

Original Article

EXPLORING CONSUMER INSIGHTS THROUGH MULTIMEDIA IMAGE DATA FUSION IN E-COMMERCE

Thomas Anderson

Department of Marketing Analytics,
University of California, Berkeley, CA,
USA

Abstract: In the era of rapid e-commerce expansion, an increasing number of consumers are opting for online purchases to fulfill their daily needs. Nevertheless, the dynamics of online product marketing have gained recognition among scholars and e-commerce professionals. The study of consumer impulse shopping behavior is currently limited, both in terms of depth and breadth, with scattered research in various countries. In the context of China, there exists room for more comprehensive theoretical exploration. The escalating competition within the realm of online e-commerce intensifies the challenge of enterprises accurately comprehending consumer motivation and behavior. Consequently, this paper delves into the theoretical underpinnings of the influence mechanism on online e-commerce product purchase behavior. The proposed model provides a thorough understanding of the formation of online shopping impulse behavior, serving as a valuable resource for e-commerce practitioners in navigating this highly competitive landscape.

Keywords: E-commerce, Impulse Shopping Behavior, Online Marketing, Consumer Motivation, Competition in E-commerce

1. Introduction

At present, under the background of the rapid development of e-commerce, more and more consumers choose to buy the goods they need in life online. However, the online marketing of goods has gradually attracted the attention of many scholars and e-commerce practitioners. At present, the research on consumers' impulse shopping behavior is relatively lacking, and the research in other countries is also relatively scattered, and some theoretical research in China is not deep enough. The competition in the network e-commerce industry is becoming more and fiercer, which makes it difficult for enterprises to accurately grasp the consumer's consumption motivation and consumption behavior. Therefore, this paper theoretically discusses the influence mechanism of online e-commerce product purchase behavior, and this model can well explain the formation mechanism of online shopping impulse behavior.

At this stage, many merchants are using online platforms to promote sales, and more consumers are becoming more and more enthusiastic about online shopping. Online shopping has become an important way of consumption in China. Zhao Xueyang investigated the watermelon consumer groups in Beijing, summarized the behavior tendency and characteristics of watermelon consumer groups from the perspective of consumption behavior, and on this basis, put forward a marketing strategy for watermelon consumer groups: develop small fruit watermelon, pay attention to its taste and quality. He adopted a low price strategy to ensure quality. In the channel strategy, it can be expanded through online stores and other network channels; In terms of promotion strategy, the watermelon market publicity should be strengthened through various forms such as holding "watermelon exhibition" [1]. Li Ting believes loneliness has become an increasingly common social

Original Article

phenomenon. In recent years, research findings on the effects of loneliness on consumer behavior have played a large role in the field of consumer behavior. Individual loneliness would affect compensatory consumption behavior, escape consumption behavior, irrational consumption behavior and unique consumption behavior. At the same time, the intimate relationship between consumers, marketing strategy, product attributes and consumption context and other factors would also have an impact on this effect. In addition, social substitution theory, sense of control theory, compensatory consumption behavior theory, self-regulation theory and personality trait theory can also be used to explain the influence of loneliness on consumption behavior. His future research should focus on the influence of loneliness on altruistic consumer behavior, the influence of the type and degree of loneliness on consumer behavior, the regulating factors of loneliness on consumer behavior, and the internal mechanism of loneliness on consumer behavior [2]. The purpose of Yang Xingxing is to clarify the formation mechanism of sports competition consumption behavior, improve the consumption level of competition consumers, and promote the high-quality development of competitive competition and performance industry. Based on the intervention theory, he used content analysis and scale and other methods to initially construct the influencing factors, and used Delphi method and mathematical statistics to optimize the influencing factors [3]. However, with the rapid development of e-commerce, an important issue that enterprises need to face in marketing and new product research and development is how to carry out online shopping to consumers and stimulate their impulse shopping desire.

In this paper, the target customers are divided into different categories, the feature set of customer portraits is established, and the characteristics of customers are described by mathematical model, so as to obtain the significant features that affect customers, and the model is tested and evaluated. This paper also studies the problem of customer management in social commerce, and discusses how to use customer portraits to optimize Yelp sites and provide targeted services and recommendations.

2. Methods of Consumer Behavior in E-Commerce Environment

2.1 Characteristics of Consumer Behavior in E-Commerce Environment

E-commerce is based on modern information technology, and its activity space has changed from traditional physical commodity trading space to electronic space. Compared with the traditional business model, consumer behavior in the e-commerce model has the following characteristics [4-5]:

Greater choices: In traditional marketing, consumers can only choose limited products in a specific place (such as a city), while in e-commerce, with the development of Internet technology, consumers can choose more products and services according to their own needs [6].

Convenient choice: Compared with the traditional business model, in the environment of e-commerce, consumers are not constrained by time and space, and they can choose products and services that meet their needs at any time and place. Therefore, compared with the traditional store shopping mode, consumers' choice is more free and convenient [7-8].

Directly participate in the production, circulation links. Under the traditional marketing model, the goods or services chosen by consumers are all designed and produced in advance by enterprises, and these goods or services can finally reach consumers through different sales channels [9]. In this model, consumers cannot clearly express their wishes and needs. At the same time, due to the constraints of technology, capital and other factors, enterprises cannot well meet the individual needs of customers [10-11]. The circulatory system of commodity circulation is realized by the three links of producers, operators and consumers, among which the commercial organization plays the role of connecting producers and consumers. In e-commerce, consumers and manufacturers directly form the circulation loop of goods, and consumers can directly participate in the design of goods [12].

Original Article

Focus on the security and reliability of the network: at present, many people on the network do not know enough about the security of credit cards, and many people are afraid of their accounts and passwords being stolen, which would bring huge losses to themselves.

Concern about the convenience and feasibility of the website: the use of broadband technology has greatly improved the speed of the Internet, and netizens have benefited a lot. If customers can't access the site, then online shopping is impossible. The lower the download rate of a website, the lower the number of customers' visits, which would have a greater impact on customers' shopping behavior.

Emphasis on corporate image: The overall image of a company refers to the overall image of a company that is recognized by consumers and the public by its external characteristics and operational capabilities [15]. Under the traditional marketing method, the visibility, credibility and reputation of the enterprise are the capital of the enterprise. In the mode of e-commerce, the image of an enterprise would also greatly affect the behavior of consumers, because consumers cannot judge the quality of goods or services according to their own feelings, so they are more inclined to buy traditional enterprise brands.

2.2 Influencing Factors of Online Consumer Behavior

The traditional shopping model revolves around the purchase behavior of consumers in the store, and retailers can use the layout of the store, environment, atmosphere and other factors to attract consumers. These factors would have a certain impact on the mood and shopping intention of consumers, resulting in unnecessary consumer behavior. In the service, the waiter has carried out a detailed introduction and explanation to the customer, and can intuitively obtain the relevant information of the product, the payment method and personal information are very reliable, and the purchase process would not be affected by its own network operation technology. Compared with the traditional way of shopping, the biggest feature of online shopping as a new consumption mode is that it relies on the development of network technology [17].

With the rapid development of network technology, more and more consumers have begun to have an interest in online consumption. At present, many scholars have conducted relevant research on the influencing factors of online consumption behavior. The emergence of the Internet provides customers with an effective way to collect information, breaking the limitations of time and space, in order to minimize search costs. Therefore, the network consumption behavior would be affected by the network information. However, searching for information on the Internet does not necessarily lead to buying behavior on the Internet. The characteristics of online shopping make the related factors of online consumer behavior show different characteristics from the past. As an external influencing factor of consumer behavior, Internet can be divided into several main factors [18].

The first is the security issue, which is the most mentioned and most important factor by scholars, because of the openness of the Internet, the Internet brings a variety of risks to consumers and retailers. Secondly, the concept of customers, in the traditional shopping habits, consumers rely on seeing is believing, through personally looking, smelling, touching, tasting, trying and other feelings to judge and choose products, so as to make purchase decisions. In online shopping, only a visual effect is provided, and consumers would form a perception and cognition of this kind of shopping, which would have an impact on consumer behavior [19].

2.3 Multimedia Image Data Fusion Algorithm

Although multi-source image fusion can also be classified as multi-sensor information fusion, the special information form of image makes it unique and complex. Therefore, the research on general data fusion is much less in depth and breadth. Image fusion is not simply the merging of multiple "independent" pixels. Image fusion has a very high requirement for the registration accuracy of participating images (especially pixel level images), but the registration accuracy of general images (such as position fusion, etc.) is relatively low. Therefore, to evaluate the fusion performance of a fusion method, it is necessary to have a reasonable evaluation method and standard.

Original Article

In consumer behavior research, when the mean and variance of each subband coefficient of wavelet decomposition are calculated, the regional mean mm_{tt} of the subband center is as follows [20].

$$m_t = \frac{1}{A \times B} \sum F(x) \sum F\left(y + t - \frac{A+1}{2}\right) \quad (1)$$

In the study of consumer behavior, the number of sub-band images of two images is fused and calculated [21].

$$RR_{HH} = WWmmWWx(FF(xx) + AA) + WWmmWWWW(FF(xx) + BB) \quad (2)$$

$FF(xx)$ is the image number gray value of the image.

3. Consumer Behavior Experiments under E-Commerce Environment

3.1 Determination of Objects

The development of social commerce platforms can be roughly divided into three categories:

(1) Construction based on e-commerce

On the basis of the existing e-commerce model, establish a special community or shopping group, in this way, would have the same buying preferences of the crowd gathered, so as to promote the development of e-commerce itself. For example, Tao Jianghu and Jingdong Lexiang are social commerce platforms based on their e-commerce platforms [22].

(2) Third-party social trading platforms

Such a social e-commerce platform is independent from the e-commerce platform, has its own user system, and is not too dependent on the e-commerce platform. For example, there are Meilishuo and Mogujie in China, and Yelp overseas, which have a lot of fans in China.

(3) Social commerce built on social platforms

Based on existing social network platforms such as Facebook, Twitter and Sina Weibo, it is a social network business platform formed by combining them with e-commerce platforms.

Founded in 2004, Yelp.com is a website that covers restaurants, shopping malls, hotels and other areas across the country, much like Dianping in China. A search on Yelp shows business profiles and reviews from other consumers, who rate businesses on a scale of [0, 5] stars based on their experience. In addition, Yelp website also has a social function, that is, users can become friends with each other, but also on the Yelp website to express their views, share their shopping experience and so on.

3.2 Data Preprocessing

The Yelp dataset is a set of public data, provided by Yelp.com, that includes information about merchants and users. There are five different tables in a dataset: Subject, Review, Users, signings, and Tips. The raw data contained 150,000 merchant entries, 1,180,000 customer entries, and 4730,000 review entries. Each set of data is a lightweight data exchange format. To better handle the data, this article uses python to import the data into the database and uses sql 2012 (Structured Query Language) to process the data:

According to the research goal, this paper mainly studies the customer characteristics based on social relationships. Therefore, three data tables of businesses, reviews and users in the data set are selected as the original data for the research.

Early data preprocessing steps:

(1) Remove unique attributes

Generally, there are some id attributes, such as business_id(id, Identity document), user_id, review_id, which cannot describe the distribution law of the sample itself, so it is only necessary to remove duplicate data.

(2) Processing of missing values

If a small part is missing, it would be removed or replaced by the average of the attribute.

(3) Ensure the rationality of data

In the Businesses data form, there should be a definite interval for the specific location of the latitude and longitude, and it should not be a random number. If it does not meet the requirements, the record should be

Original Article

deleted; The "is_open" attribute is mainly used to record whether the store is currently open. If the store is closed, then the record cannot be kept, but is removed, that is, the column with the "0" is removed. Assuming that the merchant is operating, if there is no record of any operating hours, then it should be deleted, that is, the blank line in the "hours" record should be deleted. In the Users data table, because the Yelp site has not been established, users that do not contain "Yelp_since" should be removed; On Yelp.com, this article is based on the number of messages to buy an odd number, so eliminate users who do not leave messages; "elite" indicates how long a person has been an elite user, which should coincide with, and should not exceed, their time on Yelp.

Table 1: Yelp public data set and processed data set

Data samples	Yelp public dataset	Processed dataset
Number of customers	1180000	1100000
Number of merchants	150000	100000
Comment data	4730000	4000000

In the reviews table, "user_id" and "business_id" should be consistent with the external keyword references for "user_id" and "business_id" in the user table and the merchant table; if they are not consistent, they should be removed. Through the above methods to process the original data, the sample data can be used for research. Yelp public data sets and processed data sets are shown in Table

3.3 Influence of Rating on Purchasing Behavior

Before shopping, because of information asymmetry, consumers often cannot fully understand the situation of the goods and lack the means to evaluate the purchased goods, which leads to the uncertainty of shopping behavior. In e-commerce, word of mouth would affect customers' purchase behavior, and the merchant's score is the sum of all the scores given by customers who have purchased, which is a form of online word of mouth. The higher the score, the more convincing it is, and the easier it is to convince consumers to buy. Therefore, a high score should correspond to a higher average number of purchases. From the merchant's point of view, raising the level means increasing the revenue. From the customer's point of view, this is the degree of customer preference for high score merchants.

4. Descriptive Statistical Analysis of Consumer Behavior in E-Commerce Environment

In Yelp's evaluation system, the star rating given by a customer is the whole star in a range [1,5], while the overall rating of a business is the average number of stars obtained by the business among all users. The value is taken as the nearest half star. The higher the rating of a business, the more satisfied the customer is with his product. According to preliminary statistics, there are currently 1100,000 customers, 100,000 merchants, and 4 million reviews. Since every Yelp review is the evaluation of customers after actual purchase, the number of reviews is used to represent the number of purchases. The number and proportion of purchases of each star-rated business are shown in Figure 1. In terms of shopping ratings, customers are clearly choosing 3.5 and 4-star merchants, with 55% choosing 3.5 to 5 stars. Therefore, the number of purchases by businesses with high stars is indeed significantly higher than that of businesses with low stars, which shows that stars would affect the number of purchases,

Original Article

and customers would be more willing to buy businesses with high stars.

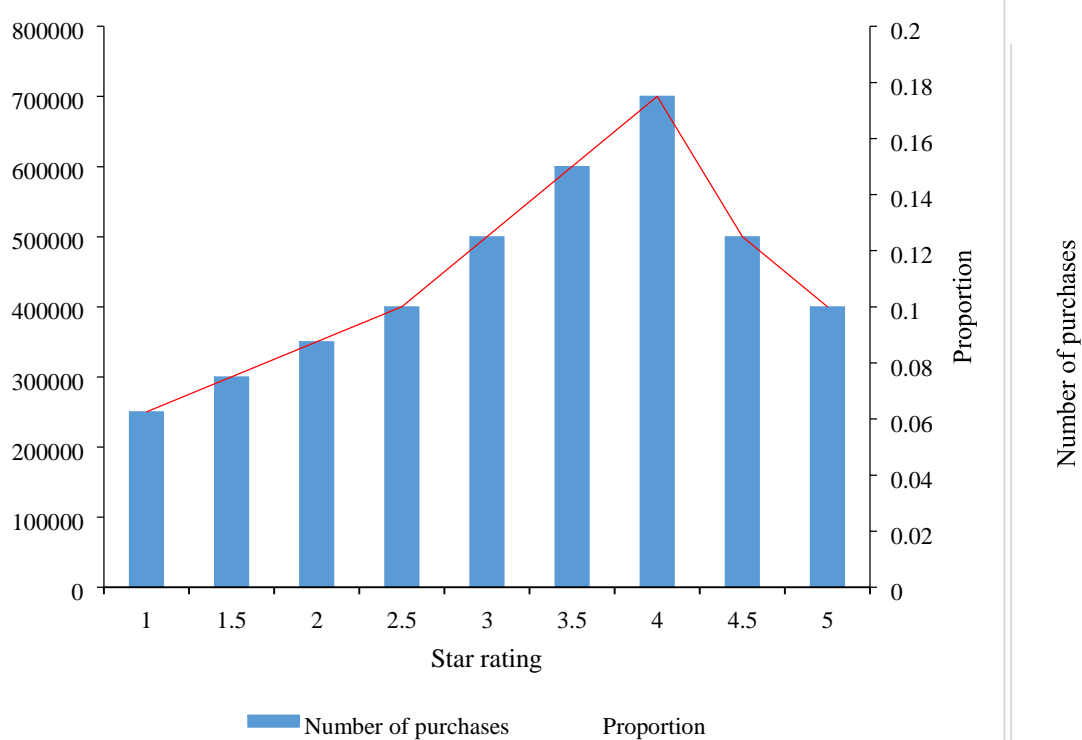


Figure 1: The number and proportion of purchases of each star merchant

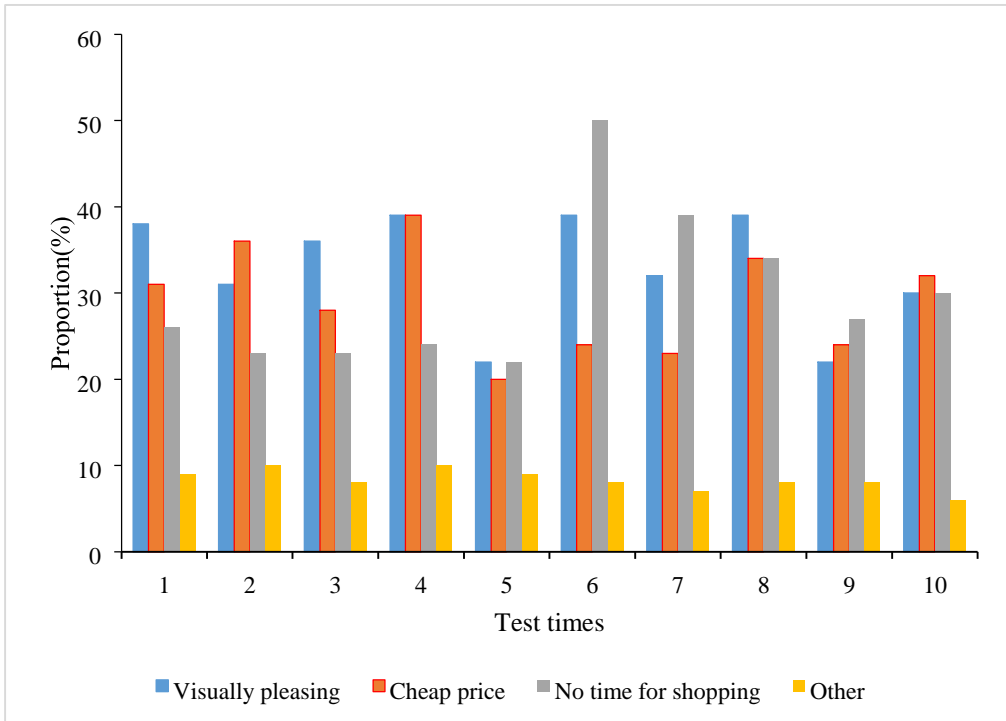
The data set construction is shown in Table 2. In terms of distinguishing between high score and low score, this paper calls the enterprises with more than three stars as high score enterprises, and the enterprises with three stars and less than three stars as low score enterprises. It builds data sets that include merchant ids, the number of purchases made by customers to merchants, overall merchant ratings, and rating groupings.

Table 2: Data set construction

Merchant ID	b1	b2
Number of times customers make purchases from merchants	40	10
Overall rating of merchants	4	2.5
Rating grouping	High score merchants	Low score merchants

Original Article

The distribution of reasons for online shopping is shown in Figure 2. The proportion of visually attractive is 32.8%, the price is cheap 29.1%, and the proportion of no time shopping is 29.8%.



Yelp has a set year for its members, and the term "elite" is a special designation Yelp gives to members, who can enjoy some special benefits, such as participating in various limited events hosted by Yelp. Here, this paper would

Figure 2: Distribution of reasons for online shopping

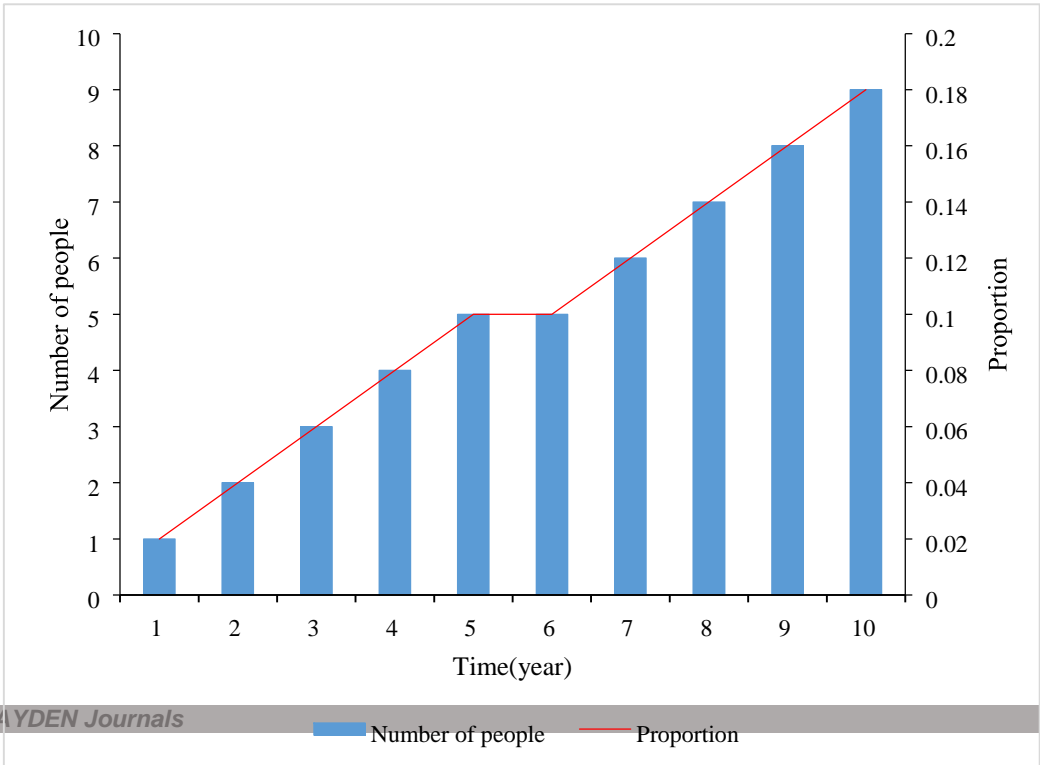


Figure 3: Number and proportion of elites

Original Article

calculate how many years a customer becomes elite, and label the customer as elite. The largest number of elite users is in the 10th year. The number and proportion of elites are shown in Figure 3.

5. Conclusions

This paper summarizes the current situation, development trend and characteristics of social commerce. On this basis, this paper reviews the research on customer purchase behavior and customer portrait in social commerce, and points out that there are few studies on customer portrait in the context of social commerce. Then, an empirical study was conducted using Yelp social commerce data set to test the social commerce features on Yelp data set, and a conclusion was obtained that could well reflect the impact of ratings and social relationships on purchasing behavior. Customer portrait technology is based on historical behavior data. In order to achieve a comprehensive expression of existing customers, future research should consider the adverse impact of historical data contained in customer portraits on the analysis results, that is, the factor of time decay.

References

- Zhao Xueyang, Hu Baogui, Liu Chao. Research on watermelon Marketing Strategy based on Consumer Behavior. *Bulletin of Chinese Agronomy*, 2018, 34(14):160-164.
- Li Ting, Kong Xiangbo, Wang Fenghua. The influence of loneliness on consumer behavior and its theoretical explanation. *Progress in Psychological Science*, 2023, 31(6):1078-1093.
- Yang Xingxing, Wang Mengyang. Research on the constituent elements of consumer behavior in sports events based on involvement theory. *Sports Science and Technology Literature Bulletin*, 2022, 30(10):202-206.
- Bytyqi N, Muji S, Rexhepi A. Consumer Behavior for Milk and Dairy Products as Daily Consumption Products in Every Household—The Case of Kosovo. *Open Journal of Business and Management*, 2020, 08(2):997-1003.
- Dholakia R R, Dholakia N, Chattopadhyay A. Indigenous marketing practices and theories in emerging economies: Consumer behavior and retail transformations in India. *Journal of Business Research*, 2018, 86(MAY):406-415.
- Wang Feiran. A comparative survey of consumer behavior and preferences in relation to pork consumption in Japan and China. *Nihon Chikusan Gakkaiho*, 2019, 90(4):327-335.
- Filice E, Neiterman E, Meyer S B. Constructing Masculinity in Women's Retailers: An Analysis of the Effect of Gendered Market Segmentation on Consumer Behavior. *Qualitative Sociology Review*, 2019, 15(1):86-104.
- Haryanto B, Purwanto D, Dewi A S, et al. How does the type of product moderate consumers' buying intentions towards traditional foods? (Study of consumer behavior in Indonesia). *Journal of Asia Business Studies*, 2019, 13(4):525-542.
- Krasonikolakis I, Vrechopoulos A, Pouloudi A, et al. Store layout effects on consumer behavior in 3D online stores. *European journal of marketing*, 2018, 52(5-6):1223-1256.

Original Article

- Lee J. A Study of Fashion Brand Experience and Consumer Behavior. *Journal of Wellbeing Management and Applied Psychology*, 2020, 3(2):13-20.
- Maheswari K I, Gorda A A N O S. Consumer Behavior in the Era of Industrial Revolution 4.0. *Russian Journal of Agricultural and Socio-Economic Sciences*, 2019, 94(10):152-157.
- Melnyk V, Carrillat F A, Melnyk V. The Influence of Social Norms on Consumer Behavior: A Meta-Analysis. *Journal of Marketing*, 2022, 86(3):98-120.
- Parfenova A, Romashova S. The role of procrastination in students' consumer behavior: Budget planning and impulse buying. *International Journal of Sociology and Social Policy*, 2019, 40(1/2): 133-144.
- Park S H. The Relationship among Servicescape, Affect Response and Consumer Behavior Intention of Billiards Club. *Korean Journal of Sports Science*, 2020, 29(2):495-507.
- Raewf M B, Thabit T H, Jasim Y A. The Relationship between the Elements of Marketing Mix and Consumer Behavior during Environmental Uncertainty: Cihan University-Erbil *Journal of Humanities and Social Sciences*, 2021, 5(1):50-55.
- Ryu Y A, Park M E, You S Y. Consumer Behavior toward Adopting Electric Vehicles. *Journal of Industrial Economics and Business*, 2020, 33(6):1961-1980.
- Shirin E, Bindu H, Kodali S, et al. The Impact of Store Environment on Consumer Behavior. *International Journal of Current Microbiology and Applied Sciences*, 2021, 10(2):1739-1744.
- Tiansi C, Hui T, Kabinga T, et al. Unlocking the Network Traffic Password of the Sudden Popularity of Oriental Selection: Consumer Behavior Decision-Making Mechanism Based on Mental Accounting Theory. *Psychology Research*, 2022, 12(11):879-889.
- Wu Y. Analysis on Marketing Strategies and Consumer Behavior during Online Shopping Carnival in China. *Proceedings of Business and Economic Studies*, 2021, 4(4):60-64.
- Yoo C K. Exploring pro-environmental consumer behavior strategies associated with in-flight service of passengers: Focusing on scarcity and compensation behavior. *International Journal of Tourism and Hospitality Research*, 2019, 33(5):77-90.
- Wei Zhiming and Zhang Bukuo. Considering the uncertain LRP site selection of consumer behavior and demand in a competitive environment. *Logistics technology*, 2023, 42(1):65-68.
- Cai Aili. Asynchronous online teaching design based on exploring the theoretical model of the community--taking the "Online Consumer Behavior Analysis" course as an example. *Jiangsu Higher Vocational Education*, 2022, 22(5):84-90.