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IoT Makes Life Simpler: How to Improve the Chinese Consumer's Intention to Use of LG HomNet Smart Home*

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Abstract

Purpose – The paper aims to develop the theory of TAM and perceived risk through a more comprehensive and rigorous understanding of the influencing factors of the consumer's adoption of LG HomNet smart home from the perspective of trade-offs.

Design/methodology – Based on the TAM and perceived risk theory, combined with the individual characteristics of consumers in the context of information technology as the external factors of the technology acceptance model, this paper constructs a theoretical model of the factors affecting the use intention of the consumer. It was empirically tested by using SEM, and survey data was collected from 458 respondents.

Findings – The research results show that 9 hypotheses of the research model are supported and have reliable prediction accuracy. Consumers' perceived interest, perceived connectivity and perceived controllability have a significant positive impact on their intention to use. In addition, this paper also confirmed the mediating effect of perceived usefulness and perceived ease of use.

Originality/value – Consumers are very concerned about gains and losses. Low-level performance risks, security risks, and financial risks will drive the consumer to have a stronger intention to use, and financial risks have the strongest impact. This research provides a useful implication and guidance for smart home equipment manufacturers and service providers in product and service innovation and marketing and promotion strategies.

Keywords: Influence factors, LG HomNet Smart Home, Perceived risk theory, Purchase intention, TAM

JEL Classifications: F47, M11, M31

1. Introduction

The related technologies of the Internet of Things (IoT) platform have received extensive attention in recent years. At the end of 2019, China has become the world's largest IoT market. Among the 1.5 billion cellular network connection devices in the world, 960 million are from

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China, accounting for 64%. China will become the world's largest consumer of the smart home market, occupying 50%-60% of the global smart home market consumption share, and profits occupying 20%-30% of the global market share. LG HomNet products are based on cutting-edge technology, breaking barriers in the field of smart home network solutions, and making LG Electronics' product portfolio networked. LG HomNet refers to LG Electronics' complete home network solution, which connects a variety of digital home appliances through the network to provide a convenient, safe, enjoyable and leisure living life anytime, anywhere. Therefore, studying the intention of Chinese consumers to use LG smart home products has important theoretical and practical significance for the current research in the field of IoT and for Korean companies represented by LG to enter the Chinese IoT market.

The current research from the perspective of consumer behaviors focuses on the impact of smart home technology attributes and social environmental factors on the perception and decision-making of users (Pal et al., 2018; Park et al., 2018). However, different individuals' psychological conditions and different perceptions of smart home will resulting in different adoption decisions. Therefore, in the context of information technology, considering the perception factors of different individuals on smart home can improve the persuasiveness of users' decision interpretation (Lee & Coughlin, 2015; Yang et al., 2017). The benefits of new products or technologies are often accompanied by risk. Adding perceived risk to the internal characteristics of new products has been widely recognized by the academic community, which is an important factor affecting users' behavior of adopting new products (Ostlund, 1974). Especially in the minds of the Chinese consumer, the smart home is a new product. When deciding to adopt, the consumer will not only consider the possible benefits, but also weigh the potential risks (Golant, 2017). Therefore, this study will build a research model based on TAM (Technology Acceptance Model) and perceived risk theory, and take the consumer characteristics of information technology situation (perceived interest, perceived connectivity and perceived controllability) as the external factors of technology acceptance model to predict the important factors affecting the Chinese consumer's intention to use the smart home and compare the degree of influence of each factor on the user's perception or intention.

One of the purposes of this study is to expand TAM theory and explore the impact of personality characteristics on consumer perception and adoption decision-making in the context of information technology. Hence, it is proposed that the perceived usefulness and perceived ease of use mediate the relationship between the personality characteristics and intention to use. In addition, the theory of perceived risk will be developed through a more comprehensive and rigorous understanding of the influencing factors of the consumer's adoption of LG HomNet smart home from the perspective of trade-offs. The findings of this study are expected to extend TAM theory, perceived risk theory and provide practical implications for the development of successful smart home strategies.

We contribute to the literature in several new perspectives. First, this study makes up for the deficiency of the existing smart home related research on the special needs of the consumer, and enriches and deepens the relevant theoretical research on the influencing factors of smart home adoption of the consumer. Second, based on the TAM, this paper introduces the perceived risk theory, which fills the lack of attention to negative factors such as risks or obstacles in the research on the consumer and intelligent technology adoption proposed by Golant (2017), and enriches the exploration of relevant factors affecting the consumer's adoption of smart home (Golant, 2017). Third, we constructed a theoretical

model based on the TAM theory and perceived risk theory, and explored the relationship between the variables of the model through the structural equation model (SEM). The model can explain and predict the usage intention of the consumer more deeply. Practically, smart home device manufacturers and service providers should pay close attention to the psychological characteristics of the consumer. The contribution of this study in practice is to provide practical guidance for government, smart home manufacturers, smart home service providers and insurance companies to increase the understanding of smart homes, and help the consumer build confidence in using smart homes.

This paper consists of five parts. The theoretical background of this study is presented in the second section following by the introduction, while the contexts of the third section are the research framework and hypotheses development. Then, research methods and data analysis are analyzed in detail in the fourth section. In the last section, the findings and highlights of the theoretical and practical implications for researchers and companies will be discussed as well as some suggestions for future research according to the limitations of this study.

2. Theoretical Background

2.1. The LG HomNet Smart Home Research

2.1.1. Introduction of LG HomNet Smart Home

Since Berg first proposed the term "smart home" in the 1980s, many concepts of the smart home have been proposed, and there is no unified definition. At present, academic circles mainly define it from two different perspectives. One is defined from the perspective of the services and functions that can be provided through a combination of technologies. Aldrich, Lutolf, and Hubert defined the nature of smart homes from the perspective of the types of user needs to be met (Aldrich, 2003; Lutolf, 1992; Hubert et al., 2018). Aldrich (2003) proposed that a smart home is a house equipped with information technology that can anticipate and respond to the needs of the occupants, and meet the needs of comfort, convenience, safety, and entertainment by managing the information technology in the house and connecting with the outside world (Aldrich, 2003). Lutolf (1992) similarly describes the smart home as integrating different services in the home through the use of a communication system, which ensures the economy, safety, comfort, and high operational flexibility of the house (Lutolf, 1992). Hubert (2018) believes that the smart home is equipped with electronic devices such as smart sensors and lights according to the expected needs of residents to increase comfort, entertainment, and safety (Hubert et al., 2018). The other is defined from the perspective of a specific service situation. Gramm Hanssen and Darby (2018) believe that the smart home connects sensors, controllers, and other devices so that residents and others can remotely monitor and control energy (Gram-Hanssen & Darby, 2018).

From the perspective of the services and functions that the smart home provides, this study will be based on the widely used concept proposed by Balta Ozkan et al. (2013). Combined with the situation of this study, the concept of a smart home is defined as "a home system equipped with high-tech network links, sensors and terminal devices, which can be remotely monitored, accessed or controlled, and can help improve the quality of life of the consumer".

LG smart home provides central air-conditioning control, power broadcast technology, elevator call function, access management control, mobile computer wireless control, smart

home appliances and other new concepts and new products of building intelligence, which opened a new page for China's construction industry and home furnishing industry.

2.1.2. User Adoption of LG HomNet Smart Home

In the field of smart home research, researchers are currently paying attention to the understanding of user habits and behaviors, and point out the factors affecting the adoption intention or behavior of smart home technology and services from the perspective of users. Tsai et al. (2019) discussed the impact of intrusion and comfort, perceived usefulness and perceived ease of use of intelligent medical, and health devices on use intention (Tsai et al., 2019). Kim et al. (2017) combined ELM (Elaboration likelihood model) and UTAUT (the Unified Theory of Acceptance and Use of Technology) to propose a model for the acceptance of location services for Internet of things devices (Kim et al., 2017). However, because smart home services are composed of interconnected (or combined) single smart devices, more and more scholars pay attention to the analysis from the perspective of the system. Many scholars pay attention to the role of smart home characteristics and potential benefits in user adoption decision-making. Shih (2013) integrated diffusion of Innovations theory and the technology acceptance model to explain the acceptance of smart home systems, and proved the influence of observability, compatibility, and other factors on the use of smart home systems (Shih, 2013). Based on the TAM (technology acceptance model), Park et al. (2018) proposes a smart home service acceptance model with core motivations such as perceived connectivity, system reliability and cost factors. With the in-depth understanding of smart home technology, more attention has been paid to the role of risk factors in personal decision-making (Park et al., 2018). Wang et al. (2018) measured the role of risk factors and positive factors at the same time and found that expected performance, compatibility, privacy risk and performance risk are the main factors affecting users' adoption intention (Wang et al., 2018). The study of Mani and Chouk (2017) found that practicality and intrusiveness are the two strongest predictors of consumers' refusal to adopt smart products (Mani & Chouk, 2017).

2.2. Features of Smart Home Products

2.2.1. Interconnection of Smart Home Products

The interconnection of smart home products refers to the connection between other smart home products through ZigBee, Z-Wave or WIFI, etc., to produce a certain effect through mutual combination. At present, although there is no unified communication standard in the smart home market, some smart home products can already be interconnected with designated categories of items or other home products. It is precisely this part of smart home products that can achieve interconnection and interoperability, making remote control and automatic monitoring technology a reality.

2.2.2. Diversified Control Methods

There are diversified control methods of smart home products, including: button type, touch type, voice control and induction type control.

Button controls are primarily operated by mechanical buttons and switches. The characteristics of this type of control method are mature technology, low fixed cost, and familiarity with users. Touch control means that users can control smart home items by touching mobile phones, tablets, and control panels. The voice control of a single product in

a smart home means that you can use voice to send specific instructions to the single product, and the corresponding single product will respond accordingly. Correspondingly, inductive control refers to that one or several sensors are embedded in a single smart home product, which will trigger its sensing mechanism under certain conditions.

2.2.3. Rich product features

From a functional point of view, smart home products are usually more versatile and humane than traditional home products of the same type. Smart home products have low learning costs for consumers and are more acceptable to consumers. Some smart home products only add control functions to the original home products. For example, if you install an automatic sensing device that can be remotely controlled on the curtains in the original home, you can set the stretching and shrinking of the curtains to automatic mode or operate on the remote terminal. In addition, some smart home products have been expanded on the basis of the functions of traditional home products. For example, the combination of a smart anti-theft lock and a smart camera can not only guarantee home security, but also can monitor the situation at home at any time, and even automatically alarm.

2.3. Technology Acceptance Model and Development

2.3.1. Technology Acceptance Model (TAM)

The technology acceptance model (TAM), originally proposed by Davis in 1989, is one of the most popular and persuasive methods to describe users' acceptance of information technology (Davis, 1989). It originated from rational behavior theory (TRA) and planned behavior theory (TPB), trying to apply psychological factors to information system research (Schepers & Wetzels, 2007). The assumption of this theory from the perspective of sociology and psychology is that individuals are always rational in the face of choice and judgment, and can fully and effectively process information; individuals can completely decide to adopt or give up a certain behavior. Davis found that TAM was better than TRA in predicting software use intention (Davis, 1989). TAM is not only the most widely used model to explain users' acceptance of new technologies, but also, its determinants are very important to explain the adoption of new technologies in social problems (Shin & Park, 2018). The two factors that affect attitudes summarized in TAM are perceived usefulness and perceived ease of use. Behavior intention is determined by two variables, perceived usefulness and attitude, and attitude is determined by two variables, perceived usefulness and perceived ease of use. Although TAM is a reliable acceptance theory, it sometimes causes insufficient explanatory power because individual differences (including age, education, income, self-efficacy, etc.), technology, culture, and use environment will affect the structural effectiveness of TAM. Therefore, the ability of the original TAM to predict self-reported behavioral intention and actual use is limited. Increasing the effectiveness of TAM by introducing new structures can improve the explanatory power of TAM, including user differences (personal cognition and other personality characteristics), system characteristics, and task characteristics (Bagozzi, 2007; Izak & Henri, 2007).

2.3.2. Development of Technology Acceptance Model (TAM)

Researchers try to extend the TAM model by introducing antecedent variables, moderating variables, and mediating variables into the TAM framework. In the field of aging research,

although from a theoretical perspective, the effectiveness of TAM in predicting the intention of adopting new technologies or services cannot be weakened. Chen and Chan (2014) pointed out that although TAM is a useful and reliable model, to better understand the consumer's technology acceptance behavior, other variables related to the consumer's physical and psychological characteristics should be included (Chen & Chan, 2014). So far, many studies have adopted the extended TAM framework to understand the ICT usage of the consumer. Mostaghel (2016) believes that the adoption of technology by the consumer is a multidisciplinary and complex process that is influenced by multiple roles such as the consumer themselves, their families, medical service providers, technology providers, and government and policymakers (Mostaghel, 2016). Lee and Coughlin believe that the adoption of technology by the consumer is not a purely technical issue, but a rather complex issue that stems from multiple aspects. It involves not only technical characteristics and personal characteristics but also the social environment and delivery channels (Lee & Coughlin, 2015). Therefore, this study proposes an extended TAM hypothetical model based on the characteristics of the research object.

2.4. Perceived Risk Theory

The concept of perceived risk was extended from the field of psychology by Harvard University scholar Bauer in 1960. Bauer believes that any individual behavior will have unpredictable consequences. Consequences leading to unhappiness or being inconsistent with expectations are beyond the individual's control, and in some ways, loss, and that is the risk that an individual's actions may face (Bauer, 1960). Perceived risk is an important factor that affects users' purchasing decisions. It mainly includes two reasons: one is the uncertainty of the results of the decision; the other is the severity of the consequences of wrong decisions. In the field of information system research, perceived risk is defined as the potential loss in the process of users pursuing the expected results of using electronic services. In addition, perceived risk is a multi-dimensional structure, and the dimensions of risk can vary according to different products or services. Perceived risk is considered to be one of the main determinants of individual acceptance and adoption (Featherman & Pavlou, 2003).

After Bauer put forward the theory of perceived risk, many scholars divided different risk dimensions. Cunningham divides the perceived risk into two categories: (a) performance risk and (b) psychological risk. Based on the assumption that all risk factors are derived from performance risk, Cunningham further subdivides the perceived risk into six dimensions: performance risk, financial risk, opportunity/time risk, security risk, social risk, and mental loss risk (Cunningham, 1967). Jacoby and Kaplan's divide perceived risk into five types based on Bauer's theory of perceived risk: performance risk, financial risk, social risk, physical risk, and psychological risk (Jacoby & Kaplan, 1972). The overall explanatory power of the above five dimensions for perceived risk reached 61.5%. In the research of information technology, many scholars have divided the dimensions according to the characteristics of research topics or research objects. Yang et al. (2017) added performance risk and physical risk to the research model to study the factors that affect users' adoption of wearable devices. The results show that two types of perceived risks are important influencing factors for measuring potential users' adoption attitudes (Yang et al., 2017). Hubert et al. (2017) added performance risk, security risk, and financial risk to the research model to study the factors that affect users' mobile shopping intentions. The results show that the three perceived risk dimensions are all significant influencing factors (Hubert et al., 2017).

For smart home applications, the risk may come from technology-based infrastructure (environmental risk), or it may come from individuals (behavioral risk) (Ring & Van, 1994). Perceived risk is likely to have a significant impact on user decision-making behavior. Therefore, in this study of the consumer's intention to use a smart home, the theory of perceived risk is introduced into the technology acceptance model. Combining the definition of perceived risk and the characteristics of smart homes, the perceived risk in this study refers to the unpleasant consequences that users may perceive when using smart homes that they cannot accurately predict. Considering the specific characteristics of a smart home and the division of smart home risk dimensions in the previous research, the perceived risk is divided into three dimensions, including performance risk, security risk, and financial risk.

3. Research Model and Hypotheses

3.1. Research Hypotheses

3.1.1. Relationship Between Perceived Interest and Perceived Usefulness

Davis et al. (1992) explored the external and intrinsic power of the technology to accept the model, and found significant relationships between the two regulatory variables that perceived interest the technical acceptance model. The definition of perceived interest in this paper is "users are happy and interesting in the process of experiencing or using smart home items". In addition, some previous studies have explored perceived interest as one of the important predictors of user views. Based on the empirical results of 195 mobile device users, Kim et al. (2010) show that there is a certain degree of connection between interest and perceived usefulness. Chung and Tan (2004) pointed out that entertainment with information-oriented service is an irreplaceable role in forming user experience. Hence, we hypothesize:

H1: Consumers' perceived interest in smart home has a significant positive effect on their perceived usefulness.

3.1.2. Relationship Between Perceived Connectivity and Perceived Usefulness, and Perceived Ease of Use

Park and Kim (2014) studied the factors that help shape users' perception and attitudes towards mobile cloud computing services by combining some factors with the TAM. Park et al. (2017) also enriched previous research based on the TAM. They applied the TAM to the construction of the user acceptance model of smart home services, and established a model to study the factors affecting the user acceptance of smart home services. Perceived connectivity in this paper refers to the ability of consumers to connect to other smart home items when they purchase or use one or several smart home items. Users may want to easily use smart home items in a home environment, and users can conveniently use their devices and products without physical interaction. With the rapid development of technologies such as sensing and voice, smart home products are becoming more and more diversified, which is more in line with consumers' daily family life. Taking into account the maximum optimization of user experience, smart home single products and single products have emerged between the technology that can be connected to each other. Based on this technology, consumers can use a single smart home product to more easily complete the functions and

functions of the original home product.

Therefore, when a smart home item can be easily connected to other items, the user may feel convenient. In this case, consumers may also have an impact on the usefulness of the single product due to other functions generated by the increase in perceived connectivity. This means that the perceived connectivity between users and home components may be one of the factors that indirectly affect the purchase intention of smart home items. Hence, we hypothesize:

H2: Consumers' perceived connectivity in smart home has a significant positive effect on their perceived usefulness.

H3: Consumers' perceived connectivity in smart home has a significant positive effect on their perceived ease of use.

3.1.3. Relationship Between Perceived Controllability and Perceived Ease of Use

Perceived controllability can be defined as "the difficulty or ease of users using smart home items". In order to develop successful products and services, manufacturers must do their best to provide effective user interfaces for their products and services, so that users can give full play to their control skills. Demiris et al. (2008) proved that perceptual behavior control helps consumers recognize the need to use smart home sensor technology. Shin et al. (2013) studied a specific smart home application: Smart TV. Through empirical analysis, the paper studied the impact of interactivity on Korean residents' attitude and purchase motivation towards Smart TV. The study found that perceived controllability is one of the components of the interactive, and the perceived interactivity has indirectly affected the user's willingness to use smart home appliances by perceived performance. According to the collection results of Korean Smart TV user data, Yu et al. (2016) also pointed out that the user's perceived controllability is one of the significant factors that accept smart TV. Hence, we hypothesize:

H4: Consumers' perceived controllability in the smart home has a significant positive effect on their perceived usefulness.

3.1.4. Perceived Usefulness, Perceived Ease of Use and Intention to Use

Perceived usefulness in this study refers to the degree to which consumers subjectively believe that using a smart home can improve their quality of life. Shin and Park both use the extended TAM to study the factors affecting the adoption of smart home technology, and find that perceived usefulness has a significant positive impact on use intention (Shin & Park, 2018; Park et al., 2018). In the context of the Internet of Things (IoT), Bai and Gao found that perceived usefulness is the most significant and powerful predictor of an individual's willingness to use the Internet of Things (IoT) technology (Gao & Bai, 2014). A meta-analysis of the TAM literature also confirmed that the impact of perceived usefulness on intention to use is statistically significant (King & He, 2006). If consumers think that using a smart home can help them manage their lives more effectively, increase independence and improve the overall quality of life, they will have a positive view of using a smart home. For example, a smoke alarm monitors the concentration of indoor smoke, and when there is a danger, it will immediately sound an alarm to remind the consumer in time. If the consumer feels that this feature helps reduce the risk of fire and other risks, they may prefer to use smart homes. Hence, we hypothesize:

H5: Perceived usefulness has a significant positive impact on a consumer's intention to use a smart home.

In this study, perceived ease of use refers to the degree to which the consumer believes that the use of a smart home does not require physical and mental labor. The ease of operation of technology strongly affects the user's adoption behavior, especially in the initial stage of technology commercialization (Cimperman et al., 2017). Perceived ease of use is an individual's assessment of the effort required to use and learn technology. It not only directly affects intentions but also indirectly affects intentions through the perception of usefulness (Davis, 1989). In the context of smart home technology, perceived ease of use has also been successfully proven its role in perceived usefulness and technology adoption (Park et al., 2018; Nikon, 2015). If the consumer thinks that a smart home can be skillfully operated without effort, they will have a positive view of the use of a smart home. For example, many users in China have the habit of getting up at night. The intelligent night light will automatically sense motion and turn on, and the night light will turn off through automatic judgment after the user going to bed. The consumer's awareness of the ease of use of this automatic operation may improve their understanding of the benefits of reducing the risk of falling and tend to buy the product. Hence, we hypothesize:

H6: Perceived ease of use has a significant positive impact on the intention to use of smart home.

3.1.5. Perceived Risk Factors and Use Intention

Performance risk in this study refers to the possibility that consumers worry about smart home devices failing to provide expected services. Ram and Sheth (1989) believe that users want to know whether an innovative product has been fully tested or proven, because they may worry that new equipment or services may not function properly, and users will defend against performance uncertainties (Ram & Sheth, 1989). Especially in terms of smart home services, users are concerned about the performance of the smart home and whether the smart home can stably provide the expected benefits (Balta-Ozkan & Boteler, 2014). Hubert et al. (2018) found that performance risk harms on usage intention in the context of the smart home (Hubert, 2018). For example, many smart cameras cannot work in the event of a power failure or sometimes confuse cats and thieves, which will cause the consumer to worry about possible bad consequences, which will have a negative impact on their buying propensity. Hence, we hypothesize:

H7: Performance risk has a significant negative impact on the intention to use of smart home.

The financial risk in this study refers to the possibility that the consumer is worried that the application of smart homes will cause a loss or waste of money. Financial factors include the cost of smart home prices, repairs and maintenance, and value-added services. This burden may cause consumers to worry about spending a lot of money, thereby hindering users from adopting smart home technology (Balta-Ozkan et al., 2014; Chan & Chong, 2012). The higher the cost of innovation, the higher the perceived economic risk, which is one of the risk barriers to refusal to adopt (Ram & Sheth, 1989). Financial risk has been shown to have a direct and negative impact on users' willingness to use technology. Users may show resistance to smart

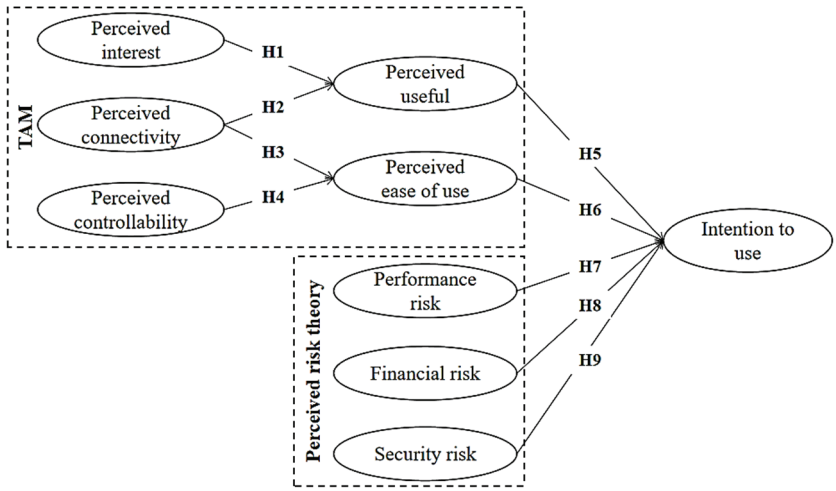
homes because they are worried about the economic burden of these costs (Yang et al, 2017). Due to a strong sense of frugality of the Chinese consumer, when adopting technology, they may have more financial concerns and be more sensitive to economic-related risks. In the context of smart home technology, if the consumer thinks that the use of smart home has a high risk of cost waste or economic loss, it will negatively impact on their mentality. Hence, we hypothesize:

H8: Financial risk has a significant negative impact on the intention to use a smart home.

The security risk in this study refers to the possibility that the consumer is worried that their personal data may be leaked or the smart home system could be hacked. The smart home system effectively provides services by collecting various lifestyle data such as residents' health data and energy usage, but it may aggravate users' perception of privacy infringement or even theft, hacking, or abuse, thus ensuring the safety of personal data as very important (Balta-Ozkan & Boteler, 2014; Mani & Chouk, 2017). Chou and Yutami (2014) also pointed out that privacy risks have a negative impact on smart meter adoption attitudes (Chou & Yutami, 2014). The eavesdropping and recording privacy of smart home technologies may cause families to perceive security risks due to unintentional sharing of sensitive information, and resist the refusal to adopt smart technologies (Mani & Chouk, 2017). Users have different views on privacy and security risks. Some people say they are not troubled by privacy issues, while others believe they pose a security threat to home automation and remote control (Lorenzen-Huber et al., 2011). The risk of privacy infringement is the main obstacle to the acceptance and adoption of smart homes, which has been confirmed by several of studies and will affect the intention to use (Yang et al., 2017). When the threat of privacy issues in smart homes makes the consumer highly sensitive, the consumer who values privacy protection will naturally refuse to use these smart homes. Hence, we hypothesize:

H9: Security risk has a significant negative impact on the intention to use a smart home.

Fig. 1. Research Model



This study puts forward 9 hypotheses and constructs a theoretical model adopted by smart home users, as shown in Fig. 1.

3.2. Research Methodology

3.2.1. Instrument

To ensure content validity, the items used to measure the constructs were adapted from the extant literature and modified to fit the study context. Perceived interest was measured using three items adapted from Kim et al. (2010). Perceived connectivity was measured using items adapted from Park et al. (2017). Perceived controllability was measured using items adapted from Yu et al. (2016). Measurement items for TAM of perceived usefulness, perceived ease of use, and intention to use were adapted from Davis. Measurement items for the perceived risk of performance risk, security risk, and financial risk were adapted from Hubert et al. (2018).

As the original items were in English, we conducted a back translation to ensure translation validity. First, a researcher whose native language is Chinese translated the source items from English into Chinese. Next, another researcher independently translated these items back into English. Subsequently, the two researchers compared the two English versions and jointly revised the first Chinese version of the items. We then invited a panel of experts in the consumer behavior field to examine the face validity of the survey instrument. Based on their feedback, minor modifications were made to improve the comprehensiveness and user-friendliness of the measurement items. A pre-test of the survey instrument was conducted to conceptually validate the instrument. All items were measured on a 7-point Likert scale, which ranged from 1 (not agree at all) to 7 (absolutely agree).

3.3. Data Collection

Considering that the degree of acceptance of smart homes in Shanghai is the highest and the people have more knowledge of intelligent technology, this paper chooses Huangpu District, Jingan District, Putuo District, and Pudong New District of Shanghai to conduct research. Based on the purpose of this study, this paper does not invite the subjects who do not know about smart homes to participate in this survey, so the final sample has good validity. Firstly, the four selected districts are the core regions of Shanghai, and the income level of these four regions is at a high level in China. Secondly, there are students in these four areas, which is convenient for a questionnaire survey. Finally, in order to help them understand the items more clearly, this paper collects data through face-to-face structured interviews with the respondents rather than filling them in by themselves. The time of a single questionnaire is about 18 minutes.

Before the formal interview, we told them that the research results were only used for research and analysis, emphasized the anonymity and confidentiality of the data, and that there was no right or wrong answer. In addition, respondents were told that they had the right to withdraw from the investigation at any time without any negative consequences. Most of the respondents completed the questionnaire, and only a few interrupted the survey because they left midway.

The data collection was conducted during summer 2021. A total of 500 responses were received over a four-week period. Thereinto, 458 responses were used for subsequent analyses after 42 incomplete and invalid responses were dropped. Table 1 summarizes the demogra-

phic information of the final sample. As Table 1 indicates, of the 458 respondents, 217 were male, and 241 were females. The age group of 21 to 40 was the largest, with over half of the respondents accounting for 58.4 percent. About 36.7 percent of the respondents had a monthly income between RMB 6001-8000 (equivalent to US $943–1257). Concerning occupation, 205 participants were corporate employees, accounting for 44.8% of the valid samples.

Table 1. Demographics of the Survey Respondents (N= 350).

Item	Characteristic	Number of Samples	Percentage (%)
Gender	Male	217	47.4
	Female	241	52.6
Age	20 or younger	156	34.1
	21–40	268	58.4
	41–60	30	6.6
	60 or older	4	0.9
Average Monthly Income	Less than 2000 RMB	68	14.8
	2001-4000 RMB	96	21.0
	4001-6000 RMB	102	22.3
	6001-8000 RMB	168	36.7
	8000+ RMB	24	5.2
Occupation	Student	54	11.8
	Corporate Employee	205	44.8
	Civil Servant	112	24.5
	Freelancer	68	14.8
	Others	19	4.1

4. Data Analyses and Results

4.1. Reliability and Validity

Construct reliability and validity were further examined through CFA. As shown in Table 2, the Cronbach's α and composite reliability (CR) values for each construct ranged from 0.837 to 0.954, both of which were above the suggested threshold of 0.7 (Straub et al., 2004) and exhibited a satisfactory level of reliability. For construct validity, both convergent validity and discriminant validity were examined. Convergent validity was confirmed by examining both the average variance extracted (AVE) and indicator loadings. As shown in Table 2, all AVE values were higher than the recommended level of 0.5 (Fornell & Larcker, 1981). The standard loadings of all items were above the desired threshold of 0.7 and significant at 0.001 thus indicated good convergent validity (Chin et al., 1997).

Discriminant validity was assessed by comparing the square root of AVE for each construct with the correlations between that construct and other constructs (Fornell & Larcker, 1981). Table 3 indicates that the square roots of the AVEs (diagonal elements) were larger than the inter-construct correlations depicted in the off-diagonal entries, suggesting adequate discriminant validity.

Table 2. Results of Confirmatory Factor Analysis

Construct	Indicator	Standard Loading a	Cronbach's α	CR	AVE
Perceived Interest	PEI1	0.851	0.897	0.907	0.766
	PEI2	0.867			
	PEI3	0.907			
Perceived Connectivity	PEC1	0.877	0.940	0.941	0.841
	PEC2	0.932			
	PEC3	0.941			
Perceived Controllability	PCN1	0.943	0.954	0.954	0.874
	PCN2	0.929			
	PCN3	0.932			
Perceived Usefulness	PU1	0.932	0.936	0.937	0.832
	PU2	0.905			
	PU3	0.899			
Perceived Ease of Use	PEOU1	0.907	0.941	0.943	0.804
	PEOU2	0.909			
	PEOU3	0.854			
	PEOU4	0.916			
Performance Risk	PR1	0.720	0.837	0.841	0.639
	PR2	0.852			
	PR3	0.821			
Financial Risk	FR1	0.909	0.927	0.926	0.759
	FR2	0.860			
	FR3	0.947			
	FR4	0.758			
	SR1	0.876			
Security Risk	SR2	0.916	0.922	0.928	0.763
	SR3	0.867			
	SR4	0.833			
Intention to Use	ITU1	0.929	0.920	0.921	0.892
	ITU2	0.876			
	ITU3	0.869			

Table 3. Results of Correlation Coefficient Testing.

Construct	M	S.D.	1	2	3	4	5	6	7	8	9
Perceived Interest	4.603	1.897	1								
Perceived Connectivity	4.150	2.147	0.087	1							
Perceived Controllability	3.953	2.129	-0.029	0.435	1						

Table 3. (Continued)

Construct	M	S.D.	1	2	3	4	5	6	7	8	9
Perceived Usefulness	4.270	2.083	0.153	0.186	0.294	1					
Perceived Ease of Use	5.288	1.802	0.020	0.201	0.255	0.607	1				
Performance Risk	5.353	1.591	-0.028	0.002	0.040	-0.019	0.070	1			
Financial Risk	6.335	1.187	0.103	-0.004	-0.016	0.023	0.188	0.276	1		
Security Risk	4.113	1.986	0.583	0.093	-0.004	-0.017	-0.080	0.080	0.090	1	
Intention to Use	3.750	1.704	-0.132	0.046	0.188	0.376	0.357	-0.171	-0.154	-0.259	1

Note: M: Mean, SD: Standard deviation.

4.2. Hypotheses Testing

After examining the measurement's validity and reliability, we tested the proposed hypotheses using AMOS. Table 4 indicates that nine of the hypothesized relationships were supported. Perceived interest significantly influenced perceived usefulness thus supporting H1 ($\beta = 0.159$, $p < 0.01$). Perceived connectivity significantly influenced perceived usefulness perceived ease of use, supporting H2 ($\beta = 0.173$, $p < 0.001$) and H3 ($\beta = 0.096$, $p < 0.05$). Perceived controllability significantly influenced perceived ease of use, supporting H4 ($\beta = 0.169$, $p < 0.001$). Regarding perceived usefulness, perceived ease of use, performance risk, security risk and financial risk all had positive influences on intention to use, thereby supporting H5, H6, H7, H8 and H9. In addition, perceived ease of use has a greater impact on intention to use than perceived usefulness.

Table 4. Results of Hypothesis Testing.

Research Hypothesis	Path Value	S.E.	t-value	p-value	Support
H1: Perceived Interest → Perceived Usefulness	0.159	0.057	2.788	0.005**	Yes
H2: Perceived Connectivity → Perceived Usefulness	0.173	0.047	3.656	***	Yes
H3: Perceived Connectivity → Perceived Ease of Use	0.096	0.042	2.270	0.023*	Yes
H4: Perceived Controllability → Perceived Ease of Use	0.169	0.043	3.941	***	Yes
H5: Perceived Usefulness → Intention to Use	0.186	0.043	4.302	***	Yes
H6: Perceived Ease of Use → Intention to Use	0.235	0.053	4.416	***	Yes
H7: Performance Risk → Intention to Use	-0.161	0.061	-2.635	0.008**	Yes
H8: Financial Risk → Intention to Use	-0.258	0.078	-3.302	***	Yes
H9: Security Risk → Intention to Use	-0.200	0.042	-4.806	***	Yes
$\chi 2$=2.404, CFI=0.957, TLI=0.949, NFI=0.929, RMSEA=0.055					

Note: *<0.05; **<0.01; ***<0.001.

4.3. Mediating Effect Testing

Perceived usefulness and perceived ease of use mediate the effect of the perceived interest, perceived connectivity and perceived controllability on consumer's intention to use and the bootstrapping approach was used to test the mediating effect (Preacher & Hayes, 2008, Shrout & Bolger, 2002). The use and test of mediating effect is the main trend in management studies. In the structural equation modeling (SEM), the conceptual model of this paper belongs to the multiple mediator model, and there are two mediating variables (perceived usefulness and perceived ease of use). The analysis of SEM-based on bootstrap can overcome the shortcomings of traditional testing methods such as the Sobel test in dealing with small sample size and small mediating effect value, etc. and can bring multiple mediating variables into the model at the same time to gain a deeper understanding of complex management phenomena (Cheung & Lau, 2007). Especially when the multiple mediator model is used, this method can estimate the mediation effect more accurately (Muthén et al., 2010). Table 6 shows that the indirect effect of perceived usefulness and perceived ease of use on the relationship among perceived interest, perceived connectivity, perceived controllability, perceived usefulness, perceived ease of use, and intention to use is significant with a 95% bootstrap confidence interval, excluding zero. This finding suggests that perceived usefulness and perceived ease of use mediates the effect of perceived interest, perceived connectivity and perceived controllability on consumer's intention to use.

Table 5. Results of Mediating Effect Analysis

IV	M	DV	Direct Effect	Indirect Effect	Indirect Effect CIs	Total Effect	Mediation
PEI	PU	ITU	-0.153*** (0.044)	0.030** (0.013)	[0.010, 0.061]	-0.123	Yes
PEC	PU	ITU	-0.052 n.s.(0.039)	0.054** (0.016)	[0.023, 0.087]	0.002	Yes
	PEOU			0.056** (0.015)	[0.029, 0.091]	0.004	Yes
PCN	PEOU	ITU	0.066 n.s. (0.041)	0.040**.(0.014)	[0.017, 0.074]	0.106	Yes

95% Bootstrap confidence intervals for indirect effect.

Notes 1: IV = independent variable; M = mediator variable; DV = dependent variable, PEI = perceived interest, PEC = perceived connectivity, PCN = perceived controllability, PU = perceived usefulness, PEOU = perceived ease of use, ITU = intention to use.

3: Significance at: *<0.05, **<0.01 and ***<0.001; SE: Standard Errors in brackets, CIs = Confidence interval.

5. Discussion and Implications

5.1. Discussion of Findings

This study reveals interesting findings. First, in TAM, perceived interest, perceived connectivity, and perceived controllability have a significant positive impact on perceived usefulness and perceived ease of use. This is in line with the results of previous studies (Park et al., 2017; Yu et al., 2016). Therefore, companies should enhance the enjoyment of smart home products, strengthen the interconnection and control of smart home products.

Second, both perceived gains and perceived loss factors affect the intention of the consumer to use smart homes. The consumer views the profit factors positively. The perception of use-

fulness has a direct and positive impact on the use intention and the perception of ease of use directly enhances the use intention. This study also researched the mediating effect of perceived usefulness and perceived ease of use among perceived interest, perceived connectivity, perceived controllability, and intention to use. The consumer will actively adopt it because they feel the differentiated value brought by smart homes and less effort required to use it.

Finally, perceived risk factors such as performance risk, security risk and financial risk weaken the use intention. As the consumer has experience in using mobile devices such as smart phones, the automated operation of smart homes plays an important role in reducing the burden. Compared with concerns about risks, the users value perceived gains more, and the driving effect of perceived usefulness is the strongest. And, compared with the concern for privacy security and performance factors, the consumer is the most sensitive to the possibility of economic losses.

5.2. Research Implications

First, according to the research results, Korean smart home companies should improve users' perceived interest, perceived connectivity, and perceived controllability when designing and producing smart home products. In addition, Korean smart home companies should also focus on improving the perceived ease of use and perceived usefulness of products when entering the Chinese market. Also, the study also suggests that companies should integrate into Chinese culture and cater to the consumption habits of Chinese consumers, which has become an important topic for the implementer of the "localization" strategy.

Second, smart home equipment manufacturers and service providers should pay close attention to the psychological characteristics of the consumer. Product innovation must focus on the lifestyle and environment of the consumer, and it is best to embed or integrate functions into existing products that they are accustomed to using. Marketing should emphasize similar information between new products and familiar products to help them overcome "path dependence" and reduce their perception bias towards innovative products.

Finally, smart home equipment manufacturers and service providers should actively improve the consumer's understanding of the differentiated value that smart homes can provide, rather than just improve their understanding of smart homes. In addition, manufacturers should improve the simplicity of interactions suitable for the consumer, including easy-to-understand user interfaces and other interactions that trigger specific functions. Service providers should provide demonstrations or training to help the consumer become familiar with the actual system operation, which also helps the consumer realize the differentiated benefits of using smart homes.

5.3. Limitations and Future Research

The limitations of this study should be taken into account before generalizing its findings. Firstly, this paper uses cross-sectional data to measure the consumer's cognition of smart homes at a certain time point, but when the consumer is more familiar with technology, their attitudes, intentions, and needs may change; especially, it is necessary to pay attention to the experience of early actual consumer adopters (Sebastiaan et al., 2014). Therefore, future research should pay attention to the relevant changes of the influence of various factors in each stage of the adoption process of the consumer. Second, the results of this paper may have application limitations in different regions and cultures. The sample data in this paper could

not accurately represent the cognition of all Chinese consumers to smart homes. The education and economic levels of the consumers in Shanghai are relatively high, while China has the characteristics of a large population, wide distribution, and many individual social attributes. There may be great differences among Chinese consumer groups in different regions. In addition, this survey was conducted in China, which may limit the effectiveness of the results in other cultures, because the psychological state of the consumer in different countries and cultures (such as collectivism/individualism) may be different (Sun & Zhang, 2006). Therefore, it is of great significance to carry out cross-regional and cross-cultural research in the future. Finally, given that different types of smart home systems meet the different needs of the consumer, there may be differences in the factors affecting the two different smart home technologies and the influence degree of each variable. For example, risk perception may be more important for intelligent security systems and intelligent health systems. Therefore, future research can test the regulatory effect of smart home types based on the research model in this paper.

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