociability in the virtual world can prompt users to construct online identities, which further promotes the development of social relationships among participants^[14]. Thus, the following hypotheses are proposed:

H5a: Sociability positively affects utilitarian value.

H5b: Sociability positively affects hedonic value.

H5c: Sociability positively affects social ties.

Informativeness is considered as an important predictor of perceived value^[13]. On the one hand, accurate, relevant and timely information can enhance utilitarian value by reducing the useless search and letting users focus on the main activities^[13]. On the other hand, informativeness improve users' pleasant experience by enhancing the applicability of the obtained information to users and making them deeply attracted and addicted^[11]. Thus, the following hypotheses are proposed:

H6a: Informativeness positively affects utilitarian value.

H6b: Informativeness positively affects hedonic value.

3.3 Network effects and customer value

Previous studies have suggested that mobile fitness platforms integrated with social networks are more likely to increase users' continued participation in exercise^[20]. As the user size increases, people are more likely to participate in fitness and thus enhance their perception of utilitarian value^[15]. Meanwhile, more users means that they can find more like-minded partners and enables them to obtain more entertainment resources^[15]. Moreover, previous studies have suggested that online communities with more members can inspire positive interaction and social ties^[21]. Thus, the following hypotheses are proposed:

H7a: Number of users positively affects utilitarian value.

H7b: Number of users positively affects hedonic value.

H7c: Number of users positively affects social ties.

Compared with strangers, the communication between companions will reduce the barrier of information transmission. With more peers, users are able to find more required services and realize utilitarian value of mobile fitness platforms^[15]. Secondly, tacit understanding between peers will make people feel happy. More peers means more hedonic value can be aroused^[15]. In addition, people tend to share with more familiar people^[20]. More peers participate in the mobile fitness platform can make users be more active in maintaining social relationships and form stronger social ties^[6]. Thus, the following hypotheses are proposed:

H8a: Number of peers positively affects utilitarian value.

H8b: Number of peers positively affects hedonic value.

H8c: Number of peers positively affects social ties.

4. RESEARCH METHODOLOGIES

4.1 Questionnaire design and construct measurement

The questionnaire includes nine latent variables. All measures of the variables were based on related studies. There were no less than 3 items for each variable, and all items were measured on a five-point Likert scale ranging from “1 = strongly disagree” to “5 = strongly agree”. Three Chinese researchers were asked to translate the English scales into Chinese. Then another researcher compared the similarity of the two scales. In order to further ensure the quality of the questionnaire, the pre-questionnaire was sent to 20 actual mobile fitness users. After repeated modification and testing, the formal questionnaire was finally generated.

4.2 Data collection and descriptive analysis

The survey was conducted from August 2019 to September 2019 through online and offline channels synchronously. The online survey were conducted through the company SoJump, which is a famous online survey platform in China. And the printing questionnaires were distributed in different universities in Wuhan and Nanchang. Participants were asked if they had used a mobile fitness app before filling out the questionnaire. Only those who answered yes were asked to complete the questionnaire. A total of 373 responses were obtained. After eliminating the invalid questionnaires, we received 320 valid questionnaires finally.

We then used SPSS Statistics 22 to conduct descriptive Statistics. The demographic profiles of the respondents indicated that the ratio of female and male was 41.3% and 58.8%. In terms of age, young people over the age of 18 account for a large proportion of the subject. When it comes to education, the majority of respondents have a bachelor's degree. Through analyzing the usage frequency, it is found that the usage frequency of respondents are distributed at various levels. On the whole, the distribution of gender, age, education and frequency of use of the samples are consistent with the actual mobile fitness users.

5. DATA ANALYSIS AND RESULTS

We used Smart PLS 3.2.7 to test the measurement model and the structural model.

5.1 Measurement model test

To test the measurement model, we analysed the reliability, convergent validity and discriminant validity.

Cronbach's α and the composite reliability index (CR) were used to assess the reliability of constructs. As shown in Table 1, the Cronbach's α values of most variables are greater than 0.8 except that the utilitarian value is 0.772. The CRs are equal to, or greater than 0.868. The Cronbach's α values and CRs are both higher than the suggested cut-off value of 0.7, indicating a relatively consistent of the content of the model.

Average extraction variance (AVE) was adopted to test the convergent validity of constructs and the AVEs of all latent variables are required to be greater than 0.5. It can be seen from Table 1 that AVEs range from 0.666 to 0.882, which indicates that the constructed latent variables can explain most of the variance of measurement items and had good convergent validity.

As shown in Table 2, the square root of AVE value of each latent variable is larger than the correlation coefficient of this variable with any other latent variable, indicating that this variable can better explain the variance of its measure term than other variables, thus having better discriminant validity.

The variance inflation factor (VIF) values range from 1.329 to 2.093 and all of them are less than the cutoff value of 10. Therefore, multicollinearity was not a point for concern.

Table 1. Convergent validity and internal reliability

Constructs	No. of Items	Items loading	Cronbach's α	CR	AVE
Personalization (PER)	4	0.814-0.869	0.863	0.907	0.709
Sociability (SOC)	4	0.826-0.893	0.887	0.922	0.747
Informativeness (INF)	4	0.756-0.847	0.832	0.888	0.666
Number of Users (NU)	3	0.838-0.856	0.809	0.884	0.718
Number of Peers (NP)	3	0.909-0.921	0.902	0.938	0.835
Utilitarian Value (UV)	3	0.808-0.860	0.772	0.868	0.687
Hedonic Value (HV)	4	0.837-0.867	0.879	0.917	0.734
Social Ties (ST)	4	0.790-0.882	0.856	0.903	0.700
Continuance Intention (CI)	3	0.932-0.950	0.933	0.957	0.882

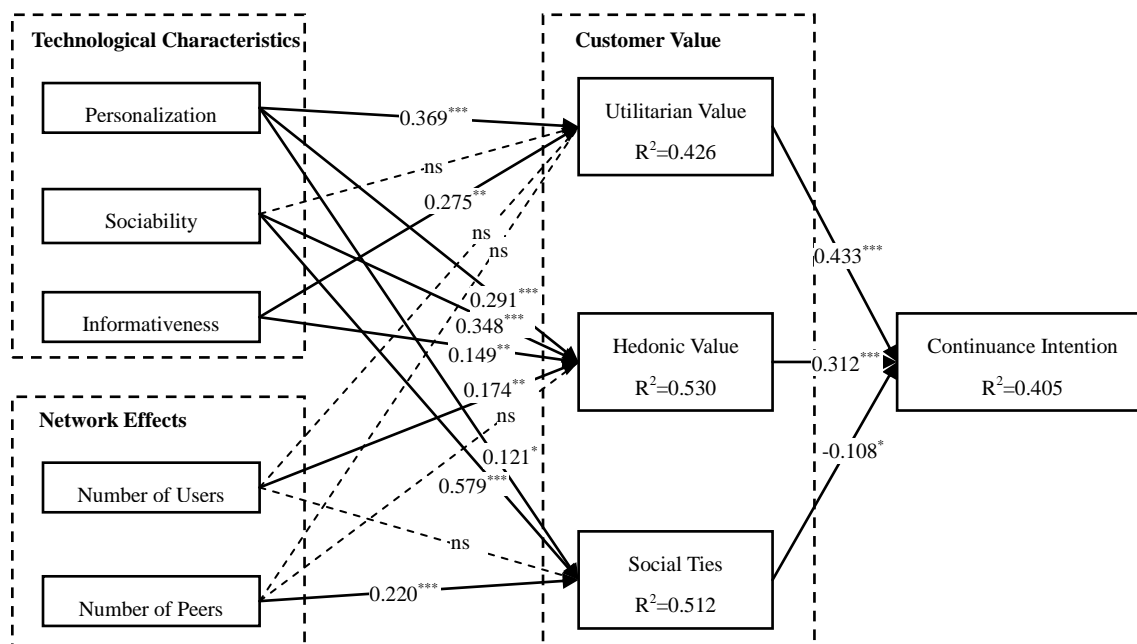
Table 2. Discriminant validity

	PER	SOC	INF	NU	NP	UV	HV	ST	CI
PER	0.842								
SOC	0.468	0.864							
INF	0.522	0.285	0.816						
NU	0.275	0.224	0.277	0.847					
NP	0.267	0.287	0.255	0.640	0.914				
UV	0.585	0.375	0.522	0.266	0.300	0.829			
HV	0.592	0.579	0.460	0.404	0.375	0.646	0.857		
ST	0.430	0.682	0.256	0.228	0.370	0.337	0.522	0.837	
CI	0.400	0.238	0.381	0.371	0.291	0.599	0.536	0.201	0.939

5.2 Structural model test

As we can see from Figure 2, the variance of continuance intention is explained by 40.5%. Utilitarian value, hedonic value and social ties are explained by 42.6%, 53.0% and 51.2%, respectively.

In addition, utilitarian value ($\beta = 0.433$, $t = 7.006$) and hedonic value ($\beta = 0.312$, $t = 4.094$) are positively associated with continuance intention. Social ties is negatively associated with continuance intention ($\beta = -0.108$, $t = 2.135$). In terms of technological characteristics, personalization is positively associated with utilitarian value, hedonic value and social ties ($\beta = 0.369$, $t = 7.027$; $\beta = 0.291$, $t = 4.669$; $\beta = 0.126$, $t = 2.329$, respectively); Sociability positively predicts hedonic value and social ties ($\beta = 0.348$, $t = 8.204$; $\beta = 0.580$, $t = 14.842$); Informativeness positively predicts utilitarian value and hedonic value ($\beta = 0.276$, $t = 5.452$; $\beta = 0.148$, $t = 2.760$). In terms of network effects, Number of users positively predicts hedonic value ($\beta = 0.174$, $t = 2.830$), while number of peers positively predicts social ties ($\beta = 0.220$, $t = 3.410$). Therefore, H1, H2, H4a, H4b, H4c, H5b, H5c, H6a, H6b, H7b, H8c are supported, while H3, H5a, H7a, H7c, H8a, H8b are not supported.



Note: *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$; ns, not significant.

Figure 2. Model results

6. DISCUSSION

The results show that utilitarian value and hedonic value significantly affect continuance intention to use mobile fitness platform and utilitarian value is found to have more predictive power than hedonic value in terms of standardized beta coefficients. This finding indicates a leading utilitarian approach of users to decide whether to continue using mobile fitness platforms, which is similar to the results of Huang and Ren^[3]. Unexpectedly, the study find that social ties negatively affects the continuance intention. The social ties between users in the mobile fitness platform can be generated by social sharing or social competition^[11]. The observed negative association in this study may be due to the fact that the mobile fitness platforms we investigated mainly adopted social competition^[2]. Social competition may generate negative interactions among users^[2]. When a person is struggling in the competition, others' achievements of others may generate negative experience on their own performance, thus reducing the continued use^[2].

Results show that technological characteristics positively predict utilitarian value, hedonic value and social ties. Network effects positively predict hedonic value and social ties. Specifically, most of our hypotheses about the influence of technological characteristics on perceived value are supported. Personalization positively predict utilitarian value, hedonic value and social ties. Informativeness positively predicts utilitarian value and hedonic value. Sociability positively predicts hedonic value and social ties. The results support that personalized services, social networking functions and reliable information services are powerful ways to enhance users' value perceptions^[13]. However, the relationship between sociability and utilitarian value is found to be insignificant. One possible explanation is that most Chinese users hope to achieve the utilitarian goal through the mobile fitness platform^[3]. Therefore, the social networking functions of the mobile fitness platform doesn't seem to make much sense for them. In terms of network effects, number of users significantly affects hedonic value. This means that more users lead to more entertainment resources, which in turn increases the users' perception of hedonic value. Meanwhile, number of peers significantly affects social ties. The more peers participating in the mobile fitness platform, the stronger the users' perception of the social attributes, which urges them to form stronger social ties^[6]. Contrary to our expectations, network effects are found to have no significant influence on utilitarian value. That's probably because that the interaction between users in mobile fitness platforms only at a shallow level. This shallow level of interaction makes it difficult for users to extract useful information and obtain the utilitarian value.

7. CONCLUSIONS

The present study explored the factors that impacts on users' continuance intention to use mobile fitness platforms based on customer value theory and socio - technical approach. Given that previous studies mainly focused solely on the perception-based factors that directly influence sustained usage, this study provides an integrated model to understand the continuous use of mobile fitness platforms. Secondly, this study carried out a specific study on the technological characteristics and network effects of the mobile fitness platforms. In addition, this study systematically investigated how technological characteristics and network effects impact the continued use of mobile fitness users, thus filling in a gap in this field.

From a practical standpoint, the findings give useful advice for mobile fitness service providers. First, platform developers should upgrade the personalized technology constantly and provide services accurately. For example, they could provide personalized services such as exercise plans based on users' preferences and needs, which could further support users' functional and hedonic needs. Moreover, information quality should be strictly controlled. Third, they can affect perceived network size by adopting some strategies such as showing other users' comments in the platform or inviting celebrities to join the platform.

Due to the limitation of human and material resources, this study has still several limitations, and we hope

that it can be further improved in the following studies. First, the sample objects of this study did not cover all ages. Future research can expand the size and richness of the respondents and take different ages into consideration. Second, it was difficult to take all platform types into consideration. In the future study, we would further consider the influence of different types of mobile fitness platforms on users' continued usage.

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Innovation Diffusion with Network Effects and Bandwagon

Effects Based on Complex Networks

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Abstract: Network effects and bandwagon effects are both well-known in the study of innovation diffusion. However, their influences on the individual adoption behavior are not the same. In this paper, we distinguish the differences between them from two aspects: the origin of demand and the influenced individuals. Based on the configuration of complex networks, we propose a diffusion model that includes the interactions between network effects and bandwagon effects. It is found that the innovation adoption rates depend closely on the individuals' preference between bandwagon effects and network effects. And the bandwagon effects are affected by the weight of neighbor relationships. Moreover, the network effects are composed of local network effects and global network effects and a trade-off between them is necessary to improve the diffusion of innovation.

Keywords: innovation diffusion, network effects, bandwagon effects, complex networks

1. INTRODUCTION

It is widely recognized in behavioral science that people are often inclined to follow a current or fashionable taste for superficial reasons rather than for any proof of the objective utility^[1]. These phenomena coincide with the definition of bandwagon effect^[2]. In fact, the phrase “jump on the bandwagon” first appeared in American politics in 1848 when Dan Rice, a famous and popular circus clown of the time, used his bandwagon and its music to gain attention for his political campaign appearances. Investigations have shown that a crucial part of the voters will change their decisions to support the likely winner based on the results of pre-election polls^{[3]-[4]}. People like being identified with a winner to obtain the sense of social safety. This kind of psychological demand also exists in economic behavior, which is described as “the extent to which the demand for a commodity is increased due to the fact that others are also consuming the same commodity.”^[5]. The kernel of this marketing strategy is to convince the customers to adopt the commodity by adding bandwagon pressure. In the context of innovation diffusion, the concept of commodities can be generalized to innovation products^[6]. Therefore, it can be said that people's decision-making behaviors are affected by psychological demand to some extent.

In practice, not only the psychological demand but also the objective usefulness of the product affects people's decision-making behavior. As mentioned above, the bandwagon pressure has direct correlation with the number of adopters. The more adopters in the society, the greater bandwagon pressure it will be. While for the usefulness of the innovation product, it seems irrelevant to the number of adopters. This is true for some products without externalities, such as the fuel, the food, and so on. The usefulness of such products only depends on the physical properties of itself. Thus, the usefulness is a linear function of the quantity of the product. However, the utilities of some products with externalities are relative to the number of users. Take the telephone network for instance. If there exists only one telephone in the network one can easily judge that the usefulness of it should be zero because no connection can be found in this case. By this way, the usefulness of such network is measured by the number of possible connections between two telephones. With the increase in telephones, the usefulness of this network will also increase, but in a nonlinear way. Precisely, maximum number of connections for N nodes network is $N(N-1)/2$, which is called the Metcalfe's law—“the value of a network grows as the square of the number of users”^[7]. This measureable value is a function of the number of adopters but has nothing to do with the user's psychological satisfaction. Katz and Shapiro^[8] named the externalities as “network

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effects” and they affected the innovation diffusion in numerous industries including information technology and communications^[9].

As mentioned above, both bandwagon effects and network effects are sensitive to the number of adopters. In recent years, these two kinds of effects have been frequently investigated^{[10]-[16]} and many interesting results have been achieved^{[7],[17]-[18]}. A well known example is Microsoft who has succeeded in setting standards in the PC operating systems industry due to bandwagon effects and network externalities^[19]. Nevertheless, the distinct differences between network effects and bandwagon effects are seldom discussed. In fact, the bandwagon effects are users’ subjective psychological phenomena, while the network effects are objective and measurable. Moreover, the bandwagon effects and network effects can influence the individual decision-making behavior independently. Therefore, it is necessary to make a rigorous identification between network effects and bandwagon effects. Based on the differences, we can discuss the corresponding questions as follows. How do network effects and bandwagon effects act on individual decision-making behavior during the diffusion process? Which one is more important for the innovation diffusion? Are there any interactions between them? In this paper, we composed a “small-world” network configuration^[20] and a social threshold model^{[21]-[24]} to obtain some interesting results.

The rest of this paper is structured as follows. Section 2 discusses the differences between network effects and bandwagon effects. Section 3 proposes a threshold model of innovation diffusion with network effects and bandwagon effects. Section 4 reports the results of simulations and presents the discussion of the results, and finally in Section 5 we conclude the remarks.

2. THE DIFFERENCES BETWEEN NETWORK EFFECTS AND BANDWAGON EFFECTS

The diffusion of an innovation depends not only on the quality of the product but also on the quantity of adopters. Both bandwagon effects and network effects are correlated directly to the number of adopters. However, the mechanisms of these two types of effects are very different. The network effects are the origin of demand and the bandwagon effects are the influenced individuals.

2.1 The different motives of demand

The network effects mean that a potential adopter’s utility evaluation of a product is often an increasing function of the number of other adopters purchasing compatible items^[8]. Or in other words, if an individual adopts a compatible item, he/she gets the network utility from the externalities of that product. The compatibility benefits include the interchangeability of complementary products, the ease of communication between people or between people and machines, and the cost savings and demand-side economies of scale^[25]. For example, the more individuals adopt the same technological product in the communication industry, the more chances there are for one individual to communicate with others. It has been pointed out that the network externalities (including direct and indirect) depend closely on the technical compatibility^{[26]-[30]}. The technical compatibility means that individuals will have higher expectation to an innovation product if it is compatible with other individuals’ products, so it is a physical characteristic of the product and corresponding service. Therefore, the individual adoption of an innovation product with network externalities is an objective result of the technical compatibility.

The bandwagon effects represent the aspiration of an individual to adopt an innovation in order to reinforce his sense of belonging and social safety, or in order to go along with a trend. They are purely psychological demand behaviors and bring the psychological satisfaction to the individual. During the diffusion process, the individual estimation on the innovation is influenced not only by his personal knowledge and experience but also by other individual decision-making behavior in the society. The bandwagon effects are created, for example, when the buying public can be convinced that a product or service is more fashionable than its competitors without objective evidence of the product’s superiority^[1]. The bandwagon pressure is generally formed by the individual’s personal social network. Because each individual has a different relationship to the adopters, the influence on the individual behavior is different. The potential adopters are inclined toward the

opinion of the more trusted adopter. Therefore, the bandwagon pressure affecting individual behavior is a subjective result of social psychological compatibility.

2.2 The difference of influenced individuals

The network effects not only increase the potential adopters' utilities, but also increase the utilities of the previous adopters. Take the telephone system for example, the benefit of the technology to a potential user increases as soon as he/she joins into the system. Meanwhile, the benefit increases for the previous adopters since each one of them can communicate with more people^[31]. This is identical with the Metcalfe's law mentioned above.

However, the bandwagon effects only increase the potential adopters' utilities. They do not increase the previous adopters' utilities. The bandwagon effect is a psychological phenomenon whereby people adopt an innovation as other people are using the same product, regardless of their own beliefs, which they may ignore or override. By bandwagon effects, the potential adopter will feel greater bandwagon pressure if the innovation has been accepted by more people. Therefore, the bandwagon pressure will urge the potential adopter to adopt the innovation. But this pressure doesn't increase the utilities of the previous adopters. The previous adopter is already a member of the public trend. He doesn't need to follow others anymore.

The technical compatibility of a product is a kind of physical characteristic and can be considered as an objective component of the utility function. We can see that the network effects will increase all of the individuals' (including the previous adopters and the potential adopters) utilities of an innovation product. However, the bandwagon effects only increase the potential adopters' utilities for their psychological satisfactions and can be regarded as a pure subjective component of the utility function.

3. THE DIFFUSION MODEL

The relationships among people in a society can be considered as a kind of complex network in which the nodes and edges represent the individuals and direct social relationships, respectively. Intuitively speaking, the edge between two nodes means that the two corresponding social members have known each other. By employing concepts of network analysis such as degree distribution, average length of path, we can trace the whole process of the innovation diffusion. Social networks often have global structures that are not random, but display stylized characteristics like power law distribution of the links, high clustering coefficients and short paths between arbitrary couple of nodes^{[20],[32]}. It has been pointed out^[20] that there exists a very important parameter called rewiring probability r to construct the randomness of the network structure. As shown in Figure 1, $r = 0$ means that the edges of a complete regular network are fixed so that the nodes in such kind of network are highly clustered but the average length of two nodes is large. While for $r = 1$, all the edges of the regular network are rewired randomly and then the average length of any pair of nodes is very short but the clustering coefficient is low. However, in between these two limits there is an area ($0 < r < 1$) where the network is both highly clustered and short distance between each other. It is very similar to the network structure of our real-world society and called by the term "small-world". We will use the same method to generate a small-world-like network including $N = 2000$ nodes to discuss the innovation diffusion influenced by network effects and bandwagon effects.

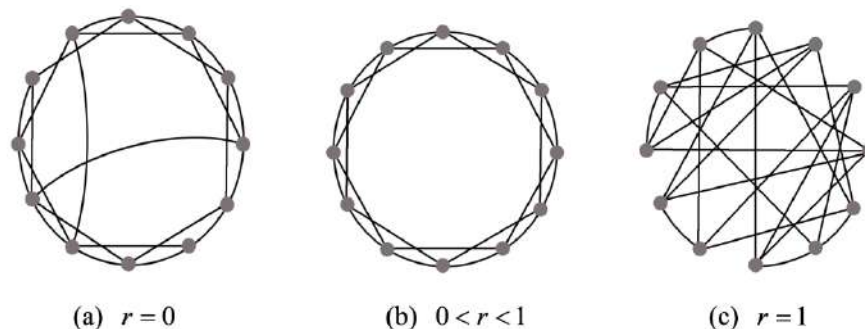


Figure 1. The regular network structure changes with the rewiring probability r

On the other hand, if we take the heterogeneity of individuals' behavior into account, the threshold model is suitable to describe the dynamics of the innovation diffusion process. Historically, the threshold model is well-known in social science research including innovation, rumours and disease spreading^[6], especially in modeling collective behaviors^{[23]-[24]} and considering the heterogeneity of each individual^[33]. The main idea of this frequently used model is that each individual has a personal threshold of utility value to decide whether to adopt the innovation product or not. The individual utility is continuously changed during the diffusion process so the diffusion rate can be considered as a time-dependent function.

As mentioned above, the network effects and bandwagon effects are two kinds of different forces to motivate the innovation diffusion. Their detailed characteristics can be described as follow.

It has been pointed out that the network effects are determined by two types of externalities corresponding to the technical compatibility, namely, local network externalities^{[13],[34]-36]} and global network externalities^[17,29,37,38]. Both of them have been widely investigated in many cases^{[9],[39]-[41]}. Generally speaking, the global externalities mean that an individual evaluates the utility of an innovation by looking at the whole society to see the total number of adopters. While the local externalities mean that an individual's utility is only affected by the number of adopters beside him or that have direct relationships with him.

The bandwagon effects reflect the individual psychological demand. By empirical evidence, people often believe or adopt things merely because many other people believe or do the same thing. In this way, the individual utility on an innovation product is affected by the others and we assume that the influences are transferred by the social relationships. According to the individual location distribution, we can separate the social relationships into two groups, namely, "neighbor relationships" and "remote relationships". Just as the implication of their names, neighbor and remote represent the distance between two linked social members. Notably, these two kinds of relationships differ from the well-known "strong ties" and "weak ties" in information spreading^[42]. Strong and weak ties depend on the combination of time, the emotional intensity, the intimacy and so on. However, the neighbor/remote relationships are determined only by the spatial distance, as it is shown in Figure 2.

From Figure 2 we can see that the solid lines connect each node to its neighbor so we named them "neighbor relationships". Dashed lines connect two nodes far away from each other so they are "remote relationships". For arbitrary node, both solid line and dash line connect it to other node in the network and the sum represents "relative ties". Each node has a utility function which changes with the interaction of bandwagon effects and network effects. We will illustrate the evolution of utility value in detail below. Once the utility value exceeds the individual's critical values, he/she will adopt the innovation and the corresponding node in Figure 2 will change from hollow to solid.

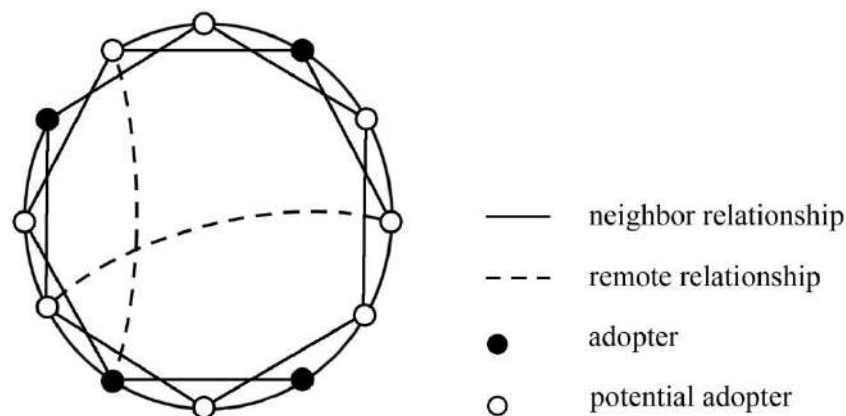


Figure 2. The sketch of innovation diffusion in a small-world like social network

The network effects can increase the utilities continuously for all the individuals in the society. And the bandwagon effects can be treated as a kind of psychological demand of joining the main trend. Hence, the bandwagon pressure will not increase the utility for the individual as long as he adopted the innovation. Formally, the utility function for the i -th individual at time t can be written as

$$U_{i,t} = \begin{cases} I_i + aB_{i,t} + (1-a)D_{i,t} & s_{i,t} = 0 \\ I_i + aB_i + (1-a)D_{i,t} & s_{i,t} = 1 \end{cases} \quad (1)$$

where

$$B_{i,t} = \begin{cases} b \sum_{j=1, j \neq i}^N s_{j,t} \varphi_{i,j} U_{j,t-1} / n_{1,i} + (1-b) \sum_{j=1, j \neq i}^N s_{j,t} (1-\varphi_{i,j}) U_{j,t-1} / n_{2,i} & n_{1,i}, n_{2,i} \neq 0 \\ (1-b) \sum_{j=1, j \neq i}^N s_{j,t} (1-\varphi_{i,j}) U_{j,t-1} / n_{2,i} & n_{1,i} = 0, n_{2,i} \neq 0 \\ b \sum_{j=1, j \neq i}^N s_{j,t} \varphi_{i,j} U_{j,t-1} / n_{1,i} & n_{1,i} \neq 0, n_{2,i} = 0 \end{cases} \quad (2)$$

And

$$D_{i,t} = c \sum_{j=1}^{n_1+n_2} s_{j,t-1} / (n_1 + n_2) + (1-c) \sum_{k=1}^N s_{k,t-1} / N \quad (3)$$

In Eqs. (1), I_i is the initial utility of the i -th individual. It depends on the intrinsic quality of the innovation product and the individual personal preference so we assume that it follows a normal distribution.

$B_{i,t}$ and $D_{i,t}$ represent the bandwagon effects and network effects for the i -th individual who hasn't adopted the innovation at time t , respectively. The value of bandwagon effects remains unchanged and is denoted by B_i when the individual whole utility is above his threshold value. And a is the weight of the individuals' preference between these two effects. " $s_{i,t} = 0$ " means the i -th individual doesn't adopt the innovation at time t and " $s_{i,t} = 1$ " is on the contrary. $t = t'$ is the critical time that the individual is adopting the innovation.

In Eqs. (2), $n_{1,i}$ and $n_{2,i}$ are the number of neighbor relationships and remote relationships of the i -th individual. " $\varphi_{i,j} = 0$ " means the individual relationship of i -th and j -th is remote, while " $\varphi_{i,j} = 1$ " means the neighbor. b is the coefficient of weight of these two kinds of relationships. We adopt $0.5 \leq b < 1$ because the remote relationships can not be stronger than the neighbor relationships. In fact, the bandwagon effects come from the psychological demand so they are hard to be quantified. Nevertheless, the adopters always share their comments on the product with others by daily communication. The comments depend closely on the utility function so we assume that the utility values can be transferred to the potential adopters to form the bandwagon pressure.

In Eqs. (3), the total number of individuals that have direct relationships ("relative ties") with the i -th individual can be written as $n_{1,i} + n_{2,i}$. " $\delta_{i,j} = 1$ " means the individuals i -th and j -th have a connection, while " $\delta_{i,j} = 0$ " is on the contrary. The adopters among them will form local network externalities to increase the utility function for the i -th individual. The global network externalities for the i -th individual are based on the number of adopters of the whole society. The weight of local externalities and global externalities can be written as c and $(1-c)$, respectively.

4. RESULTS AND DISCUSSION

Within the threshold model mentioned above, we perform our simulation on a society with 2000 members where each member has 26 social relationships with others on average. Below are some results and corresponding discussion.

4.1 The weight of bandwagon effects and network effects in the innovation diffusion

Firstly, we perform the simulation in a small-world network with a rewiring probability $r=0.06$ because most of the social networks are something like “small-world”. In the case of $b=0.8$ and $c=0.2$, the diffusion rate p changes with the vary of parameter a , as shown in Figure 3.

We can observe that the diffusion rate will firstly increase with the increase of a and then decrease until $a=1$. Hence, there exists a peak on the curve so it is an optimal value of a for maximizing the diffusion rate. Or in other words, if we want to obtain the best diffusion rate, we should consider not only the network effects but also the bandwagon effects. The network effects and bandwagon effects influence the individual decision-adopting behavior from technical and psychological demand on the innovation. Therefore, a reasonable combination of these two kinds of effects is nontrivial for the optimization of innovation diffusion. We can also see that in two ultimate limits, i.e. $a=0$ and $a=1$, the diffusion rates are different. Obviously, $p(a=0)$ is much greater than $p(a=1)$. It means that the individuals’ decision-making behaviors are mainly influenced by the technical demand that corresponds to the network effects.

The phenomena mentioned above are important to guide innovation in organizations. They should take two kinds of effects into account and find a rational weight between them. That is to say, if the innovating organization wants to perform a successful marketing effort they should firstly pay attention to the quality or technical compatibility of the products, meanwhile, they should also consider the exterior fad and style to meet the psychological demand of the customers.

4.2 The influence of neighbor relationships and remote relationships for bandwagon effects

The bandwagon effect is a kind of psychological phenomena. In the present study, we assume that (1) each individual utility can be transferred to others by social relationships and that (2) there are two kinds of relationships — “neighbor relationships” and “remote relationships”, as shown in Eq. (2). The simulation is performed in the same network structure as mentioned in Section 4.1 and the coefficient $c=0.8$. The diffusion rate varies with coefficient b is shown in Figure 4.

It can be seen that the diffusion rates increase monotonically with the increase in coefficient b for different non-zero values of a . From Figure 4 one can see that for $a=0.3$ the diffusion rates reach to high levels (all larger than 65%) for arbitrary b ranging from 0.5 to 1. In the cases of $a=0$ and $a=1$, the maximum diffusion rates are lower than that of $a=0.3$ because only single influence from bandwagon effects or network effects can not optimize the diffusion, as claimed in Section 4.1. It is worth pointing out that for $a=0$, which means that the diffusion rate is only affected by network effects, the diffusion rate does not vary with the increase in b because the bandwagon effects have been ignored in this case. From Section 4.1 we

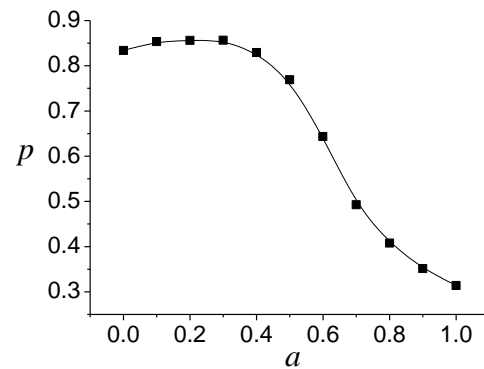


Figure 3. The diffusion rate (after 80 time steps) varying with the individuals’ weight of preference between bandwagon effects and network effects

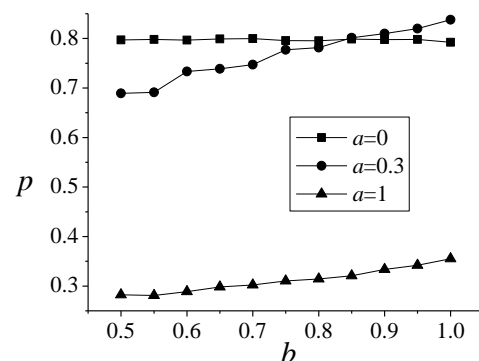


Figure 4. The diffusion rate (after 80 time steps) varying with the weight of “neighbor relationships” for some different values of a

know that adding a little weight of bandwagon effects can improve the diffusion rate to some extent. Therefore, the diffusion rate is proportional to the bandwagon effects in certain conditions (e.g. $0 < a \leq 0.3$). We can see from Figure 4 that the bandwagon effects depend closely on the weight of “neighbor relationships”. That is, the more consideration of neighbor relationships, the better of the bandwagon effects and thus the higher the diffusion rate. As we claimed above, the bandwagon effects reflect the group psychological phenomena. People’s comments on the innovation product can radiate to his/her neighbors directly as a utility value like the description in Eq. (2). This result shows that the forming of bandwagon effects looks more likely in local areas. In our real society, the utility of neighborhood radiation is always stronger and faster than that of distant relationships. It can be used to understand the people’s group behavior during the bandwagon pageant.

4.3 The influence of local externalities and global externalities for network effects

The influence of local externalities and global externalities can be expressed by the coefficient c as shown in Eq. (3). The simulation is performed in the same small-world network structure as before, i.e. $r = 0.06$. The coefficient $b = 0.8$. The simulation results are shown in Figure 5.

For $a = 0$ and $a = 0.3$, we can see that the diffusion rates increase firstly and then decrease with the increase in c , so there exist maximal diffusion rates and the corresponding optimal values of c . However, this trend changes for $a = 0.5$. In this case, the diffusion rate decreases monotonically with the increase in c . Furthermore, the diffusion rate for $a = 0.5$ can not reach to higher percentages (larger than that of $a = 0$ and $a = 0.3$) for arbitrary c . This result is in accordance with that shown in Section 4.1. Hence, we only discuss the cases of $a = 0$ and $a = 0.3$ below.

Substituting $c = 1$ into Eq. (3) we can see that the second item of the right-hand side disappears. It means that the individuals only consider the network externalities by looking at the adopting-behavior of the other individuals who have direct social relationships with him. This can be considered as an instance of local externalities. In the case of $c = 0$, the individual considers the behavior of all N individuals among the society. This is an instance of global network externalities. From Figure 5, we found that the diffusion rates for $c = 0$ are always much larger than that for $c = 1$. It means that the global externalities are the main forces pushing the innovation diffusion. The simulation results also show clearly that neither $c = 0$ nor $c = 1$ can optimize the diffusion rate. The maximal values of diffusion rate exist in the area close to $c = 0.1$. Therefore, a little weight of local externalities can optimize the network effects and then the diffusion rates are improved. In our real world, it is reasonable that a person should look at both his neighbors and the whole society before he makes a decision to adopt the innovation or not.

From Figure 5, we also find an intersection close to $c = 0.6$. In the case of $c < 0.6$, the diffusion rates of $a = 0.3$ are larger than those of $a = 0$. Whereas, the situations are on the contrary for $c > 0.6$. As we mentioned above, a little weight of local externalities and bandwagon effects can improve the diffusion rate. However, too much weight of local externalities reduces the innovation diffusion rate and the bandwagon effects will make the situation worse. We should pay attention to this kind of negative feedback.

5. CONCLUDING REMARKS

In this paper, we considered innovation diffusion with network effects and bandwagon effects. Both of these effects increase the utility function as the number of adopters increases. However, the mechanisms

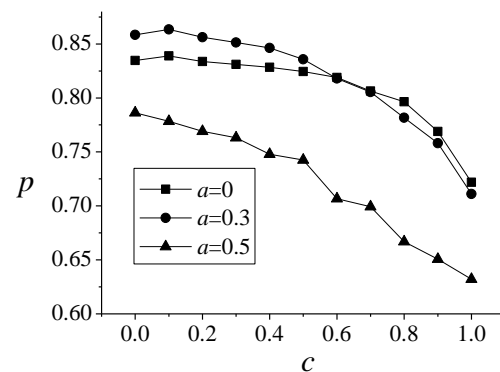


Figure 5. The diffusion rate (after 80 time steps) varying with respect of coefficient c for different values of a

between network effects and bandwagon effects are different from each other. However, their underlying mechanisms are what distinguish the two effects. Firstly, the network effects are caused by the technical compatibility of the innovation, while the bandwagon effects are purely psychological behavior. Secondly, the network effects increase not only the potential adopters' utilities, but also the utilities of the adopters. In comparison, the bandwagon effects only increase the potential adopters' utilities and will stop influencing the individual utility function as soon as he adopts the innovation.

Based on the "small-world" network structure, a threshold model of utility function including the network effects and bandwagon effects is proposed to simulate the innovation diffusion. The results show that in order to obtain the optimal innovation diffusion the following factors should be taken into account.

(1) The network effects are important for innovation adoption. However, we can not ignore the influence of bandwagon effects. Except for the technological quality and compatibility of innovation product, the consumers' psychological demand of fad and fashion from the product is also important to promote the innovation diffusion.

(2) If we consider the influence of bandwagon effects, direct social relationships can be separated into "neighbor relationships" and "remote relationships" according to the distance between two nodes in the network. The simulation results show that the bandwagon effects depend closely on the weight of "neighbor relationships". This conclusion coincides with the psychological origin of bandwagon effects^[43].

(3) The network externalities can be distinguished by local externalities and global externalities. Both of them are important to the network effects. In our model, they are estimated by calculating the number of adopters among the personal network and the total network, respectively. It is shown that an individual decision-making behavior is affected not only by the number of adopters having direct social relationships with him but also by the number of adopters in the whole society. A reasonable weight between local and global network externalities is crucial for innovation diffusion.

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Research on Privacy Paradox in Social Networks Based on Evolutionary Game Theory and Data Mining

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Abstract: In order to obtain social benefits, social networks have started taking benefits from private information of network users. While having increased concerns about the risk of privacy disclosure, users still generally disclosed under high privacy concerns, which directly formed the privacy paradox. The expansion and generalization of privacy paradox indicate that the implementation of privacy protection in social networks is still in a dilemma. Studying and solving the problem of privacy paradox is conducive to ensure the healthy development of social network industry. Based on this, this study has designed a research system that analyzes the privacy paradox of social networks from three dimensions: cause, existence and form. After studying existing research of privacy paradox in social networks, evolutionary game theory is determined to be introduced into the procedure of cause analysis, while data mining is used as a data analysis method for empirical research. Within the whole research process, the evolutionary game model of privacy paradox in social networks is built up first, while the necessary conditions for the generation of privacy paradox is addressed, which is derived from the evolutionary stable strategy. Secondly, the questionnaire survey method is used to collect private data of active users of both Weibo and WeChat. Lastly, Apriori and CHAID algorithm are used to determine the relationship of user privacy concerns, privacy behavior, and other factors, which then confirms the existence of privacy paradox on two social networks and makes a comparison between their forms of privacy paradox in specific. This research systematically makes a useful an in-depth analysis to the privacy paradox in social networks and is meaningful for establishing a hierarchical protection system of users' privacy for enterprises.

Keywords: Privacy paradox; Privacy concerns; Privacy behavior; Evolutionary Game Theory; Data mining

1. INTRODUCTION

With the rapid development of Network Information Technology, the theme of Internet gradually has extended from technology to all fields of economic society. Among them, the rise of social networks is particularly remarkable. As an essential element of the development of network applications, social networks build a strong relationship chain and effectively break the barriers of information monopoly, making multiple instant communication possible without time and space constraints. At the same time, a huge data collection, production and transaction mechanism has been gradually established in social networks to produce personalized products and services for users. As an important source of the data accumulation in social networks, the privacy provided by users shows great commercial value, but it also causes the privacy security issues that are widely concerned by the society. The public are increasingly concerned about the risk of privacy disclosure, but their privacy disclosure behavior does not reduce, which leads to the formation of privacy paradox.

2. RESEARCH PURPOSE AND CONTENTS

Based on the above background, the existence of privacy paradox will affect the order and efficiency of information exchange across the entire network. Therefore, the purpose of this study is to establish a systematic

research path to analyze privacy paradox, so as to provide effective suggestions on how social network service providers and users should deal with the challenges brought by privacy paradox. Specifically, the research includes three parts: 1) Research on the basic theory of social networks privacy paradox; 2) Research on the causes of social networks privacy paradox based on evolutionary game theory; 3) Research on the existence and manifestation of social networks privacy paradox using data mining.

3. RESEARCH METHODS

1) In the research of the first module, we drew on the literature and practical experience to clearly define the concepts and characteristics of privacy concerns, privacy behavior and privacy paradox. We also summarized the measurement methods of privacy concerns and privacy behavior, and determined the research paths and technical means of the latter two modules. 2) In the research of the second module, we constructed a privacy paradox evolutionary game model between social networks users and social networks service providers and got the stable strategy of the two-party game to analyze, as well as explained the formation reasons and conditions of social networks privacy paradox. 3) In the research of the third module, we selected two Chinese social software Weibo and WeChat as the research objects, designed and distributed 600 online questionnaires, and analyzed the data obtained from the questionnaire survey using association rule mining algorithms (Apriori algorithm) and classification rule mining algorithms (CHAID algorithm), so as to discuss the existence and manifestation of the privacy paradox in different social platforms.

4. RESEARCH RESULTS

1) The research of the first module has obtained two research results. First, different privacy paradox interpretation theories have certain common characteristics, that is, users make privacy behavior decisions under the condition of limited rationality and incomplete information, which is in dynamic change under the influence of comprehensive factors. Evolutionary game theory highly matches the above-mentioned privacy paradox cause analysis needs. Therefore, we choose to analyze the formation reasons for the privacy paradox through evolutionary game theory in the second module. Second, different social platforms have different functions, and there are also differences in users' service demands, which results in distinguishing privacy concerns and behavior. Therefore, we choose to discuss the similarities and differences of privacy paradox on two platforms in the third module. 2) The second research module obtained two sets of evolutionary game stable strategies. According to the analysis, when the privacy concerns of social networks users are less than the value-added benefits that can be obtained by providing privacy to the social networks service providers, the users will prefer to disclose their privacy. When the users' privacy concerns break through this limit, they may turn to a more conservative privacy behavior. However, social networks service providers will not provide users with privacy protection measures whether they obtain user privacy or not. 3) In the mining of the privacy paradox association rules of the third module, 19 Weibo privacy paradox association rules and two privacy items (gender and age) with privacy paradox characteristics were obtained, and 15 WeChat privacy paradox association rules and six privacy items (gender, age, birthday, name, photo and mood state) with privacy paradox characteristics were obtained at the same time. In the mining of classification rules, the above privacy items that exhibit the privacy paradox were selected to participate in the calculation. Finally, we got 22 privacy disclosure rules that describe the manifestation of privacy paradox.

5. CONCLUSIONS

1) Evolutionary game theory is an effective method to analyze the cause of privacy paradox. From the

results of evolutionary game analysis, we can see that users can enjoy the core value of social networks services only by providing their privacy to service providers under the current market background. Therefore, the emergence of privacy paradox has certain rationality and inevitability. 2) There is privacy paradox in social networks, but the privacy paradox on Weibo and WeChat is quite different. Comparative analysis shows that users in strong social networks have higher willingness to disclose themselves, and the probability of forming privacy paradox is greater; users in weak social networks have relatively conservative privacy behavior, and the scope of privacy paradox appears is more limited. 3) The manifestation of privacy paradox is diverse, and it is related to many factors throughout the whole process of users from using social services to finally disclosing their privacy. Although the focus of privacy paradox is to discuss the positive correlation between privacy concerns and privacy behavior, it is still necessary to consider the transition and cohesion of other factors between these two factors.

In summary, this study systematically analyzes the privacy paradox. It breaks the tradition of privacy paradox study limited to qualitative analysis and enriches the quantitative research content in this field. Meanwhile, it links the quantitative analysis results with market guidance and decision-making, providing the basis for social network service providers and users to make their own privacy policies.

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Factors Influencing the Perception of Seller Credibility in Online

Reputation System: an Eye-Movement Approach

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Abstract: The current online reputation systems for online sellers face great challenges from bad-faith behavior such as malicious negative reviews, click farming, mismatch between images and commodities, and forged commodities. To optimize the design of online reputation systems, explore the consumer utilization of credit clues, and describe the law of mutual trust, this paper puts forth three hypotheses about the influencing factors of consumer perception of online seller credibility and integrates various research methods such as an eye-movement experiment, questionnaire survey, econometric analysis, and empirical research. To evaluate the three hypotheses, the display modes of commodities on a current e-commerce platform were optimized, and eye-movement experiments were conducted on original and optimized webpages. Results show that the display of sales growth, the refinement and tagging of review content significantly impacted consumer perception of seller credibility. Further, designers of online reputation systems were advised to display sales trends, provide personalized sales queries, and tag a variety of reviews for consumers to easily ascertain credible sellers. This advice helped curb bad-faith behavior.

Keywords: e-commerce platform, credit clues, reputation system, eye movement experiment

1. INTRODUCTION

Reputation is the foundation for the trusted trading relationship between the buyer and the seller, and an important guarantee of the orderly development of the market ^[1, 2]. After years of exploration and innovation, China has made marked progress in the construction of e-commerce credit system. However, bad-faith behaviors are still commonplace in the field of e-commerce, such as malicious negative reviews, click farming, mismatch between image and commodity, forged and fake goods, etc. The rampant spread of such behaviors has disrupted the order of the online market, and violated the legitimate rights and interests of consumers, posing a serious threat to the healthy transactions ^[3]. Lack of information about the background, especially trustworthiness of participants in these markets, creates suspicion and mistrust among participants. The scarcity of trust has become a significant bottle neck in the development of e-commerce ^[4, 5].

The online reputation system, a cornerstone of e-commerce platform, maintains the stability of online transactions, laying the basis for good mutual trust and high market efficiency ^[6, 7]. But every silver lining has a cloud: the traditional online reputation system is prone to malicious attacks and rating fraud, when faced with numerous bad-faith behaviors ^[8, 9]. To overcome these defects, cement the credit mechanism of e-commerce platform and make up for the lack of good faith in e-commerce, it is necessary to optimize current online reputation system ^[10, 11].

The remainder of the paper is organized as follows: Section 2 introduces related works on online reputation systems from eye tracking perspective. Section 3 introduces the main process of eye movement experiment and

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the analysis of the simulation results is provided in section 4. In the last section, we present conclusions and directions for future work.

2. RELATED WORKS

With the aid of eye-tracking devices, scholars have been able to analyze information cognition and browsing modalities of subjects using large online shopping platforms. This has enabled researchers to understand shopper intentions and decision-making as affected by information clues on e-commerce platforms^[13, 14]. Online reviews, celebrity endorsements, brands, and trademarks have also been evaluated for this purpose^[15]. Via experimental analyses, Yan et al. suggested that consumers paid more attention to negative reviews than to positive ones, even when they contradicted. They also found that good brands improved consumers' cognition of online reviews, combating the passive influence of negative reviews^[16]. References [17, 18] investigated the advertising effects of celebrity endorsements, revealing that they resulted in more effective advertising, especially when the celebrity image complemented the product's function. Bertarelli discovered a correlation between consumer cognitive needs and the match between celebrity and product. The advertising effect improved with the matching degree for those having high cognitive needs, whereas those with low cognitive needs were insensitive to the matching degree^[19]. Beldad et al. examined how the match between the gender of the virtual sales assistant and the product gender affected consumer purchase intentions, concluding that consumers tended to trust an assistant's advice if they were highly matched; they were unaffected by assistant gender or product gender alone^[20].

Over the years, fruitful results have been achieved via eye-movement experiments conducted with online reputation systems, leading to new methodological and theoretical insights on advertising research. Unfortunately, several of these studies are marred by significant issues. Relevant studies on online reputation systems have experimentally analyzed the effectiveness of market guarantees and have improved the identification and classification of moral hazards based on a trust model. However, they have failed to discuss the utility of external credit clues provided by the system from the perspective of consumer perception. They have further disregarded the impact on consumer perception of seller credibility. Online reputation systems have been studied via economic experiments, simulations, game-theory applications, and other methods. However, few scholars have extended psychological methods, such as eye-movement experimentation, to studying these systems or to analyzing how credit clues affect consumer perception of seller credibility. Current studies on eye movement experiments have concentrated on application scenarios of products like books, webpages, and toys, highlighting the influence of the numbers, types, and forms of design elements on consumer purchase intentions and transaction behavior. Nevertheless, there is no in-depth report on the selection of credible sellers when multiple sellers offer homogenous commodities. To help resolve these shortfalls, this research starts with the consumer perception of seller credibility and then introduces the eye-movement experiment to help optimize a new design for online reputation systems, aiming to bolster consumer decision-making abilities of selecting credible sellers and boosting the effectiveness of online reputation systems.

3. EXPERIMENT DESIGN

We first conducted a questionnaire survey online, which mainly covered two aspects, namely, demographic characteristics (gender, occupation, age, monthly income/living cost) and online shopping information (online shopping experience, monthly online shopping frequency, commodity search habit and awareness of click farming on Taobao.com). In total, 289 questionnaires were returned. Excluding 8 invalid ones, 281 valid questionnaires were available for analysis. In terms of demographic characteristics, about 60% of the respondents are females, over 90% of them are students, 83.39% are aged between 18 and 25, and 42.91% earn

or spend 1,000~1,500 yuan per month (the monthly income/living cost reflects the fact that the respondents are predominantly students). According to the online shopping information we collected, 281 of the respondents have online shopping experience, with only 8 have never shopped online; 79% of them shopped online 1~2 or 3~5 times per month; 85.41% are aware of click farming on Taobao.com. Also, we utilized five-point Likert Scale to explore where consumers usually select items (such as flagship store or Tmall, “Hot Sell”, etc.) and what information they think highly of when shopping on Taobao.com (for example, sales volume, reviews volume, reviews content, etc.). The reliability coefficients of the data matrices were 0.859 and 0.969, respectively, both of which are greater than 0.7, indicating that the data are fully trustworthy and usable.

Questionnaire analysis revealed that consumers were more concerned about the commodity itself than propriety or information of the store. High correlation was found by matching consumer attention to commodity sales, review volumes, review content, and positive and negative review rates. Further analysis revealed that consumers focused the most on three credit clues: review content, negative reviews, and commodity descriptions. Refer to [14, 15, 18], drawing from studies on click farming, we summed the typical features of stores engaging in fake order placements, learning that sales volumes soar over the short term and reputation was high despite new registrants. The volume of reviews rapidly increased over a short period, and the content of reviews was extremely similar and pretentious. On the basis of this, three hypotheses are put forward as follows:

H1: The presentation of sales growth will positively impact consumer perception of seller credibility.

H2: The display of the growth in the number of reviews will positively impact consumer perception of seller credibility.

H3: The tagging of review content will positively impact consumer perception of seller credibility.

3.1 Preparations

In the context of the Internet, there is a new product classification framework called Search, Experience, and Credence. Search products are identified as those for which consumers have the ability to obtain information on product quality prior to purchase, while experience products are those whose relevant attribute information cannot be known until the trial/use of the product/service. And credence products are those whose relevant attribute information is not available prior to and after the use of the product/service for a considerable period of time. We selected an experience-type commodity for the experiment as the purchase of search and credence products is mostly unaffected by external credit clues. In light of the questionnaire survey and relevant studies, pitaya fruit found in a flagship store on Taobao.com was determined as the target of the study.

According to the credit clues (store sales, store credit, number of reviews and tagging of review content) mentioned in the four hypotheses, the original webpage was photoshopped based on the existing webpage of the store. To eliminate the interference of other factors, any content irrelevant to our experiment was removed from the webpage, e.g. “add to the shopping cart” and “price”. The original webpage thus designed is shown in Figure1.

As mentioned before, the typical features of a store engaging in click farming include the sale volumes soars in a short period, the reputation is high despite recent registration, the volume of reviews explodes in a short period, and the reviews are extremely similar in content or bombastic. In light of the three hypotheses, we presented three optimized webpage designs (shown in Figure 2).

• **Sale volume design.** Seller credibility can be well-demonstrated by analyzing long-term historical data. We originally planned to group monthly sales variations annually or semiannually. Unfortunately, accurate sales data were unavailable for these durations. Therefore, we observed daily sales changes of the target commodity, deriving a daily sales measure. After a week, we plotted the data on a line chart to show the sales trend and used this evaluation to verify H1.

• **Review volume design.** Similar to the acquisition of sales data, we observed daily changes in the volumes of reviews, deriving the number of reviews daily for a week. The obtained data were plotted on a line chart to describe the trend and used to verify H2.



Figure 1. Original webpage design



Figure 2. Optimized webpage design

• **Review content design.** The original webpage displayed the content of all reviews at once. Owing to the huge amount of data, consumers often browse only the first few pages of reviews, most of which are positive as selected by sellers. Within this display mode, it is impossible for consumers to fully understand the overall rating. To resolve this issue, we originally planned to mine the content of all reviews using Java programming to extract high-frequency words. However, this was extremely difficult because only 10 reviews could be expanded at once when clicking on the link to a detailed subpage of reviews. Therefore, we extracted 100 reviews, from which high-frequency words were identified. Next, we extrapolated the total number words in all reviews. Finally, the words were tagged to verify H3. After typesetting, the optimized webpage design was improved.

3.2 Experimental process

Forty-one students conversant with online shopping were recruited from a university, with 90.9% of them shopping online at least once or twice per month. Each subject was tested continuously for five minutes. The experimental process was as follows:

Step 1: We instructed the subject to adjust their sitting posture such that the eye tracker could accurately record eye positions.

Step 2: We notified the subject to look at a moving ball appearing on the screen and to perform the fixed-point calibration.

Step 3: We described the shopping scene to the subject with the following verbiage: “Let us say that you want to buy some pitayas, which are currently in season. Please do not consider the price; look carefully at the commodity information and answer the questions. To ensure the experimental effect, please retain the same sitting posture throughout the experiment, so that the eye tracker can record your eye position and related data.”

Step 4: All subjects were shown the original webpage first and their eye position were recorded by the eye tracker. After answering the questions, they then browsed the optimized webpage and repeated the previous process.

4. EXPERIMENTAL ANALYSIS

After 41 subjects completed their tests, the invalid data of 5 subjects were eliminated. Then, the eye movement data collected through our experiment were subjected to regression analysis to verify the four hypotheses separately. According to related references, the eye movement was described by the following variables: time to first fixation (*tff*), first fixation duration (*ffd*), fixation duration (*fd*), fixation count (*fc*), and visit duration (*vd*).

4.1 Analysis of sale volumes

4.1.1 Chart analysis

- Trajectory analysis

The subjects fixed their eyes on monthly sales from the start to the end of the eye-movement recording. After the webpage was optimized, fixation on monthly sales became more prominent and lasted for a longer duration.

- Heat map analysis

After webpage optimization, the subjects' eye sight covered a wider range of heat points on monthly sales, showing a trend of sales figures from the original webpage, and the highlight values reached their peak levels. This means that the subjects were more interested in the optimized module of store sales (Figure 3, Figure 4).

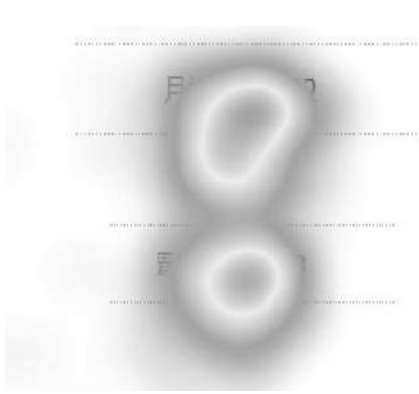


Figure 3. Heat map for sale volumes in the original webpage

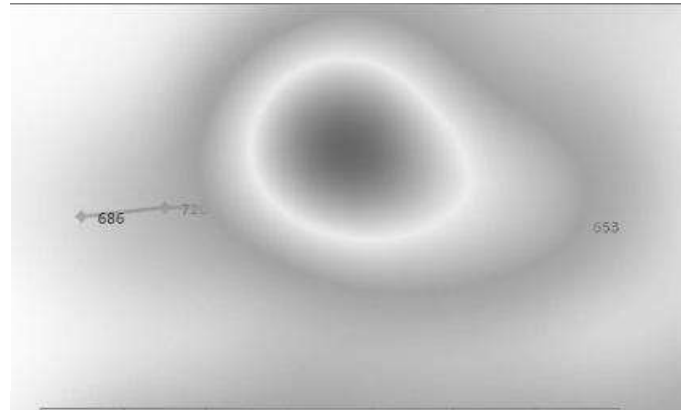


Figure 4. Heat map for sale volumes in the optimized webpage

4.1.2 Data analysis

Using a simple linear regression, significantly effective indices were identified from subjects' visits to the webpage. Finally, a fitting regression was carried out with the commodity credit score rated by subjects using the explained variable and the relevant variables acquired from paired sample t-tests.

Taking the *vd* as the explained variable, two indices with high significance through stepwise regression were selected as the explanatory variables, namely, *ffd* and *fd*. The linear regression was calculated to test which independent variable were significant (Table 1). The results indicate that both first fixation duration and fixation duration are significantly effective ($p < 0.05$).

Table 1. stepwise regression analysis results of original webpage (sales volumes)

	Unstandardized Coefficient	Standard error	T statistics	Sig.
Intercept	1.56	0.40	3.87	0.000***
<i>ffd</i>	-6.99	2.89	-2.42	0.021**
<i>fd</i>	8.69	3.15	2.75	0.009*
Adjusted R^2	0.138			
<i>F</i>	3.81			

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results indicate that the p-values of both first fixation duration (*ffd*) and fixation duration (*fd*) were smaller than 0.05, indicating that the two explanatory variables were significantly effective.

Results of the linear regression indicate that after webpage optimization, the first fixation duration (*ffd*) comprised the only eye movement index with a p-value smaller than 0.05, indicating that this variable was significantly effective (Table 2).

Table 2. stepwise regression analysis results of optimized webpage (sale volumes)

	Unstandardized Coefficient	Standard error	T statistics	Sig.
Intercept	-0.12	0.61	-0.20	0.841
<i>ffd</i>	3.57	1.66	2.16	0.038*
<i>fd</i>	1.77	3.12	0.56	0.574
Adjusted R^2	0.118			
<i>F</i>	3.33*			

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The *vd* to the sale volumes of the original and optimized webpages were considered two independent samples and subjected to paired sample t-tests. The test results ($t(35)=4.22$, $p<0.001$) indicate an obvious difference in the visit durations to store sales in the original and optimized webpages. This means the display of sales trend over a period of time helped prolong the visit duration of the subject.

The *ffd* of the sale volumes in the original and optimized webpages were considered two independent samples and subjected to paired sample t-tests. It can be seen that $t(35)=0.31$, $p=0.763$, where the p-value of the t-test was far greater than 0.05. Thus, there was no significant difference in the first fixation duration of store sales in the original and optimized webpages. The change of display mode did not immediately lengthen the first fixation duration. The credit scores (*Score*) rated by the subjects before and after webpage optimization were considered two independent samples and subjected to paired sample t-tests. The test results show an obvious difference in commodity credit scores rated by subjects before and after webpage optimization ($t(35)=-3.914$, $p<0.001$). The post-optimization score was 0.838 units higher than the original score. The fitting regression equation of the original webpage is expressed as Eq. 1, extrapolated in Table 3:

$$Score = \alpha + \beta \times sales_vd2 + \gamma \times sales_ffd + \varepsilon \quad (1)$$

Table 3. Fitting regression analysis results of original webpage (sale volumes)

	Unstandardized Coefficient	Standard error	T statistics	Sig.
Intercept	4.89	0.24	20.29	<2e-16***
<i>sales_vd2</i>	-0.21	0.13	-1.66	0.107
<i>sales_ffd</i>	-2.27	1.07	-2.12	0.041*
Adjusted R^2	0.136			
<i>F</i>	3.75			

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The fitting regression equation of the optimized webpage can be expressed as (Table 4):

$$Score_after = \alpha_1 + \beta_1 \times sales_vd_after3 + \gamma_1 \times sales_ffd_after3 + \delta \times sales_ffd_after + \varepsilon \quad (2)$$

Table 4. Fitting regression analysis results of optimized webpage (sale volumes)

	Unstandardized Coefficient	Standard error	T statistics	Sig.
Intercept	5.51	0.39	14.22	2.23e-15***
<i>sales_vd_after3</i>	-0.01	0.04	-2.38	0.023*
<i>sales_ffd_after3</i>	0.45	17.68	0.03	0.980
<i>sales_ffd_after</i>	-2.31	3.02	-0.77	0.449
Adjusted R^2	0.197			
<i>F</i>	3.86			

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Results of the fitting regressions and paired sample t-tests on credit scores revealed that the credit score of the commodity was positively correlated with the first fixation duration at the store sales section.

Overall, the subjects generally attached high attention to monthly sales of the commodity during online shopping. After the graphic display of the monthly sales of the commodity over a period, the subjects fixed their eyes at the monthly sales trend for longer durations. Moreover, the first fixation time had a linear positive correlation with the visit duration to the store sales. Additionally, the visit duration was greatly extended after webpage optimization. Thus, the display of sales growth positively impacts consumer perception of seller credibility. Therefore, H1 is supported.

4.2 Analysis of reviews volumes

4.2.1 Chart analysis

After webpage optimization, the subjects' eyesight covered a wider range of heat points on the number of reviews than that on the original webpage. However, the peak level of highlight values remained basically unchanged (Figure5, Figure6).

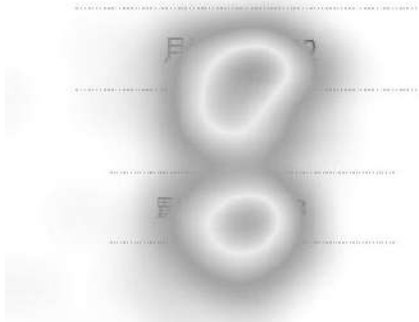


Figure 5. Heat map for reviews volumes in the original webpage

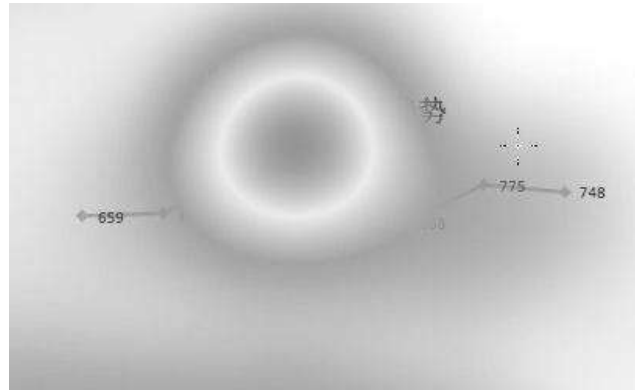


Figure 6. Heat map for reviews volumes in the optimized webpage

4.2.2 Data analysis

Taking the *vd* as the explained variable, an index with high significance (*ffd*) through stepwise regression was selected as the explanatory variable. Results show that the five variables were closely correlated on the number of reviews. Hence, the relevant variables were directly subjected to paired sample *t*-tests, and the commodity credit of the original webpage was contrasted with that of the optimized webpage. Results of the linear regression indicate that the *t*-statistic of the first fixation duration was in the effective range, indicating that this explanatory variable is significantly effective (Table 5).

Table 5. stepwise regression analysis results of original webpage (reviews volumes)

	Unstandardized Coefficient	Standard error	T statistics	Sig.
Intercept	0.29	0.13	2.31	0.028*
<i>ffd</i>	1.13	0.49	2.26	0.030*
Adjusted R^2	0.106			
<i>F</i>	5.13			

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The linear regression results of the optimized webpage show that this explanatory variable is not significant (Table 6).

Table 6. stepwise regression analysis results of optimized webpage

	Unstandardized Coefficient	Standard error	T statistics	Sig.
Intercept	0.38	0.13	2.85	0.007**
<i>Comment_ffd</i>	0.77	0.51	1.49	0.145*
Adjusted R^2	0.034			
<i>F</i>	2.22			

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The visit durations to the number of reviews in the original and optimized webpages were considered two independent samples and subjected to paired sample *t*-test. Because the *p*-value (0.182) of the *t*-test ($t(35)=-1.362$) was far greater than 0.05, and the *t*-statistic fell outside the effective range, there was no significant difference in

the visit durations to the number of reviews in the original and optimized webpages. Thus, the number of reviews is not a primary clue for the subjects to perceive seller credit during online shopping.

The first fixation durations on the number of reviews in the original and optimized webpages were considered two independent samples and subjected to paired sample t -tests. It can be seen that $t(35)=0.726$ and $p=0.047$. Thus, the first fixation durations on the number of reviews in the original and optimized webpages differed insignificantly.

The commodity credit scores rated by the subject before and after webpage optimization were considered two independent samples and subjected to paired sample t -tests ($t(35)=-3.914$, $p<0.001$).

In summary, the subjects had no significant changes in their attention, visit duration, and first fixation duration concerning the number of reviews via webpage optimization. Therefore, the display of the growth in the number of reviews had an insignificant impact on consumer perception of seller credibility.

4.3 Analysis of reviews contents

4.3.1 Chart analysis

Owing to the addition of typical tags following webpage optimization, the subjects' eyesight covered a wider range than on the original webpage, and the highlight values concentrated on all tags (Figure 7, Figure 8).



Figure 7. Heat map for reviews contents in the original webpage

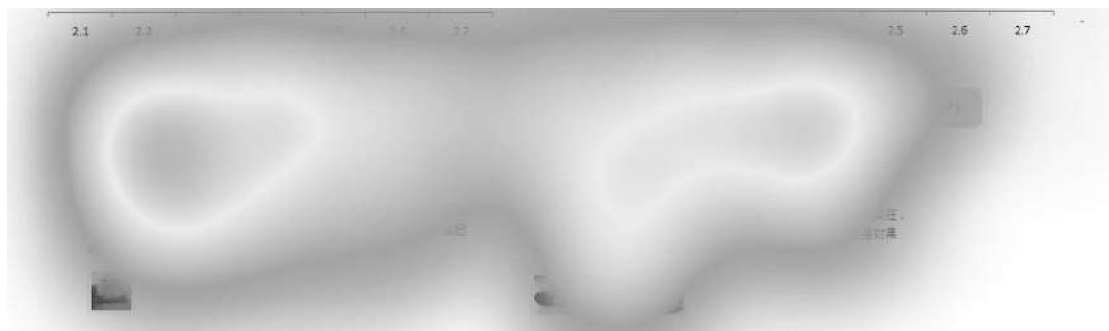


Figure 8. Heat map for reviews contents in the optimized webpage

4.3.2 Data analysis

Taking vd as the explained variable, eye movement indicators ffd , fd , and fc were regressed in a stepwise manner. No explanatory variable was found to be significantly effective. Thus, we performed a principal component analysis. All eye movement indices were summed and subjected to a fitting regression with the commodity credit score as the explained variable.

Visit durations vs. the review content in the original and optimized webpages were considered two independent samples and subjected to paired sample t -tests. The test results ($t(35)=-1.532$, $p=0.134$) show insignificant differences between visit durations of review content before and after webpage optimization.

The times to first fixation on the review content in the original and optimized webpages were considered two independent samples and subjected to paired sample t -tests. The test results ($t(35)=-2.857$, $p=0.007$) show

that the time to first fixation on the review content changed considerably from the webpage optimization. After more tags were added to highlight the review content, the subjects observed the tagged content more quickly than before.

The first fixation durations on the review content in the original and optimized webpages were considered two independent samples and subjected to paired sample t-tests. The test results ($t(35)=-2.478$, $p=0.018$) show a significant difference in the first fixation duration before and after webpage optimization. The subjects fixed their eyes on the webpage for longer durations after the optimization.

The commodity credit scores rated by the subject before and after webpage optimization were considered two independent samples and subjected to paired sample t-tests. The test results ($t(35)=-3.914$, $p<0.001$) show a significant difference in the commodity rating score before and after webpage optimization.

In summary, the subjects fixed their eyes on tagged content for a long duration, and the trajectory almost covered all tags. There were significant changes to the time to first fixation and the first fixation duration from webpage optimization. Subjects noticed the content having more tags sooner and spent more time reading the review content. Comparing the fitting regression results before and after optimization, it is clear that the commodity credit score was mainly affected by the first fixation duration and that the two factors had a positive correlation. In other words, the addition of highly generalized tags encouraged consumers to spend more time reading reviews, enabling them to make more rational purchase choices. Thus, H3 is supported.

5. CONCLUSIONS

According to the results of the questionnaire survey, consumers pay the most attention to three credit clues in online shopping: review content, negative review rate, and commodity description. Drawing from studies on click farming, we summed the typical features of a store engaging in fake order placement. Those features are indicated by phenomena wherein sales volume soars over a short period, reputation is high despite recent registration, review volumes explodes in a short period, and content of reviews is extremely similar and pretentious. Therefore, three hypotheses were put forward and subjected to econometric analysis.

H1 is supported. The display of sales growth positively impacted the consumer perception of seller credibility. H2 is not supported. The display of growth in the number of reviews did not significantly impact the consumer perception of seller credibility. H3 is supported. The tagging of review content positively impacted consumer perception of seller credibility.

Based on the above empirical results, we put forward the following suggestions for online reputation systems on e-commerce platforms. Rather than displaying only monthly sales and relevant data, sellers should display the changes in daily sales over a recent period and, perhaps, the changes in monthly sales over the past year or so. They could also enable consumers to search for sales in any period. This way, the buyer has more power to judge if the seller is legitimate and can estimate trustworthiness. Trustworthy sellers will then attract more buyers, consumer rights and interests will be safeguarded, and e-commerce platforms will remain fair and safe. Furthermore, sellers should add positive tags to review content so that consumers can easily gain an objective and thorough understanding of the commodity. This measure helps crack down on bad-faith behavior.

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Deceptive Advertising Strategies in a Two-period Model

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Abstract: Deceptive advertising is the behavior that the operators make use of the advertisements to fabricate the facts and cause the consumers' misunderstanding of their goods or services so as to gain benefits. In this paper, the governments and consumers are taken into account. From the perspective of companies, the main target is to maximize the profits. In that case, we discuss the impact of government supervision, consumer negative word-of-mouth, product cost and other factors on company advertising decision-making. A two-period model is established to analyze the optimal propaganda and maximum profits of the four possible advertising strategies, e.g., the company doesn't make deceptive advertisements, makes deceptive advertisements in the first period, makes deceptive advertisements in the second period, and makes deceptive advertisements in both periods. In this paper, we investigate the two-period model and find which one strategy is more profitable for the company and the optimal advertising levels. We find that the company will make deceptive advertising when the difference in cost between high-quality and low-quality products is large, the government supervision is loose, and negative word-of-mouth effect is small. Based on different market environment and product characteristics, we derive some useful advertising advices for the company, and also give management insights to consumers and government regulatory authorities.

Keywords: deceptive advertising, optimal decision, decision-making model, two-period model

1. Motivations and Research Questions

Advertising is an important source of information for consumers to choose products, and it is also an important marketing tool for companies to expand the market and make profits. When promoting products, especially for some products that are not easy to be directly evaluated by consumers such as drugs and cosmetics, companies may launch deceptive advertising through false origins, exaggerated product functions in order to make more profits. With the rapid development of e-commerce, some online retailers choose to increase the sales volume by scalpers. In order to restrain the deceptive advertising, the new version of the Anti-Unfair Competition Law, which was enforced in January 2018 in China, has added the laws and regulations of online fictitious trading behaviors. In a word, deceptive advertising has become frequent in the market.

In this paper, we establish a two-period model to study the advertising strategy selection of a single company. We analyze the advertising decisions of a single company that monopolize the market. In order to investigate the negative impact of deceptive advertising, we analyze four cases by establishing a two-period model: (1) No deceptive advertising, HH (control group); (2) Only make deceptive advertisements in the later period, HL; (3) Only make deceptive advertisements in the early period, LH; (4) deceptive advertising, LL.

In each period, the company chooses whether to provide low-quality products and whether to make deceptive advertisements. Intuitively, companies that pay more attention to product quality and positive word of mouth will make provide high-quality products and make normal advertisements, while companies that focus on short-term benefits will more often choose deceptive advertisements. There are also many companies providing low-quality products in one period tentatively. The company's goal is to choose one of the four advertising strategies to maximize its own profits. Based on this, the main questions in this paper are that: (1) What factors will affect the advertising levels and profits of a company in our two-period model? When will a company

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provide low-quality products and make deceptive advertisements? (2) What is the optimal choice of a company in the four strategies? How does this choice change as the market environment changes? (3) How to refrain the deceptive advertising of companies and purify the market environment?

2. The Theoretical Contributions

The researches on deceptive advertising mainly analyze it from the legal perspective, and lack of further exploration on the timing and strength of advertising^[1-4]. In this paper, a two-period model is established to analyze the maximum profits of the four possible advertising strategies. We analyze whether the companies should make deceptive advertisements, and we make a research on the timing and level of advertisements. Based on the market environment and product characteristics, we put forward advertising advices to companies, and also give opinions to consumers and government regulatory authorities.

3. Results

Corollary 1. No matter the company provides high-quality or low-quality products, its advertising level in the second period will not be influenced by the first-period decisions. **Corollary 2.** When the company provides high-quality products in the first period, the first-period advertising level will not be influenced by the price of the second-period products. **Corollary 3.** When the company provides low-quality products in the first period, the first-period advertising level will be influenced by the price of the second-period products. **Corollary 4.** The company will provide low-quality products and make deceptive advertisements when: (1)The difference in unit cost between high-quality products and low-quality products is large; (2)The government supervision is loose; (3)Negative word of mouth effect is sufficient small. **Corollary 5.** If the price cannot be changed in the two periods, the company will not choose the third advertising strategy (LH), because $R_{HL}^* > R_{LH}^*$.

We find that the advertising level in the second period is not affected by the first period, which is consistent with the concept of sunk cost in economics, but the advertising level in the first period is limited by the cost of the product in the second period. In many situations, there is a certain cost difference between high-quality products and low-quality products, and government supervision is not strict enough. Therefore, the company may maximize its profit by introducing deceptive advertising in a certain period. We find that making deceptive advertisements at the later stage is always better than the early stage when the prices cannot be changed. Only when the difference between high-quality and low-quality product costs is narrow, and the government supervision is stringent enough, the company tends to make no deceptive advertisements.

Companies should consider the current profits as well as the impact of word of mouth on the long-term profits, so they may choose to make deceptive advertisements at the later stage of product life cycle. For government, if the supervision is strict enough, the company may choose to make no deceptive advertisements. However, for products with a large difference in costs, the government needs to pay a huge cost of supervision. Only for the products with little difference in costs, government supervision can play a significant role.

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