

*Full Length Research Paper*

# Research on the mechanisms of big data on consumer behavior using the models of C2C e-commerce and countermeasures

Min Tang<sup>1\*</sup> and Zhong Wu<sup>2</sup>

School of Management, Shanghai University of Engineering Science, No.333, Longteng Rd, Songjiang District, Shanghai, 201620, China.

Received 19 August, 2014; Accepted 13 January, 2015

The purpose of this study is to investigate the mechanisms of big data on consumer behavior on the models of C2C e-commerce. From the beginning of the following five aspects: recommendation system, information search, reputation system, virtual experience and security system, the paper discusses some factors that affect buying intention in C2C e-commerce under big data. It fully considers the characteristics of big data, and then constructs the behavioral decision-making model of C2C e-commerce consumers, especially the factors of perceived usefulness, perceived risk and trust are integrated into the model of this research. We conduct the survey method and collect 245 valid questionnaires on consumers in each area in Shanghai and online using the quota sampling method. The empirical data show that it has six hypotheses being rejected, and others are supported in 20 hypotheses. According to the results, the paper also discusses why these hypotheses are not supported and give some marketing countermeasures in order to help the e-commerce enterprises better respond to the challenges of big data.

**Key words:** Big data, C2C e-commerce, behavioral decision-making model, mechanisms, countermeasures.

## INTRODUCTION

The aim of the paper is to highlight the relationship among perceived usefulness, perceived risk, trust and consumer's buying intention. This relationship is viewed as a significant issue in the field of consumer behavior since the heat of research on big data by enterprises and academia is increasing year by year. The potential value of this paper is to provide discussion platform in the field of consumer behavior. From the start of the recommendation system to the popular social media marketing

recently, these all prove that the mode of C2C e-commerce has taken a great change at the background of this era. According to the characteristics and development of big data on the models of C2C e-commerce, our paper builds up a conceptual framework among security system, reputation system, recommendation system, information search, virtual experience, perceived usefulness, perceived risk, trust and consumer's buying intention and supply an expected causal relationship in

\*Corresponding author. E-mail: [m.latifiyan@yahoo.com](mailto:m.latifiyan@yahoo.com)

order to explore their corresponding relationship attributes.

The development of big data and related technologies has brought huge impacts on the traditional network marketing.

By collecting different data of Internet users in this era, such as attribute data on geographic distribution, real-time data on search phrases, behavioral data on shopping and browsing behavior, as well as social data on hobbies and social connections, enterprises can achieve geographical orientation, demand orientation, preference orientation, relationship orientation and other directional ways in the advertising push, realize precision and personalized marketing. Additionally, they can achieve commodity push across different platforms and terminal by the integration of big data. However, compared with the relatively mature commercial practice, theoretical research on what a fundamental shift in consumer behavior in C2C e-commerce at the background of big data is relatively backward, and it has not caused widespread interest and concern by scholars. Therefore, it is necessary to carry out this research.

Perceived usefulness means the users subjectively think that using this system can improve the degree of their job performance. There are many areas researching the influence of perceived usefulness currently. In technology promotion, Sanchez and Hueros (2010) found that perceived usefulness can affect the user attitudes and thus indirectly alter the user behavior in the applications of new technology or a new form of business promotion. In the library management, Wang and Guan (2010) applied gap theory, and verified that perceived usefulness played an important role in improving service quality of university library from three aspects of service quality, information quality and online system quality by empirical analysis. In network marketing, combining the theory of environmental psychology and TAM, Koufaris and Hampton (2002) explained the consumer behavior of online shopping. He considered that perceived usefulness in TAM had more significant influence on consumer behavior of online shopping compared to other factors. From the research of previous people, we can find that the key determinant is perceived usefulness of consumers whether consumers are willing to accept a new information systems or technology in TAM.

The original concept of perceived risk was proposed by the Harvard University, professor Raymond Bauer in 1960. He believed perceived risk was actually that any purchasing behavior of consumers was likely to lead to its own unpredictable results (Bauer, 1960). From the perspective of expectancy theory, Wang et al. (2003) thought that perceived risk is expectations of withstanding the loss of consumers on a predictable result. In the area of e-commerce, it often comes with the issue of information asymmetry. This information asymmetry makes the consumer at a disadvantage when online shopping

and its decisions need to face a lot of risks and uncertainties (Cha, 2006). From six dimensions of social risk, privacy risk, economic risk, time risk, performance risk and psychological risk, Featherman and Pavlou (2002) researched the consumer acceptance of e-commerce. Doolin and Stuart (2005) also confirmed the relationship between perceived risk and consumer behavior decision of online shopping by empirical research. Therefore, this paper views perceived risk as one of the intermediate variables to research the consumer behavior in C2C e-commerce at the background of big data.

In the emerging e-commerce, more and more people pay attention to trust. Todd (2011) believed that trust was the consumer perception of the business commitments and consumer awareness of the business honest behavior. Lee and Turban (2010) confirmed the trust tendency of consumers would act on trust through three factors of safety factors, online shopping environment, trustworthiness of online businesses together. Walczuch and Lundgren (2004) mainly research the psychological determinants of consumers on online shopping trust, including those based on perception factors, experience factors and knowledge factors. Gordon et al. (2006) pointed out that customer trust is a key factor in the success of mobile e-commerce. Therefore, this paper views trust as one of the intermediate variables to research the consumer behavior in C2C e-commerce at the background of big data.

## LITERATURE REVIEW AND HYPOTHESIS SETTING

This framework is mainly derived from Davis (1986) and it is mainly used to research the behavior of people accepting information systems. TAM considers that the behavior of individual use information systems is determined by the behavioral intention of use information systems. In the area of e-commerce, the first person who introduced TAM into this field is Judy and Lin (2000). They used TAM to explain consumer acceptance of shopping sites. Then TAM is extended by Pavlou (2003). They introduced trust and perceived risk into TAM in order to predict consumer acceptance of e-commerce. Leo (2010) added subjective norms variable of Theory of Planned Behavior (TPB), variable of Innovation Diffusion Theory (IDT), variables of privacy, security and self-efficacy based on TAM to predict consumer acceptance of online shopping. However, with the scale of online shopping in the proportion of social spending increased year by year; C2C has become an important part of online shopping and major business types. User consumption habits, behavior habits, browsing habits and search habits also have experienced a complex evolution. Such huge data and amazing growth represent a new challenge to interpret the data and accurate insight into

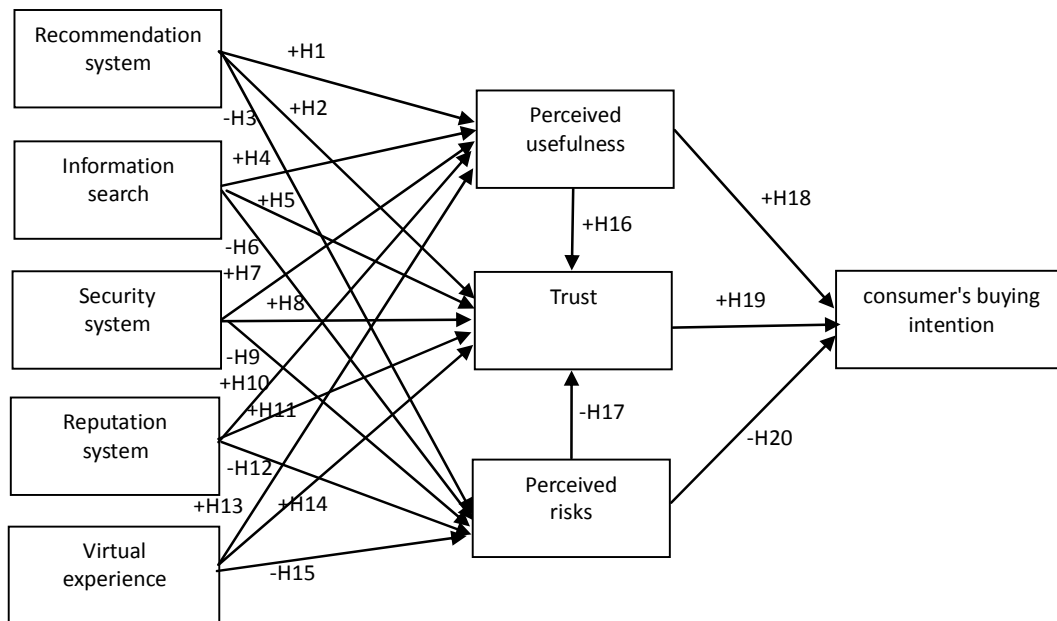


Figure 1. Research framework.

customer needs. A variety of information has had some positive and negative effects on consumer behavior and habits. Combined with research angles of many scholars at home and abroad, as well as the long-term online shopping practices and observation of the authors, the authors select out five influencing factors: security system, credit system, recommendation systems, information search and virtual experience, and proposed an integrated model to explore the effects of big data on consumer behavior on the models of C2C e-commerce. Figure 1 displays the conceptual framework of this study.

**Effects of recommendation system on perceived usefulness**

In the era of big data, the consumer can not directly confront with retailers. What is more, product differentiation gradually decreases. These two factors resulted in businesses lacking understanding of consumer preferences and consumer hesitation of choosing goods. Komiak and Benbasat (2006) once experimentally verified that individuation of products recommendation would affect consumer trust, thereby affecting consumer perceived usefulness of products recommendation.

Xiao and Benbasat (2007) suggested that the presentation of products information would affect consumer purchase decisions, thereby affecting consumer emotional perception of the site. Therefore, the research assumes:

**Hypothesis H1:** The more perfect recommendation

system is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.

**Effects of recommendation system on trust**

Komiak and Benbasat (2003) found that interface design based on the demand dialogue can increase user trust beliefs of personalized recommendations, thereby affecting the user plan of adopting the personalized recommendation as an aid of decision-making. Based on the information of customer purchasing behavior, browsing behavior and evaluation of goods, C2C recommendation system learns the customer's interest to do commodity matching, and then recommends goods to customers.

Information richness, the accuracy and reliability of goods have an impact on generating perceived trust of consumers, thereby affecting the purchasing behavior. Therefore, the research assumes:

**Hypothesis H2:** Recommendation system has positive effect on consumer trust.

**Effects of recommendation system on perceived risk**

Using recommendation system to obtain information can reduce the browsing pressure because of overload information, and perceived risk of the users can be reflected by the user judgment of the experience of recommendation system (Liang et al., 2006). Thus, the

intention of using recommendation system to obtain information reflects the value judgment, perception and experience of users on recommendation system. Recommended system provides consumers with information such as expert reviews and consumer reviews, which will shake consumer evaluation and attitudes of goods in varying degrees. Therefore, the research assumes:

**Hypothesis H3:** The better recommendation system is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.

#### **Effects of information search on perceived usefulness**

According to the model of availability - diagnosability, reputation information of high quality the consumer can help consumers identify and locate the products or service being evaluated accurately because of the clear, substantial and credible content; it has diagnosis of high capacity. Due to the exponential growth of data, consumers often get information through an external search at the background of big data. Childers et al. (2010) found that the emotional experience of consumers had an impact on their attitudes in the information searching process of online shopping, and this emotional experience often comes from the external searching process of others' comments. Therefore, the research assumes:

**Hypothesis H4:** The better information search is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.

#### **Effects of information search on trust**

Yao (2009) found that the satisfaction of information search had a positive impact on the perceived usefulness, safety and consumer trust. In big data environment, when the amount of data reaches a certain level, the query reaches a certain number and many people inquire at the same time; it will usually take a long time to find the data which they need from a database. If consumers can quickly search the products information they need, the cost of time will get corresponding reduction, thereby producing the trust. Therefore, the research assumes:

**Hypothesis H5:** Information search has positive effect on consumer trust.

#### **Effects of information search on perceived risk**

Consumers mainly collect the products information through online information. In big data environment,

consumers click to know the products information they need like the ocean of information. Consumers can search for the information they are interested in by themselves, select and browse from a lot of information and utilize the information comprehensively, in order to form their own judgments of a product or service and make the initiative of online transactions grasp in their own hands. Therefore, the quickness and safety of online information collection increase the perceived value of online shopping. Therefore, the research assumes:

**Hypothesis H6:** The better the information search is, the lower the consumers' risk perception of C2C e-commerce is in the big data environment.

#### **Effects of security system on perceived usefulness**

C2C is a virtual and non-face trading form of business transactions; its security of trading information had been consumer concern. Cyberspace covered a broad range of data sources, such as sensors, social networks, record archiving, e-mail; a large collection of data inevitably increased the risk of user privacy leaks (Feng, 2013). CNNIC surveyed to find that 89.2% of the e-commerce site visitors worried about fake websites, in which 86.9% of people said that if they could not get further confirmation of this website, they would choose to drop out the deal (Gold, 2010). So consumers will greatly reduce the perceived usefulness of the website when their perceived security cannot reach their expectations. Therefore, the research assumes:

**Hypothesis H7:** The better the security system is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.

#### **Effects of security system on trust**

Lu and Zhou (2005) showed that website security had a significant impact on initial establishment of online consumer trust. Shao et al. (2006) also believed that the measures of the website privacy protection and security control had a significant impact on the trust. Pavlou (2003) studied to find that perceived security also had a significant impact on the trust. In C2C online shopping, the safety of commodity distribution, quality, transaction, payment, privacy, safety and after-sale service and other security systems had a great relationship with whether online consumers trust or not. Therefore, the research assumes:

**Hypothesis H8:** Security system has positive effect on consumer trust.

### Effects of security system on perceived risk

In a virtual network environment, customer had full uncertainty in the purchase of products and service (Gefen D, 2000). Consumers would be asked to provide personal information such as name, address, and credit cards to complete the online transaction (Hatlestad, 2001). The utilization of big Data will make the service suppliers collect customer information and even monitor the consumers under the circumstance of consumers who do not know and agree. This will lead to the consumer privacy leaks. Consumers often worry that their trading information will be attacked by hackers and invaded by viruses. Therefore, the research assumes:

**Hypothesis H9:** The better the security system is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.

### Effects of reputation system on perceived usefulness

The utilization of e-commerce websites broke down the boundaries of distance, but increased the asymmetry of consumer purchase information (Mcknight, 2002). This asymmetry of information had a tremendous impact on perceived usefulness of consumers. Resnick and Zeckhauser (2002) considered that the design of reputation feedback system could minimize the fraudulence and reduce the behavior of network fraudulence in e-commerce transactions, thereby improving the perceived usefulness. Kiku and Leonard (2002) pointed out that the reputation after several trading behavior would further affect the credit behavior; reputation had become an indispensable factor of online shopping applications. Therefore, the research assumes:

**Hypothesis H10:** The better the reputation system is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.

### Effects of reputation system on trust

Many scholars have come to a similar conclusion about the research on seller prestige and reputation. They thought that seller prestige had a positive impact on the Trust of online consumers. Chrysanthos (2003) considered that prestige would become an important reference index of consumer choice with the same kind of merchandise. The results of domestic scholars (Lu and Zhou, 2005) also showed prestige had a significant effect on initial establishment of online consumer trust. Therefore, the research assumes:

**Hypothesis H11:** Reputation system has positive effect on consumer trust.

### Effects of reputation system on perceived risk

Non- face to face communication between consumers and sellers in C2C platform results in the importance in communication between buyers and sellers and the evaluation recognition extent of other consumers on sellers. Serious problems such as false propaganda, inconsistent quality with introduction, poor after-sales service have affected the purchasing behavior of consumers. In order to reduce the risk, consumers generally prefer the e-business with high reputation. Therefore, the research assumes:

**Hypothesis H12:** The better the reputation system is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.

### Effects of virtual experience on perceived usefulness

Virtual experience is sensory stimulation generating the virtual and real thinking space; it is a collection of many emotions and thinking such as emotional information and psychological phenomena. It is also a collection of changes in consumers' unique physical and psychological factors (Yao, 2009). From the perspective of consumer demand, Cao and Yu (2010) thought that the experience of virtual products is the promotion of online shopping from purchasing the products of meeting their own needs to purchasing the products of suiting their own characteristics. Therefore, the research assumes:

**Hypothesis H13:** The better virtual experience is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.

### Effects of virtual experience on trust

According to the user trust of virtual shopping, acceptance intention and willingness to pay for personalized recommendation service, Urban et al. (2009) found that most people trust and accept virtual shopping.

Theory of reasoned action says that a person's consequence assessment of an act will affect his behavior and attitude. In the research, behavior and attitude correspond to consumer trust. The corresponding behavior is completing online shopping in C2C e-commerce.

Consumer satisfaction of purchasing products in the past determines online shopping attitudes held by different trust. Therefore, the research assumes:

**Hypothesis H14:** Virtual experience has positive effect on consumer trust.

### Effects of virtual experience on perceived risk

Experience is a response to communication among customer, product or service, enterprises and representatives. Positive response would encourage consumers to approve the value of products or service (La et al., 2003). Rich experience content of the website would make consumers spend more time in cyberspace, and immerse in the network experience, as well as they would generate a positive perception (Chen, 2006). When participating in experienced activities, enjoyment of the process, feeling and good or bad fantasy would affect the customers' assessment (Yao, 2006). According to previous studies, the research assumes:

**Hypothesis H15:** The better virtual experience is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.

### Effects of perceived usefulness on trust

Trust is the statement of the nature of people, events or objects, or a fact. The statement is thought to be reliable or trustworthy. Some academics have also explored the relationship between perceived usefulness and trust between. Koufaris and Hampton (2002) considered that perceived enjoyment would have a positive impact on trust by perceived usefulness and perceived ease of use when consumers shop online through the website. Therefore, the research assumes:

**Hypothesis H16:** There is a positive relationship between consumers' usefulness perception of C2C e-commerce and consumer trust.

### Effects of perceived risk on trust

The influence of perceived risk on trust has also been confirmed by scholars. In online shopping environment, perceived risk was considered to have a negative impact on trust (Kimery and McCord, 2002). Heijden (2003) considered that the reduction of perceived risk could indeed increase the trust and attitudes of online shopping, thus increasing the online shopping intentions of purchasers. Therefore, the research assumes:

**Hypothesis H17:** There is a negative relationship between consumers' risk perception of C2C e-commerce and consumer trust.

### Effects of perceived usefulness on consumer's buying intention

Perceived usefulness is the subjective evaluation that a

new technology can bring benefits for their own from the users' psychological levels. Logically speaking, it is only when people feel a technology can help their work and life will they use technology. According to the TAM, perceived usefulness could affect consumer behavior (Davis, 1989). In addition, other scholars have confirmed the existence of this effect (Yang et al., 2006). Therefore, the research assumes:

**Hypothesis H18:** There is a positive relationship between consumers' usefulness perception of C2C e-commerce and consumer's buying intention.

### Effects of trust on consumer's buying intention

Wang and Emurian (2011) thought that the present and future development of e-commerce would be vulnerable for the lack of an atmosphere of trust. The empirical result by Gefen et al. (2003) showed that consumer familiarity and trust of the e-commerce website and its process had brought a significant positive effect on consumer buying behavior. The research by Heijden (2003) showed the same result. Trust would determine the consumer's buying intention by affecting the attitudes of consumers. By studying 45 researching papers in the academic journals, Chang et al. (2005) found that lack of trust was a major obstacle to online shopping. As the research is conducted in the context of big data, the trust factor is necessary as an important factor affecting the decision-making of consumer behavior. Therefore, the research assumes:

**Hypothesis H19:** Trust has positive effect on producing consumer's buying intention.

### Effects of perceived risk on consumer's buying intention

There are some studies to verify the influence of perceived risk on consumer's buying intention. Kimery and McCord (2002) demonstrated that perceived risk of consumers had a negative impact on purchase intentions in e-commerce environment. Kuhlmeier and Knight (2005) found that there is a negative relationship between perceived risk and buying intention by studying the antecedents of online shopping. The utilization of big data is full of uncertainties. If customers have high perceived risk of uncertain factors, it will hinder the buying behavior of customers. Therefore, the research assumes:

**Hypothesis H20:** There is a negative relationship between consumers' risk perception of C2C e-commerce and consumer's buying intention.

## METHOD

### Survey method

In our study, we use quota questionnaire as our sampling method and the sample presents the population characteristics. The sample is drawn from consumers in Shanghai. First, we compute the number of questionnaires that will separately be circulated in each area of Shanghai. Second, we circulate the questionnaire on the internet through the questionnaire star and chatter, such as QQ, Wechat. A total of 300 questionnaires were distributed for this research, 245 questionnaires were recycled, and the rate of recycling was 81.7%. After the consistency inspection, 43 copies of invalid questionnaires were dropped out, 202 valid questionnaires were retained, and the valid rate of recycling was 82.4%.

### Measurement

There are nine variables in our research study, which are independent variables (security system, reputation system, recommendation system, information search and virtual experience); intermediary variables (perceived usefulness, perceived risk and trust); dependent variables (consumer's buying intention). Our questionnaire refers to the literatures by foreign and domestic researchers and employs a 5-point Likert scale to measure each variable by the items in the questionnaire. The range is from "strongly disagree" to "strongly agree." Among them, "1" represents "strongly disagree," "5" represents "strongly agree."

## EMPIRICAL RESULTS

### Descriptive statistics

Table 1 shows the descriptive analysis of the samples based on the recycled questionnaires. From it, we can see that men account for 41.1% and women account for 58.9% in terms of gender in the valid samples, indicating that women consumers have a larger proportion in C2C e-commerce at the background of big data. In terms of age, the ages between 18 to 45 account for 89.6%, indicating that consumers are dominated by middle-aged and youths in this environment. In terms of marital status, the proportion of married and single is 48 and 52%, indicating that consumers have little difference in marital status in this environment. In terms of educational background, the proportion of junior college degree is 92.6%, indicating that the vast majority of consumers are the people who have a higher level of knowledge in this environment. In terms of occupation, the proportion of commuters in the samples is 28.2% and the proportion of the students is 71.8%, indicating that most consumers are students in this environment. In terms of durable years of Internet, sample proportion of 5-7 years reaches more than half, indicating that this is similar to the development of C2C e-commerce. In terms of the average time of day online, the samples were mainly concentrated on the range of 1-4 hours, indicating that the network activities take up a lot of entertainment and

leisure time out of work. In terms of online shopping experience, 92.1% say they have online shopping experience, indicating that the coverage of C2C e-commerce has been quite extensive at the background of big data.

### Reliability analysis and convergent validity analysis

According to nine factors and 43 indicators in the decision-making model, the research uses the Cronbach's  $\alpha$  coefficient to make the reliability measurements. The purpose is to verify the reliability of the questionnaire. According to Formell and Larcker (1981), a composite reliability larger than 0.6 indicates an acceptable fit of the data. Hence, the higher the value of Cronbach's  $\alpha$ , the greater the internal consistency and reliability in our questionnaire will be. The results of this research are shown in Table 2. The Cronbach's  $\alpha$  value of most variables are all above 0.7, and the Cronbach's  $\alpha$  value of each variable does not change significantly in the deletion of a single indicator, indicating that the questionnaire reliability is good.

In addition, the research uses the indicator of factor loading to evaluate the validity. We apply the LISREL model to analyze the results. From Table 2 we can see that all completely standardized factor loading are greater than 0.5 and reached a significant level ( $p < 0.05$  or  $p < 0.001$ ), indicating that it has a high degree of convergent validity between each variable and indicator.

### Fit indices of the proposed measurement model

In the Lisrel model, we adopt various fitness indices to examine the validity of the model and fit indices of the proposed measurement model are shown in Table 3. In our model, we calculate that the  $\chi^2/df$  is 2.15 between 2 and 5. The goodness-of fit index (GFI) is a measure of the relative amount of variance and covariance in sample data that is jointly explained by sample data (Joeslog and Sobom, 1984). If the model possesses a good fit, then the value is usually above 0.90. Note shows that it is 0.91. In our model, *CFI* is 0.94, *NNFI* is 0.97, *NFI* is 0.92, *GFI* is 0.91, and *IFI* is 0.93, individually. Moreover, *Root mean square error of approximation* (RMESA) provides information about the fit of the model with unknown but optimally chosen parameter values for the population covariance matrix, if it is available (Bagozzi and Yi, 1988). In our study, the RMSEA is 0.052, which indicates a good fit. Consequently, our model is well-settled (Anderson and Gerbing, 1988).

### The results of the structural model

The research uses the software of AMOS 17.0v to make

**Table 1.** Sample structure.

Feature variables	Category	Sample size	Percentage	Feature variables	Category	Sample size	Percentage
Gender	Male	83	41.1%	Occupation	Commuters	57	28.2%
	Female	119	58.9%		Students	145	71.8%
Age	Under 18	14	7.0%	Durable years of Internet	Within a year	2	1.0%
	18-25	129	63.9%		2-4 years	35	17.3%
	26-35	40	19.8%		5-7 years	106	52.5%
	36-45	12	5.9%		More than 8 years	59	29.2%
	Up 45	7	3.4%		Less than 1 hour	9	4.5%
Marital status	Married	97	48.0%	The average time of day online	1-2 hours	51	25.2%
	Single	105	52.0%		2-3 hours	78	38.6%
Educational background	High school	15	7.4%	Online shopping experience	3-4 hours	46	22.8%
	Junior College	49	24.3%		More than 4 hours	18	8.9%
	Undergraduate	82	40.6%		Yes	186	92.1%
	Graduate	56	27.7%		No	16	7.9%

Data source: This study.

**Table 2.** The results of each variable reliability and validity test.

Variables	Index	Cronbach Alpha if item is deleted	Cronbach Alpha	Factor loading	variables	Index	Cronbach Alpha if item deleted	Cronbach Alpha	Factor loading
Security system	SC1	0.812	0.873	0.88	Information search	IS1	0.732	0.834	0.65
	SC2	0.836		0.85		IS2	0.765		0.77
	SC3	0.841		0.81		IS3	0.724		0.62
	SC4	0.832		0.74		IS4	0.787		0.68
	SC5	0.827		0.83		IS5	0.802		0.61
	SC6	0.794		0.69		IS6	0.813		0.73
Recommendation system	RS1	0.849	0.865	0.83	Virtual experience	VE1	0.759	0.764	0.69
	RS2	0.846		0.86		VE2	0.786		0.65
	RS3	0.838		0.72		VE3	0.809		0.81
	RS4	0.841		0.71		VE4	0.683		0.80
	RS5	0.796		0.77		VE5	0.712		0.77
	RS6	0.818		0.78		VE6	0.743		0.74
Reputation system	RP1	0.783	0.855	0.86	Perceived usefulness	SC1	0.831	0.825	0.63
	RP2	0.845		0.71		SC2	0.785		0.68
	RP3	0.851		0.81		SC3	0.821		0.85
	RP4	0.849		0.67		PR1	0.695		0.70
	RP5	0.786		0.83		PR2	0.793		0.80
	RP6	0.847		0.78		PR3	0.827		0.82
buying intention	PW1	0.774	0.817	0.81	Trust	PR4	0.818	0.858	0.76
	PW2	0.781		0.66		TR1	0.852		0.78
	PW3	0.769		0.75		TR2	0.786		0.82

Data source: This study.



**Table 3.** The fitting results of structural equation model.

Project type	Fitting index	Judging criterion	Results of this research	Conformity between results of this research and ideal results
Absolute fitting index	$\chi^2/df$	$2.0 < \chi^2/df < 5.0$	2.15	Yes
	GFI	$> 0.90$	0.91	Yes
	RMSEA	$> 0.05$	0.052	Yes
Value-added fitting index	NFI	$> 0.90$	0.92	Yes
	CFI	$> 0.90$	0.94	Yes
	IFI	$> 0.90$	0.93	Yes
Simple fitting index	PGFI	$> 0.50$	0.53	Yes
	PNFI	$> 0.50$	0.52	Yes

Data source: This study.

the structural equation model analysis for the hypothesis and then verify the proposed hypothesized relationships, using the maximum likelihood estimation method (ML) to fit the model. The concrete data are shown in Table 3, each fitting index value reaches the criteria.

Based on the good model fitting, the research tests the hypothesized relationship through the path relationship. Path relationship is mainly shown by standardized coefficient relationship. The bigger the coefficient is, the greater the importance is in causality. As shown in Table 4, among 20 hypothesis of the research, six hypotheses (H2, H3, H5, H6, H14, H15) do not reach the significant levels and be rejected, others reach the significant level. Ultimately, the modified decision-making model of C2C e-commerce consumer behavior in the environment of big data is formed (Figure 2).

### Empirical analysis of models

The research makes the theoretical hypothesis and empirical analysis for the factors that affect the decision-making model of C2C e-commerce consumer behavior in the environment of big data. It focuses on validating the influence of perceived usefulness, trust and perceived risk on consumer's buying intention (behavior). Based on the TAM, the research constructs the decision-making model of C2C e-commerce consumer behavior in the environment of big data and uses the structural equation model to verify the 20 hypotheses, whose six hypotheses (H2, H3, H5, H6, H14, H15) were rejected, and others supported by the empirical data. Hypothesis 2 (recommendation system has a positive impact on consumer trust) is rejected. The reason is that the information of goods and discount push result in meeting the consumer demand unseasonably because of the time difference

and asymmetric information. Therefore, it cannot have an impact on consumer trust. Hypothesis 3 is rejected; the reason may be that recommendation system simply pushes based on the previous goods searching information and shopping information, and does not have much impact on consumer privacy. Therefore, it does not have obvious relative relationship between them. Hypothesis 5 (Information search has positive effect on consumer trust) is rejected; one of the possible reason is that the number of consumers accepting the information will affect the pleasure in the process of shopping, and there is no direct impact on consumer trust. Therefore, the hypothesis is not significant. Hypothesis 6 (The better information search is, the lower consumers' risk perception of C2C e-commerce is in the big data environment) is rejected; the possible reason is that in the middle of information search, perceived risk has two or even more than two variable as an intermediary, so that the relationship between them is not significant. Hypotheses 14 (Virtual experience has positive effect on consumer trust) and 15 (The better virtual experience is, the lower consumers' risk perception of C2C e-commerce is in the big data environment) are rejected; the reason may be that consumers' awareness of the virtual experience is very vague. They just know that it can help them better select products. In all the hypotheses supported, the significance of hypothesis 17 (negative relationship between consumers' risk perception of C2C e-commerce and consumer trust) is the most prominent, indicating that perceived risk has a great influence on the consumer trust in the environment of big data. Also, it shows perceived risk plays a very important role in the decision-making process of consumers' buying behavior. From the significant level of hypotheses 19 (Trust has positive effect on producing consumer's buying intention) and 20 (negative relationship between consumer's risk

**Table 4.** Inspection results of structural equation of hypothesized relationship.

Hypothesized content	Coefficient	Level p	Result
H1:The more perfect recommendation system is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.	0.431	***	Supported
H2:Recommendation system has positive effect on consumer trust.	0.063	0.642	Rejected
H3:he better recommendation system is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.	-0.103	0.583	Rejected
H4:The better information search is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.	0.552	**	Supported
H5:Information search has positive effect on consumer trust.	0.003	0.782	Rejected
H6:The better information search is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.	-0.054	0.562	Rejected
H7:The better security system is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.	0.382	**	Supported
H8:Security system has positive effect on consumer trust.	0.458	***	Supported
H9:The better security system is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.	-0.231	*	Supported
H10:The better reputation system is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.	0.203	**	Supported
H11:Reputation system has positive effect on consumer trust.	0.392	**	Supported
H12:The better reputation system is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.	-0.494	**	Supported
H13:The better virtual experience is, the higher consumers' usefulness perception of C2C e-commerce is in the big data environment.	0.309	*	Supported
H14:Virtual experience has positive effect on consumer trust.	0.007	0.705	Rejected
H15:The better virtual experience is, the lower consumers' risk perception of C2C e-commerce is in the big data environment.	-0.005	0.692	Rejected
H16: There is a positive relationship between consumers' usefulness perception of C2C e-commerce and consumer trust.	0.276	**	Supported
H17: There is a negative relationship between consumers' risk perception of C2C e-commerce and consumer trust.	-0.786	***	Supported
H18: There is a positive relationship between consumers' usefulness perception of C2C e-commerce and consumer's buying intention.	0.386	***	Supported
H19:Trust has positive effect on producing consumer's buying intention.	0.674	***	Supported
H20: There is a negative relationship between consumers' risk perception of C2C e-commerce and consumer's buying intention.	-0.623	**	Supported

Data source: This study.

perception of C2C e-commerce and consumer's buying intention), perceived risk also has effect. From these two hypotheses, we can see that the influence of perceived risk and trust on consumers' behavior in decision-making in C2C e-commerce at the background of big data is more prominent compared to perceived usefulness. These hypotheses tell us that C2C e-commerce merchants and platforms should take effective measures to reduce the perceived risk of consumers and increase consumer trust when they are marketing in the era of big data. For example, they can increase the business supervision and establish effective evaluation criteria of shops, thus improving loyalty and satisfaction of C2C consumers.

Other hypotheses are also significant, indicating that not only do C2C e-commerce merchants and platforms need to reduce the perceived risk of consumers and increase consumers' trust by constructing a stable security system and perfect reputation system; also they need to design good system of products recommendation, improve the function of information search and popularize the goods function of virtual experience. The purpose is to enhance the consumer's perception of usefulness. These measures are the changes that the special environment brings for behavioral decision-making of C2C e-commerce consumers. Enterprises and platforms should be aware of the changes and develop corresponding marketing strategies by several influencing

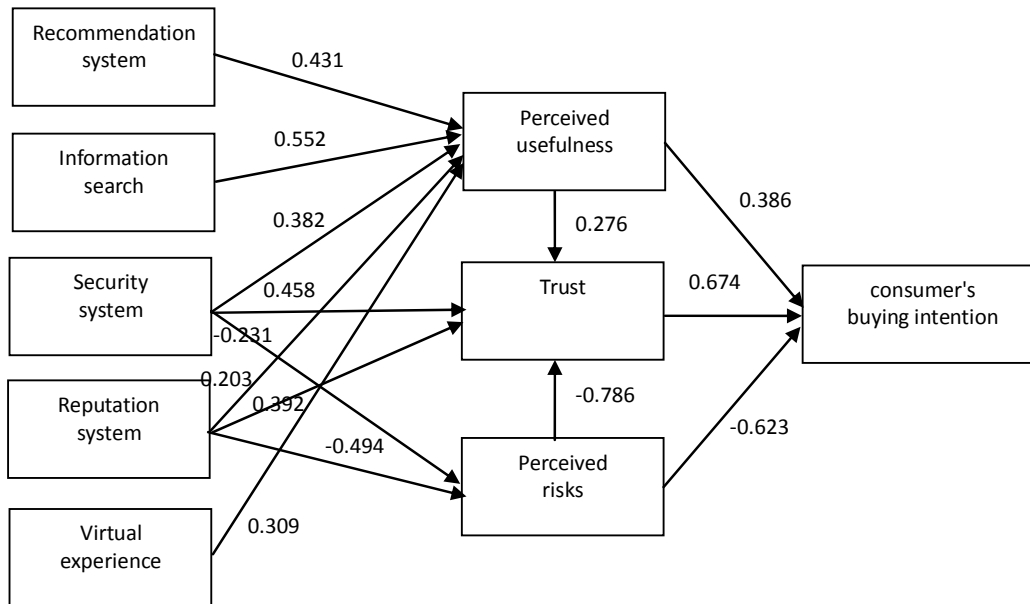


Figure 2. Path diagram of LISREL model.

factors above.

**Conclusion**

The paper uses the TAM to empirically analyze the decision making influences of recommendation system, information search, reputation system, virtual experience and security system on consumers of C2C e-commerce in big data environment. After making the optimization and improvement for several influencing factors above, the paper attempts to propose five main paths to provide consumers with better shopping experience, and provide more excellent marketing strategies for e-commerce enterprises.

The first path is to construct excellent recommendation system based on the big data. From the empirical results, we determined that there are three suggestions. The first one is to strengthen the strategic cognition of recommendation system, promote the decision making process of buyers and sellers. In this paper, hypotheses 1 and 18 show that excellent recommendation system will have a profound impact on the decision making in purchasing of consumers in the era of big data. Moreover, the impact will be fully reflected in the final selection, the quality of decision making and other aspects. First, recommendation system can save a lot of time of information search, evaluation and selection; it makes consumers to locate and match their preferences and points of interest easily. For example, the usage of recommendation system can expand the range of commodity search and evaluation,

so that consumers have a greater choice of goods, thereby enhancing the consumer's buying intention and desires. Furthermore, the extensive application of recommendation system will undoubtedly have certain impact on the decision making of buyers and sellers. From the perspective of consumers, consumers want to use recommendation system to improve their decision making in purchasing, thus purchasing the products of meeting their own preferences and needs with more reasonable and acceptable price (Zhao, 2012). From the perspective of interest groups, they want consumers to accept the recommendation of recommendation system in the largest extent in order to accelerate the process of decision making in purchasing, thus achieving or exceeding the sales target in the specified region. Therefore, constructing the excellent recommendation system has become an urgent need in the era of big data. The second one is to enhance the reliability of the recommended service, improve the consumer evaluation and acceptance of recommendation system. Product recommendation system recommends more reliable information; the easier it is to generate consumer's confidence, accompanied by a feeling of pleasure and motivation (Li, 2009). In order to effectively enhance consumer's acceptance of the recommendation information, to attract more potential customers to make a decision within a shorter time to buy the commodity businesses, online merchants must find ways to increase consumer's acceptance with the help of the product recommendation system which allows consumers to fully understand the product recommendation system is

dedicated to provide services to them. Consumers' perception of the recommendation system will not only help them to greatly reduce the time and effort required for product information search, evaluation and screening, but also it can help them to buy more in line with their own needs and preferences of goods at more reasonable price. Businesses can illustrate product's reliability by the rankings based on sales rank and reputation. It can also be described by influential opinion leaders' or experts' related fields experience to recommend the use of such actual similar cases and data can significantly enhance consumer's confidence on commodity recommendation system. The third one is to feature a well-designed recommendation system itself and optimize personalized service. In the era of big data, to let each consumer be able to experience "one to one" personalized shopping services to the maximum extent, shopping sites can track real-time changes in consumer demand through various channels, to find consumer's demand preferences and points of interest, to recommend consumers product which meets their needs, so that the recommended products' prices, features, quantity, size, brand, style and other attributes can best meet the selection criteria and preferences of consumers, which will improve consumer's acceptance and satisfaction of goods recommendation system (Wu, 2013). Through the development of new technologies, websites can also be automated access to information through the context of contextual information, which is synthesis to extend the scope of the collection of contextual information, and to determine changes in consumer demand for goods based on changes in a particular context, in order to improve reliability and accuracy of personalized product of personalized e-commerce platform commodity recommendation, to improve recommendations adaptability, to achieve better personalized merchandise recommendation service.

The second path is to establish a sound reputation system based on big data. From the empirical results, we determined that there are two suggestions. The first one is to enhance the certification authority of the third party and establish the trust mechanism. The highlighted significance of hypothesis 19 indicates that trust has a significant impact on consumer behavior in decision-making which is not to be underestimated. So, good work of third-party certification is bound to reduce consumers' concerns about online transaction security, enhancing consumer's confidence index. We need to increase efforts to introduce well-known certification body throughout the industry, to strengthen the construction of third party certifications' authority; but we also need to step up publicity efforts on third parties, and to spread related organization information on third party, allowing consumers to learn what they can do and the role they play. Eliminating consumer's misunderstanding of these third-party in a gradual way will increase consumer's recognition of third party establishing trust between

consumers and third parties (Nie, 2013). Furthermore, the trust is transferred to buyers and sellers through a third party, and thus can contribute to lower consumer trust established C2C mode. At the same time, government agencies should also establish consumer confidence through the development and improvement of laws and regulations under the C2C e-commerce model, increase security of online transactions through technical means, of reducing speculation of businesses to enhance consumer's C2C confidence of electronic Business. For the public, in order to focus on improving the social and moral level, we need to create faith-based moral values to strengthen the integrity of the concept of public education, which is particularly important for the current situation of low trust. The second one is to enhance the quality of the platform site, reduce the perceived risk of consumers. From the point of view of this study's empirical results, the highlighted significance of hypotheses 17 and 20 have fully illustrated that the perceived risks associated with consumers' confidence and willingness to buy is important in consumer's buying behavior in the decision-making process. Therefore, businesses and interest groups can start in improving system's assessment evaluation, improving the quality of the site to meet consumer's trust and better expectations. In addition to doing their own web site quality assurance work, they should also vigorously promote the maintenance of the website for consumers, such as "payment system", a third-party guarantee, etc, to create an atmosphere of trust. To some extent, this will reduce consumer's perceived risk, enhancing consumer's confidence. In addition, in order to get more consumer's confidence, they can use traditional media to advertise, thereby enhancing awareness in consumers, and promoting the consumer's trust with high visibility.

The third path is to optimize and popularize the function of virtual experience. From the empirical results, we determined that there are three suggestions. The first one is to optimize the virtual experience of products, enhance the full display of products. Optimizing the virtual experience of products mainly breaks through the traditional model of products presentation like text and picture, optimizing the consumer awareness of products by the experience of virtual products, and further builds the confidence of purchasing. In the level of virtual products presentation, some relatively complex products like digital products and cars apply it more. They use the technologies like 3D products presentation and interactive animation to make consumers understand the overall details of the products through the network platform. The second one is to build up the management mechanism of virtual experience based on the technology of big data. In the level of virtual experience of products, virtual experience online makes consumer's awareness that products bring the satisfaction of their own needs for consumers get further promotion. Hypotheses 14 and 15

are rejected. The reason may be that consumer awareness of the virtual experience is very vague and they just know that it can help them better choose products. Because online shopping cannot be experienced personally, how to buy the products of meeting and suiting their own needs by online shopping has become an important factor affecting the satisfaction of online shopping. Therefore, the function of virtual experience of products is to make consumers understand the style and match of products by virtual usage, so as to choose more in line with their own needs. The third one is to make plans with the help of big data, enhance the virtual experience. Not only is big data able to find the short-board of user experience, but also big data itself bears the solutions to enhance the user experience. Because the big data has a diverse nature and rich source, it lays a foundation to solve the following problems (Kang and Liu, 2013): (1) discover the bottlenecks timely in the trading process with the help of big data; (2) achieve the larger trading volume with the help of big data; (3) optimize the information recommendation and reduce the consumer cost perception of virtual experience with the help of big data.

The fourth path is to improve the function of information search. From the empirical results, we determined that there are two suggestions. The first one is to integrate the search and marketing and reduce the perceived cost of consumers. With the popularity of the Internet and the development of e-commerce, the phenomenon of information overloading and complexity of choice will be more and more common. What is more, it will affect the consumer's buying intention. Therefore, enterprises of the e-commerce platform should display the commodity in the most acceptable and understandable manner by consumers for reducing their cognitive costs. At the same time, enterprises should improve the matching degree of shopping-oriented search and provide personalized products recommendation for reducing the searching costs. In order to help consumers relieve the pressure of information overloading, firstly, enterprises can adopt the products recommendation agent (RA) whose development is more mature to provide more comprehensive, adequate and personalized information for consumers in the phase of consumer information retrieval. The purpose is to make the consumer's evaluation for the products features, performance and price reasonableness more in-depth and accurate, thereby reducing cognitive deviation of different brands of products. Secondly, for the recommended products, RA often provides the information like expert comments and consumer reviews for consumers (Cheng and Cai, 2009). Hypothesis 3 is rejected; the reason may be that recommendation system simply pushes based on the previous goods searching information and shopping information, and does not have much impact on consumer privacy. Therefore, it does not have obvious relative relationship between them. The

second one is to introduce the technology of cloud computing, strengthen the service of information retrieval and reduce the perceived cost of consumers. For the perceived ease of use and perceived low cost of shopping sites, the emotional experience of consumers is more important in the process of information search. Hypothesis 5 is rejected, one of the possible reasons is that the number of consumers accepting the information will affect the pleasure in the process of shopping, and there is no direct impact on consumer trust. Therefore, the hypothesis is not significant. Hypothesis 6 is rejected; the possible reason is that in the middle of information search and perceived risk has two or even more than two variables as an intermediary, so that the relationship between them is not significant. In the specific cultural environment of China, people are more inclined to trust the more familiar enterprises. When consumers are no stranger to the shopping site and acquainted with it after interacting, it may build up consumer trust. Large-scale computing power provided by cloud platform architecture and processing capabilities of big data can provide the powerful function of personalized information retrieval. In addition, these abilities can bring about the new services of information retrieval, such as the service of information push, hot information push and information recommendation (Huang, 2012). The technical advantages of cloud computing enable the information retrieval and services to solve the long-standing problems of the comprehension of human natural language and knowledge reasoning, giving full play to the functions of data mining deeply and knowledge discovery. The purpose is to analyze and handle the behavior of the user information quickly and accurately, understand the expression of users' natural language and carry on the corresponding intelligent retrieval. Finally, the information and products meet the needs of users, thus improving the speed and accuracy of the service for users and promoting the satisfaction of consumers maximally (Yu, 2010).

The fifth path is to construct a stable security system in the era of big data. From the empirical results, we determined that there are two suggestions. The first one is to reduce information asymmetry and enhance customer security. Online payment has many characteristics, such as virtuality and Macross. Both transactions conduct online payment in a virtual environment of big data, and the two sides are difficult to evaluate objectively for authenticity and accuracy of the other party's information. In this case, the occurrence of the information asymmetry has certain inevitability. Therefore, the information asymmetry is the biggest obstacle to online payment and settlement. Applying big data in e-commerce, especially in C2C e-commerce cannot only reduce the risk of trust arising by information asymmetry, but also make consumers experience virtual shopping, thereby affecting the model of consumer shopping behavior. Under this scenario, big data becomes the new hot spot in the field

of e-commerce information in cloud computing and networking. The second one is to improve security system and increase customer loyalty. E-commerce based on big data as a new business model has great development prospects. Meanwhile, the e-commerce model puts forward higher requirements on management and information transferring technologies. The construction of security system is particularly important. How to build a safe and convenient environment of e-commerce applications and provide adequate protection for information are the concerned topic by businesses and users. In security system of data and application, it mainly considers that application system can seamlessly connect with the security service of the system layer and network layer, services for the software that are constructed in the operating system. In security management system, from the perspective of user management, enterprises should achieve unified partitioning strategies of user roles; from the perspective of resources management, enterprises should achieve distributed configuration of resources and unified management of resource directory; from the perspective of dual technology management, enterprises should achieve unified safety supervision in the light of all layers of requirements to provide the basis for IT decisions. In security system of network information, through the unified platform of security management, enterprises should provide comprehensive content of security service and form a mutual cooperative unity. The entire system covers all levels of security requirements from physical communications to network, the platform of system and the platform of data and application, thus forming a complete architecture of information security system.

### Conflict of Interests

The authors have not declared any conflict of interests.

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**Appendix.** The questionnaire of this study.

Variable	Items
Security system	<p>SC1: When shopping online, I am worried about the low safety of the site and the risk</p> <p>SC2: When shopping online, I am worried about a lot of uncertain security problem of payment and abandon the purchase</p> <p>SC3: When shopping online, safety is an important basis for our reference and choice of shopping website</p> <p>SC4: High safety of shopping website can let me feel at ease and satisfaction in shopping</p> <p>SC5: When shopping online, I will choose the high safety of shopping website</p> <p>SC6: I believe that the shopping website won't put my personal information out</p>
Recommendation system	<p>RS1: Shopping website recommendation of goods is what I need</p> <p>RS2: Shopping website recommendation of goods is that I have not purchased but want to buy</p> <p>RS3: I believe that the recommendation information is an act of kindness</p> <p>RS4: I believe that the recommendation of goods will not intentionally provide false information</p> <p>RS5: I doubt that recommended shopping website is how to get my personal information</p> <p>RS6: I'm worried about recommended shopping website will sell my personal information to others</p>
Reputation system	<p>RP1: When shopping online, I only choose the business who have good reputation and high evaluation</p> <p>RP2: When shopping online, the reputation of shopping website has a certain influence for my choice of shopping</p> <p>RP3: When shopping online, I will refer to the netizen's comments and opinions in this website</p> <p>RP4: I think business reputation and the risk of buying goods have an inverse relationship</p> <p>RP5: If the shopping website reputation is low, I will not buy goods in the website</p> <p>RP6: When shopping online, I usually compare different businesses reputation to make my choice</p>
Information search	<p>IS1: I can always search the useful information in the shopping website</p> <p>IS2: The information I search in the shopping site are detailed and completed</p> <p>IS3: I trust this shopping website because of the powerful search function</p> <p>IS4: Search results provided by shopping website is very real</p> <p>IS5: Considering the unsafe search information, I will give up to shopping in the website</p> <p>IS6: If the shopping website provides false results, I will give up to shopping in the website</p>
Virtual experience	<p>VE1: I prefer to choose the shopping site which provides virtual experience</p> <p>VE2: I'm very satisfied with shopping in the website which provides virtual experience</p> <p>VE3: The shopping website which provides virtual experience can let me choose more suitable goods</p> <p>VE4: Function of virtual experience is one of the most important factors that we choose the shopping website</p> <p>VE5: If the virtual experience reveals my privacy, I will give up this function</p> <p>VE6: If it has no related security measures, I won't use this function of virtual experience</p>
Perceived usefulness	<p>PU1: Online shopping can save time and money</p> <p>PU2: When I use the shopping website, I can feel fun and enjoy my time</p> <p>PU3: In a word, online shopping is very useful to me</p>
Perceived risk	<p>PR1: As soon as I see the problems of user reviews on the shopping website, I will never buy anything on the site</p> <p>PR2: The reason why I choose this shopping website is that I think it has low shopping risk</p> <p>PR3: I worry about the virus or hacker to steal my account information when shopping online</p> <p>PR4: I will feel the risk when shopping online</p>



**CONT Appendix.** The questionnaire of this study.

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Trust	TR1: I think trading by this website is reliable
	TR2: The recognition and trust to the suppliers of the online shopping service will affect the adoption of the shopping website
	TR3: I will be at ease when I use the site for shopping
Purchase willingness	PW1: I will use the site for shopping as soon as possible
	PW2: I will share the experiences of using the site with my friends
	PW3: I will use the site of e- commerce for shopping frequently in the future

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