Consumer acceptance of wearable devices: An empirical study in China

Bozhen An
152119360

Dissertation written under the supervision of
Prof. Daniel Fernandes

Dissertation submitted in partial fulfilment of requirements for the
MSc in Business, at the Universidade Católica Portuguesa, Jan 2021

Abstract

The advancement of the wearable devices industry has long emphasized the significance of consumer acceptance of the products. Despite there are lots of theories in this field, few particular theoretical models and researches are conducted in China's market. This research investigates factors influencing consumers' intention to adopt wearable devices in China's market by measuring the relationships between thoughtfully selected variables and consumers' intention. We conduct Mixed Methods Researchs to pre-test the validation of hypotheses and measure correlations between factors. The Proposed model consists of elements applied from Technology Acceptance Model (TAM), Diffusion of Innovations (DOI), Functional Expressive Aesthetic Theory (FEA), Unified Theory of Acceptance and Use of Technology (UTAUT), along with perceived risks and privacy calculus field. The findings indicate that perceived ease of use (PEOU) and perceived usefulness (PU) are significant antecedent factors; prior factors namely perceived compatibility and perceived comfort also show positive impacts. This research provides several practical and theoretical implications for stakeholders and manufacturers to potentially increase consumers' intention to adopt wearable devices.

Keywords: wearable devices; adoption intention; technology acceptance; China; structural equation modeling

Dissertation title: Consumer acceptance of wearable devices: An empirical study in China

Author: Bozhen An

Resumo

O avanço da indústria de dispositivos vestíveis há muito que enfatiza o significado da aceitação destes produtos pelos consumidores. Apesar de imensas teorias neste campo, são poucos os modelos teóricos particulares e estudos conduzidos no mercado chinês. Este estudo investiga fatores que influenciam a intenção dos consumidores de adotar dispositivos vestíveis no mercado chinês, medindo as relações entre variáveis cuidadosamente selecionadas e a intenção de compra dos consumidores. Conduzimos metodologias mistas para pré-testar a validação de hipóteses e medir as correlações entre fatores. O modelo consiste em elementos aplicados a partir do Modelo de Aceitação de Tecnologia (TAM), Difusão de Inovações (DOI), Teoria Estética Expressiva Funcional (FEA), Teoria Unificada de Aceitação e Utilização de Tecnologia (UTAUT), juntamente com os riscos percebidos e a preocupação com a privacidade. Os resultados indicam que a Perceção da Facilidade de Utilização (PEOU) e a Perceção da Utilidade (PU) são fatores antecedentes significativos; fatores anteriores, nomeadamente a perceção da compatibilidade e do conforto também mostram impactos positivos. Este estudo fornece várias implicações práticas e teóricas para stakeholders e fabricantes de produtos orientadas para o aumento potencial da intenção dos consumidores em adotar dispositivos vestíveis.

Palavras-chave: dispositivos vestíveis; intenção de adoção; aceitação de tecnologia; China; modelação de equações estruturais

Título de dissertação: Aceitação dos dispositivos vestíveis pelo consumidor: um estudo empírico na China

Autor: Bozhen An

Acknowledgement

Firstly, I would like to express my sincere appreciation to my supervisors, Professor Miguel Fontes Rita and Professor Daniel Fernandes for their convincing guidance, insightful feedback, and persistent help.

Secondly, my heartfelt thanks go to my friend, Muhan Zhao who offers me numerous valuable comments and encouragement. I would also like to thank my friendly colleagues Chi Hang Ng and Wai In Ng, wish you marry soon.

Finally, to my caring, loving, and supportive significant other and soulmate, Luís: my deepest gratitude. Every second by your side is of preciousness and treasure for me. You lighten up my life in a foreign land with your sense of humor, charm, and affection. I would not have accomplished my dissertation without your support and company.

LIST OF FIGURES AND TABLES

Table of Contents

1. Introduction

1.1 Context & Background

In the past several decades, the Internet has achieved tremendous development in its technology and applications. Back in the early 1990s, it only provided people with a fixed computer network to communicate via email. At that time, only the first million people had access to this novel wireless connectivity. After then, in the 2000s, the condition has changed due to the pervasive use of mobile and tablets. With novel technology and the possibility of connecting more than billions of ends, applications could build a relatively complete social network for the users. The using scenarios of the Internet have changed again in recent years: 5G technology potentially provides connectivity for all kinds of devices and all different types of applications that may benefit from being connected, including mobile connectivity for people and various objects in the user's environment (Dahlman et al., 2014), and it is at this time that wearable devices have entered people's lives. With the rapid evolution of the Internet of Things (IoT), it only took a few years for the wearable technology from being "non-existent to arise everywhere."

Wearable devices (also known as wearables for short) are a general name for intelligent devices requiring users to wear. They are the intersection products of at least three cutting-edge technologies: Big Data, mobile technology, and IoT. Generally speaking, wearable devices can be classified into three different segments based on their specifications and applications, namely healthcare wearable devices, textile wearable devices, and wearable electronics (Cicek, 2015).

Among segments, the healthcare wearable devices field is the most well-received, because wearable technology manifests natural advantages in such an area (Chan et al., 2012). According to the latest global market report published by Research and Market, wearable devices have been remarkably booming in medical and healthcare markets over the last few years (Future Markets, 2020). This development is primarily due to the fact that wearable devices are capable of providing continuous measurement of different biological metrics such as body temperature, electrocardiograms (ECG), electro-encephalograms (EEG), and blood pressure, blood glucose, and calories burned (He Li et al., 2016). With these collected indices, users will have a more systemic understanding of their health status. Moreover, users can also transmit the collected biological data to their family doctors or hospitals, so as to improve doctor-patient communications as well as reduce the medical consumption of time and money. This novel way of real-time monitoring service is highly beneficial to the ageing population, especially people with chronic diseases and those who focus closely on their health. Compared with the conventional health-monitoring machines in the hospital, wearable devices can provide more convenience and feasibility. These lightweight and miniature devices are usually placed on the body in the form of wearable pads, watches, wristbands, which offers users the opportunity to wear while in motion and the possibility to use non-keyboard commands such as voice and hand gestures. Combined with 5G technology, these devices can also improve individuals' well-being and help them make wiser and more informed decisions. In conclusion, adopting wearable devices in healthcare facilities can (1) assess patients' health conditions remotely, (2) enhance the efficiency of the health information acquired, (3) decline the number of non-urgent patient visits. Thus healthcare wearable devices promote medical procedures and maintain the treatment quality of patients (S. Y. Lee & Lee, 2018; Vijayalakshmi et al., 2018).

As consumers demand more than just being protected, apparel is supposed to function as a tool to augment human beings' capabilities by offering ubiquitous connectivity (Jeong, 2009). In this regard, numerous efforts have been made during the past decades to expand textile wearable devices into a variety of fields, including military, sports, healthcare, and leisure (Cakir, 2011). This tendency led to a market prediction indicating that textile wearable devices will increase from approximately US$212[1] million in 2014 to over US$1.8 billion by the end of 2021 (NanoMarkets, 2014).

With the advancement of IoT, wearable electronics have shown various and promising possibilities of development; and hence have been considered as one of the next ubiquitous technologies after smartphones. According to the financial report of Apple technology company, in the year 2019, the segment of "Wearables, Home, and Accessories" is US$24,482 million, accounting for 9.4% of the total net sales (Apple Inc., 2019). This demonstrates the passionate enthusiasm from consumers, in line with Huawei's annual report that the shipments of their wearables products increased respectively by 170% and more than 200% year-on-year (Huawei Ltd, 2019). Furthermore, the data from International Data Corporation (IDC) in 2019 indicates that the constant popularity of wearable devices like smartwatches and sport bands will

[1] 1 euro approximately equals to 1.2 USD

maintain the market forward. Therefore, wearable electronics will usher in an era of prevalence among consumers.

1.2 Problem Statement and Research Questions

As is shown above, product manufacturers continuously make extraordinary efforts to enhance their products and release novel models to satisfy consumers' demands. Hence, wearable devices have become prevalent nowadays (Sinha & Gupta, 2019), corresponding to the fact that in 2019, wearable electronics' total sales were 141 million units, roughly double times of 2017 (statista.com, 2020). Unfortunately, about half of consumers abandon their wearables within the first six months (JUNAEUS, 2015; Ledger, 2014; Pwc, 2014).

Despite the significant market share, all the above-mentioned advantages of wearable devices, and the fact that these devices are considered as the next generation of core products in the Information Technology (IT) industry (Chang et al., 2016), the consumer acceptance of wearables is still relatively low (Sultan, 2015). Only a few articles have been written on measuring consumers' intention to adopt wearable devices, even fewer based on the acceptance model. However, targeted research in this regard can provide wearable designers and manufacturers with helpful insights into these devices' critical features and capabilities to win over the consumers. It can also help marketers develop more efficient messages to promote wearables in marketing campaigns to address consumers' primary needs and concerns.

Therefore, to fill the multidisciplinary blank of literature studying consumers' acceptance and contribute to the practical market, this research strives to investigate the factors that influence the consumers' intention to adopt wearable devices in China's market.

To complete the aim mentioned above, we presented the following research questions:
RQ 1: What percentage of consumers purchase wearable devices?
RQ 2: What factors prevent consumers from adopting wearable devices?
RQ 3: What kinds of wearable devices do consumers incline to purchase?
RQ 4: What factors make consumers give up using wearable devices?

1.3 Dissertation Outline

The paper is structured as follows: Section 2 presents the literature review of previous studies on wearable devices and the related theories for the conceptual framework. And then, in Section 3, we propose the theoretical foundation, hypotheses, and the conceptual model. The applied methodologies and findings of qualitative research are explained in Section 4. In section 5, The structural tests, data analysis, and research results are described. Then, section 6 illustrates the discussion of conclusions and implications. Finally, limitations and future research are demonstrated in Section 7.

2. <u>Literature Review</u>

This section presents a literature review on the wearable devices and the related theories for the conceptual framework.

2.1 Development of Wearable Devices

In the beginning, we focused on the relevant work that illustrated the architectures of e-health monitoring using wearable sensors to explore the advantages of using wearable devices in the healthcare area. According to (Duan et al., 2020), the author presented a remote monitoring architecture where hospitals could get real-time information of patients via healthcare wearable devices. Another example was an article revealing the whole picture of what sort of remote-sensed data should be collected and how they played a vital role in medical monitoring (Parra et al., 2016). Other articles showed some different architectures of e-health monitoring applications over 5G technology, centering around healthcare wearable devices (Lal & Kumar, 2017; Mishra & Agrawal, 2015).

Moreover, a wearable device can be classified in terms of different positions to wear. A shoe-based wearable sensor system succeeded in recognizing the users' motions, such as sitting/standing motionless, walking, running, ascending/descending stairs, cycling, and so on and so forth (Sazonov et al., 2011). Bubelle dress invented by Philips Company was renowned for changing its color based on the user's emotions (Bialoskorski et al., 2009). A smart shirt with the functions of observing consumers' activities was created to obtain their real-time biological information, namely the acceleration data and electrocardiogram. A base-station would then receive the data, guaranteeing remote surveillance and emergency responses (Y. D. Lee & Chung, 2009). Furthermore, the emergence of 5G technology and nanomaterials have realized many conceptual innovations and led to remarkable changes in the textile wearable devices industry (Jones & Katzis, 2018; McCann & Bryson, 2009). Besides the garments mentioned above, many electronic industry company leaders such as Google, Microsoft, Apple, Samsung, Huawei, Xiaomi, and Qualcomm have made strategic investments in the wearable electronics field. Like smartphones, most wearable electronics perform as a multifunctional interactive tool. They have touch screens, wireless communication, and other various user-friendly functions (Dehghani & Dangelico, 2017). Babak Parviz, the project leader from Google Glass, stated that consumers would receive the information from the glasses immediately as if they had known it initially (Ackerman, 2013). A system based on the smartwatch, named EchoWear, with the function of ensuring patients' efficient speech and voice exercises remotely, was proposed to facilitate the therapy of Parkinson's disease (Dubey et al., 2015). Moreover, wearable devices like wristbands, headbands, necklaces, and rings also show promising growth in the market.

For the future use of wearable devices, several authors presented various possible research directions over 5G technology. An architecture combined with a big data network and 5G wireless monitoring was built to overcome the insufficiency of data storage and latency (Kadir et al., 2015). Another proposal was a medical video streaming system over 5G technology, which enabled the health and social care sectors to offer a more qualified and secure remote service (Philip & Rehman, 2016). Another paper designed a multifunctional virtual doctor server to meet patients' various needs, such as storing the historical data, generating daily medical tips, providing first aid assistance instructions, and making emergency calls (Barakah & Ammad-Uddin, 2012).

2.2 Conceptual Development

Prior literature on consumers' intention to adopt wearables has investigated the value and significance of technology acceptance and consumer psychology theories.

The most frequently used and classic model is the Technology Acceptance Model (TAM), which explains how and why users accept and use new technology (Davis et al., 1989). For instance, TAM was used to study consumers' intention to adopt fitness wearable devices. The results suggest that perceived health outcomes are a statistically significant factor (Lunney et al., 2016). The same model was applied in another research and indicated that perceived compatibility and perceived risks also affect consumers' adoption. (Nasir & Yurder, 2015). The Unified Theory of Acceptance and Use of Technology (UTAUT) model focuses on four essential constructs[2] that may influence the individual's behavioral intention of technology innovations (Venkatesh et al., 2003). Venkatesh then improved the theory to UTAUT2 by

[2] A hypothetical construct consists of a latent variable and its observed variables. In different using contexts, we may call latent variable as factor and observed variable as item.

adding three more constructs: habit, price value, and hedonic motivation (Venkatesh et al., 2012). Since then, researchers started to apply UTAUT2 in their studies. Future researchers are advised to regard antecedents of UTAUT2 as influence indicators of consumers' adoption (He Li et al., 2016). Another research that takes UTAUT2 as the primary model was to distinguish facilitators and inhibitors for consumers to adopt wearable devices (Talukder et al., 2019). Moreover, Diffusion of Innovation (DOI) Theory reveals the dissemination of a novel technology through which users will form an attitude toward it when they obtain the knowledge about it. This attitude will affect the individual's choice to accept or reject this new technology (Demir, 2006; Rogers, 1962). Researchers built a conceptual framework combined with TAM, UTAUT, and DOI to study the consumers' adoption of smartwatches (L. H. Wu et al., 2016). In addition, researchers also adapted Uses and Gratifications Theory (U&GT) from the communication field to study users' motivations to accept new technology to satisfy their particular gratifications (Mondi et al., 2008; Stafford et al., 2004). A theoretical model centering around U&GT was proposed to measure consumers' intention to adopt AR smart glasses (Rauschnabel, 2018). Furthermore, the Social Shaping of Technology (SST) Model examines the mutual influencing effects of technology and society on one another (MacKenzie & Wajcman, 1998; Williams & Edge, 1996).

3. Hypotheses and Research Model

This section presents hypotheses we make on the basis of prior literature and the unique theoretical model we propose for China's market.

3.1 Factors to Consumer Acceptance and Hypotheses

3.1.1 The Impact of TAM Factors on Consumers' Intention to Adopt Wearable Devices

Perceived ease of use (PEOU) and perceived usefulness (PU) are the two main elements of TAM. These two terms were respectively defined as "the degree to which a person believes that using a particular system would be free of effort" and "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). Besides that, Davis also suggests that they are statistically different dimensions according to factor analyses[3]. Studies showed that PEOU (Davis et al., 1989; Gao et al., 2015; H. W. Kim et al., 2007; K. J. Kim & Shin, 2015; Ko et al., 2009) and PU (Beemer & Gregg, 2010; H. W. Kim et al., 2007; K. J. Kim & Shin, 2015; Ko et al., 2009) determine users' acceptance to a particular technology. Furthermore, empirical researches revealed that PU might mediate the relationship between PEOU and behavioral intention to accept a technology (Dishaw & Strong, 1999; Gefen & Straub, 2000; Venkatesh & Davis, 2000). It is also worth mentioning that external variables have impacts on consumers' intention to adopt technology through PEOU and PU, which is the reason why we introduce prior factors in the theoretical model. In this context, we anticipate that the results mentioned above will also be valid in our study on consumers' adoption of wearables and hypothesize:

H1. Perceived ease of use is positively related to consumers' intention to adopt wearable devices.
H2. Perceived usefulness is positively related to consumers' intention to adopt wearable devices.
H3. The perceived ease of use on wearable devices positively affects perceived usefulness.

3.1.2 The Impact of DOI Factors on Consumers' Intention to Adopt Wearable Devices

Despite the availability of new technology, consumers may give up adopting it when they face

[3] Factor analysis is a statistical method of evaluating variable relationships for complex concepts.

trouble like knowledge barriers, which causes insufficient acceptance and use. Thus Davis (1989) suggested that the external variables of a system's properties and design features influence users' motivation to use the system. A variety of studies related to DOI show that compatibility is an essential external variable influencing behavioral intention to accept an innovation (Agarwal & Prasad, 1998; Carter & Bélanger, 2005; Rogers, 2003; Shareef et al., 2014; J. H. Wu & Wang, 2005; L. H. Wu et al., 2016; Yi et al., 2006). Nevertheless, several researchers find it inappropriate to use perceived compatibility and TAM factors as antecedents simultaneously in a conceptual model. Because they frequently load on the identical factor, leading to the difficulty to distinguish each other (Karahanna et al., 1999; Moore & Benbasat, 1991). We can explain this outcome straightforward: perceived compatibility suggests how well a technology innovation suits the consumers' lifestyle and previous experiences. PEOU indicates that consumers incline to adopt such an innovation if it requires less effort. Therefore, good compatibility leads to less substantial adjustments in novel technology. Only if wearables are more compatible, will consumers find them easier to use. In recent researches, perceived compatibility appears as a prior variable of TAM predictors (Agarwal & Karahanna, 1998; Choi & Kim, 2016; Koenig-Lewis et al., 2010; Wang & Liao, 2008). This research supposes perceived compatibility as the extent to which wearable devices comply with other products' functionality (i.e., smartphones, tablets), consumers' dressing style, and lifestyle. Thus, we propose two hypotheses about perceived compatibility:

H4a. Perceived compatibility positively affects the extent that a customer perceives wearable devices as easy to use.
H4b. Perceived compatibility positively affects the extent that a customer perceives wearable devices as useful.

3.1.3 The Impact of FEA Factors on Consumers' Intention to Adopt Wearable Devices

Smart clothing's complex nature needs to address user's satisfaction with clothing attributes, namely functional, expressive, and aesthetic (Lamb & Kallal, 1992). The functional dimension requires features such as fit, mobility, and comfort in such a model. Sontag (1985, p. 10) regarded physical comfort as "a mental state of physical well-being expressive of satisfaction with physical attributes of a garment such as air, moisture, heat transfer properties, and mechanical properties such as elasticity, flexibility, bulk, weight, texture, and construction."

Researchers proposed that smart clothing should maintain ordinary clothes' comfort and usability (Suh et al., 2010), owing to the fact that consumers would not wear uncomfortable clothing (Shanley et al., 1993). Especially for the wearable devices by way of example, smartwatches and sport bands, they demand soft tactile properties and sweat-absorbing function. Several theoretical models have considered perceived comfort as an antecedent variable and measured its significant influence on the behavioral acceptance of wearable technologies. However, the results turn out to be insignificant because it overlaps with perceived ease of use and perceived usefulness (Spagnolli et al., 2014). Thus, in many other studies, perceived comfort is regarded as an external variable affecting the TAM outcomes. Therefore, similar to perceived compatibility, we introduce perceived comfort as a prior variable of perceived ease of use and perceived usefulness, and then propose two following hypotheses:

H5a. Perceived comfort positively affects the extent that a customer perceives wearable devices as easy to use.
H5b. Perceived comfort positively affects the extent that a customer perceives wearable devices as useful.

3.1.4 The Impact of UTAUT Factors on Consumers' Intention to Adopt Wearable Devices

Social influence, which is one of the four essential constructs of UTAUT, refers to how individuals are affected by others' perceptions (Venkatesh et al., 2003). Several studies point out that consumers tend to adopt new technologies to improve their social image and differentiate themselves from one another (Buenaflor & Kim, 2013; Southgate, 2003).

Besides that, some researchers also believe that social influence always appears in the form of peer pressure (López-Nicolás et al., 2008). This situation mostly corresponds with the young generation; they are more likely to accept the new technologies to enhance their social images and become the subjective norm (Yi et al., 2006). Previous empirical studies have incorporated social influence into the factors that affect consumers' intention to adopt new technologies and found it statistically significant in a positive way (Buenaflor & Kim, 2013; Yang et al., 2016). Kwee-Meier (2016) investigated passengers' acceptance of wearable locating systems and found that social influences (social image and subjective norms) are the most significant predictor for consumers' intention to adopt these systems on account of people's needs for safety in social background. This finding aligns with the fact that in the context of IoT and Big Data, a tremendous quantity of wearable device users are deeply engaged with their social networks and tend to be prone to suggestions from their social networks. Nevertheless, social influence sometimes negatively affects behavioral acceptance due to psychological resistance and disreputable technology, for instance, online games (Hsu & Lu, 2004) and biometrics threats (Lancelot Miltgen et al., 2013). As Social influence plays a vital role in affecting consumers' intention to adopt innovation by respectively being facilitators or inhibitors, we propose that social influence is the extent to which users are affected by their social networks' perception of wearable devices to be 'normal.' Hence, we hypothesize as followed:

H6. Social influence substantially affects consumers' intention to adopt wearable devices: the extent to which a wearable device is perceived as 'normal' by consumers' social networks increases their adoption of wearables.

3.1.5 The Impact of Perceived Risks on Consumers' Intention to Adopt Wearable Devices

Perceived risks refer to the consumers' uncertainty about the possible consequences of the purchase decision (Schiffman & Kanuk, 2000, p. 153), which may affect their intention to adopt an innovation. The wearable devices category is involved in multidimensional risks, such as performance risk, financial risk, security risk, sociopsychological risk, and so forth. Among all different types of risks that consumers may highly concern, perceived performance risk (Hwang et al., 2016; Ko et al., 2009; Nasir & Yurder, 2015) and perceived physical risk (Buenaflor & Kim, 2013; Ko et al., 2009; Nasir & Yurder, 2015) are two principal factors that determine behavioral intention to accept new technology.

In fact, these risks may lead to higher adverse effects on consumers' adoption when they face relatively new technology, and thus cause more uncertainty (Rogers, 1995)) In terms of wearable devices, they are still in the emerging stage; not all consumers are accustomed to their characteristics and functions. Therefore, perceived performance risk can be a vital barrier that prevents consumers from purchasing wearables. Moreover, studies show that higher perceived risks are associated with a lower degree of adoption (C. Kim et al., 2010; H.-M. Lee, 2009).

Especially for the wearable industry, which is related to biometric technology, consumers are less likely to accept these risks than other technology innovations (H.-M. Lee, 2009; Shen & Chiou, 2010). Regarding perceived physical risk, we define this concept, in this study, as the possibility that may cause consumers to be risky by hurting their health. Consequently, we propose a hypothesis about the impacts of perceived risks (combined perceived performance risk and perceived physical risk) on consumers' intention to adopt wearable devices, given as:

H7. Perceived risks are negatively related to consumers' intention to adopt wearable devices.

3.1.6 The Impact of Privacy Concerns on Consumers' Intention to Adopt Wearable Devices

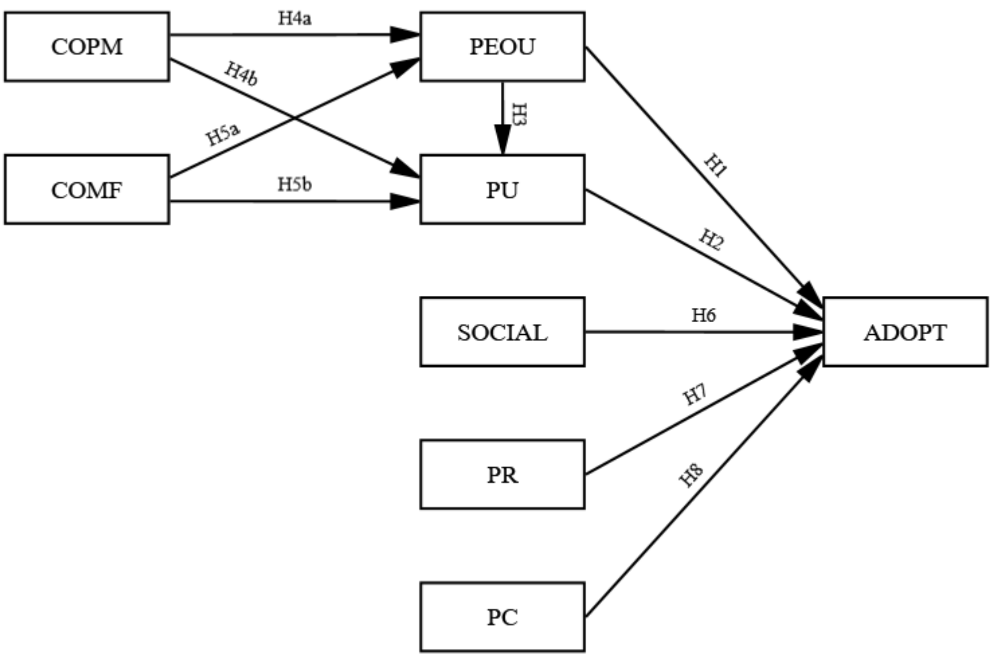
Privacy refers to users' right to withhold their personal information (Dinev & Hart, 2004). With the advancement of internet technology, identity theft has become an enormous problem, leading to information disclosure and even fraud (Eisenstein, 2008). Therefore, consumers are more concerned about potential data disclosure or misuse. This situation is even worse in the context of wearable devices since personal health data collected by wearables seems more sensitive for consumers than other sorts of information by way of example demographic features, transaction and balance information (Bansal et al., 2010). It also corresponds to the finding that Health Information Technology (HIT) may intensify users' privacy concerns due to the potential misuse of personal health information (Han Li et al., 2014) and the finding that wearable devices require security to protect users' anatomy (Mills et al., 2016). To study perceived privacy concerns, researchers introduce privacy calculus: users would make a risk-benefit analysis balancing the facilitators (perceived benefits) and inhibitors (perceived privacy risk) when they decide whether they want to offer their personal information (Awad & Krishnan, 2006). It means only if users' expectancy exceeds their privacy concerns, will they adopt the wearable technology (Han Li et al., 2014). In other words, the growing privacy concerns lead to more substantial adverse effects on consumers' intention to adopt wearable devices (Chang et al., 2016; Gao et al., 2015; Nasir & Yurder, 2015; Spagnolli et al., 2014). Therefore, a negative relation between privacy concerns and behavioral intentions is hypothesized:

H8. Privacy concerns are negatively related to consumers' intention to adopt wearable devices.

3.2 Theoretical Model

Taking the literature review and factors mentioned above into account, a theoretical framework guiding the research is illustrated to understand the consumers' adoption of wearables comprehensively, in Fig. 1 given below. We consider consumers' intention to adopt wearable devices as the dependent variable, which is also regarded as the consequent factor. Moreover, according to prior studies in a similar field (Hwang et al., 2016; Lancelot Miltgen et al., 2013; Tan et al., 2014), we deem that consumers' adoption of wearable devices was determined by the antecedent factors including PEOU, PU, social influence, perceived risks, and privacy concerns. Besides that, perceived compatibility and perceived comfort are two prior factors depicted in the conceptual model.

Figure 1 Proposed theoretical framework



Note: COMP: Perceived compatibility, COMF: Perceived comfort, PEOU: Perceived ease of use, PU: Perceived usefulness, SOCIAL: Social influence, PR: Perceived risks, PC: Privacy concerns, ADOPT: Adoption

4. Research Methodology

Mixed Methods Research has been prevalent in the areas of applied social research and evaluation (Bazeley, 2006), for it points out a distinct way of selecting methodological mixes that would assist researchers in better answering many of their research questions (Johnson & Onwuegbuzie, 2004). In this paper, we implemented a mixing of qualitative and quantitative research methods.

4.1 Qualitative Research

Even though the articles related to wearable devices are growing, few focus specifically on China's market. Hence, it is necessary and appropriate to carry on an exploratory qualitative research project in order to verify the literature results, find new possible hypotheses, and support future research (Babbie, 2011, p. 17).

4.1.1 Qualitative Research Design

Individual depth interviews are particularly suitable for circumstances involving sensitive or personal topics (Robson & Foster, 1989). Moreover, with the proper respondent selection and process flexibility, researchers could yield more profound and more comprehensive outcomes (Cassell & Symon, 2004; Walker, 1985). Hence we tended to use individual depth interviews in this study.

In this qualitative research, each interview lasted 15 to 20 minutes. After a brief introduction to the project, the interviewer asked for descriptive information about the participants and their user experience with wearable devices. Exhibit 1 presents the proposed procedures and questions of the individual depth interview. As Bryman (2015) has advised, the individual interviews were recorded to understand completely what the participants had expressed.

The chosen empirical background of this research was China and China's market. China is the largest country in terms of population (Worldometers, 2020) and the world's second-largest economy (IMF, 2020; World Bank, 2020), and thus, an enormous consumer market for most types of innovations. It is also imperative to mention that the Chinese government pays close attention to citizens' physical health and launches various plans to promote physical activities and fitness. In 2007, the Ministry of Education published a slogan: "Exercise one hour every day, work healthily in fifty years, and live happily for the entire life" (gov.cn, 2006). To facilitate public health and boost the fitness industry, the Chinese government in 2020 claimed to build more physical facilities and fields (english.gov.cn, 2020). In such a context, Chinese citizens arise their passion to make physical training and keep a healthy lifestyle. They do exercise in gyms, jog regularly, keep a diet, and maintain appropriate calorie intake. The facts mentioned above make wearable devices become a must in their daily life.

According to IDC, in the year 2019, the total sale number of wearable devices in the Chinese market reached 99.24 million units, increasing by 37.1% compared with 73.21 units the previous year. Besides that, the outlook of total sales of wearable devices in China in 2020 will increase by 18.6%, while the total global sales will only raise 9.4% (IDC, 2019). Actually, with a predicted market volume of US$6,053 million in 2020, China will generate the most revenue around the world (statista.com, 2020). Additionally, China's national development and reform commission announced that 5G wireless network aims to cover all prefecture-level cities in China; China has built nearly 700,000 5G base stations, more than twice the total installation in the rest of the world (Xinhua, 2020), which provides wearables industry an opportunity to become prevalent and multi-oriented. Therefore, China is the most appropriate market for the researchers to carry on the empirical research about the factors that affect consumers' intention to adopt wearable devices.

Market research suggested that the largest consumer group of wearable devices in China, as a share of 39.4% of users, are between 25 to 34 years old (statista.com, 2020). Thus, the interview respondent sample was selected for ages ranging from 25 to 33 years old. In sum, 10 Chinese participants were interviewed in this research, of which six are male and four are female. Among them, one participant is a student, one participant is a current graduate, and the rest have been working for at least one year. However, segments of chronic disease (Bonato, 2005; Spil et al., 2017) or senior people monitoring (Selem et al., 2019) were not included here. Thus, the research might neglect some consumers who would like to accept this innovation (Yi et al., 2006).

4.1.2 Qualitative Research Findings

The general sessions of individual interviews went well. All the participants were talkative and cooperative during the interviews. Only one of them had never tried wearable devices; he claimed as "I once had the desire to buy a Huawei sport band to track my daily steps and calories burned, but the price was around 500 CNY[4], which was a bit expensive for me, I didn't really think it was a must at that time". Five of them had used wearable devices but already gave up using them when we conducted the interviews. The main reasons were the short battery life of wearable devices and the use of other alternative devices, as demonstrated by this quote: "I didn't develop the habit of wearing the band, at least not in a regular way, I actually think my mobile phone has more functions than the band, by the way, wearing a band was kind of unsightly from my perspective." The rest of the four participants were still using wearable devices daily. However, among all participants, only three of them announced that they would not purchase any new wearable devices in the future. The rest would still try new models "when my device is worn out" or "when some trendy or attractive function is released." There was a notification function neglected by the researcher but mentioned by five participants during the interviews, going as "The band would vibrate when there was a call or message so I would not miss any of them even in a bustling place" and "The band would ask me to stand up and stretch a bit if it detects that I have stayed in the same place for more than one hour." However, this function can be classified into the factor of perceived usefulness. Moreover, some findings were different from the predictions. None of the participants reckoned that using a wearable device would harm the body, illustrated as "I believe radiation emitted by the laptop or mobile phone would be much higher than a sport band, so why bother." Similarly, almost all participants claimed that they were concerned about disclosing their personal information, but the concerns would not prevent them from purchasing wearable devices. This inconsistency was explained as "I had the concerns, but we are living in modern life. You upload the information, and you lose them in the next second. Unless you don't use electronic devices". Finally, regarding social influence, most respondents adopted the wearable devices totally with their wish, not affected by any other people.

Despite the small amount of respondent sample this research involved, we basically can

---

[4] 1 euro approximately equals to 7.9 CNY

conclude that PEOU, PU, perceived compatibility and perceived comfort in our conceptual model are relevant to consumers' adoption, and the hypotheses we make are validated. However, the impacts of social influence, perceived risks, and privacy concerns on consumers' intention to adopt wearable devices remain unclear or insignificant, but they still deserve to be tested on account of the prior studies.

4.2 Quantitative Research

As the second stage of the Mixed Methods Research, we present quantitative research as follow:

4.2.1 Quantitative Research Design

According to (Black, 1999), it is imperative to adopt systematic empirical approaches to test the hypothesis with quantitative data. As the researcher primarily aims to investigate consumers' actual and post-used attitudes and behaviors regarding wearable devices, an online questionnaire survey would be a more productive and appropriate way to obtain their opinions. Exhibit 2 shows the whole vision of the questionnaire.

The survey consists of 2 sections, namely, descriptive statistics of respondents and hypothesis items. In the descriptive statistics section, the researcher collected profile information such as citizenship, gender, age, education, work, income, and consumers' use habits to learn the China market's general condition. In the hypothesis section, we used 7-point Likert scales ranging from "strongly disagree" to "strongly agree" for respondents to grade items. This criterion draws on the experience of the research from Davis (1989). The selected items in this research were mainly modified from prior studies to ensure they could interpret the concepts generalized from the hypotheses and guarantee the content validity for the quantitative research. Two groups of three items adapted from Davis (1989) assessed consumers' perceived ease of use and perceived usefulness. Another two groups of three items chosen from the research of Hwang (2016) were used to evaluate consumers' perceived compatibility and perceived comfort. Items measuring social influence resulted from the paper of López Nicolás (2008). Consumers' perceived risks were assessed by three adapting items from the work of Grewal (1994). Gao (2015) presented three appropriate items to scale consumers' privacy concerns. Besides that, three items adapted from the article of Chuah (2016) were used to evaluate consumers' intention to adopt wearable devices.

Eventually, after collecting all the data mentioned above, we use SmartPLS (v.3.3.2) to test hypotheses and calculate the PLS algorithm.

5. Data analysis and Research Results

5.1 Sample Profile

A total of 303 usable responses (excluding one respondent who does not live in China) were received. Approximately 54.45% of the respondents are male, and 25.74% of the respondents are young adults between 25 to 34 years old. Nearly 42.90% of the respondents have a college degree, and 53.80% of the respondents have a full-time job. Furthermore, according to the results, 44.88% of the respondents have a salary ranging from 3k to 12k CNY. However, among 68.65% of the respondents who have purchased wearable devices (RQ 1), only 52.40% of them still use wearable devices regularly. The Bluetooth set and sport band are two well-received products in China, respectively with a proportion of 64.90% and 38.46% in the population who have used wearables (RQ 3). Table 1 illustrates the descriptive statistics relating to the respondents' characteristics.

Table 1 Sample Profile

Characteristic	Frequency	Percentage
Citizenship		
In China	303	99.67%
Not in China	1	0.33%
Gender		
Male	168	55.45%
Female	135	44.55%
Other	0	0%
Age		
Under 24	52	17.16%
25 - 34	78	25.74%
35 - 44	59	19.47%
45 - 54	71	23.43%
Over 55	42	14.19%
Education		
High school or less	17	5.61%
College degree	130	42.90%
University degree	92	30.36%
Postgraduate degree	28	9.24%
Tech/trade school	36	11.88%
Employment		
Student	4	1.32%
Full-time	163	53.80%
Part-time	170	56.11%
Not employed	33	10.89%
The income per month (CNY)		
Under 3,000	83	27.39%
3,000 – 12,000	138	45.54%
12,000 – 25,000	27	8.19%

Characteristic	Frequency	Percentage
The income per month (CNY)		
25,000 – 35,000	20	6.60%
35,000 – 55,000	31	10.23%
Above 55,000	6	1.98%
Have you ever used wearable devices?		
Yes	208	68.65%
No	95	31.35%
What wearables have you used?		
Bluetooth set	135	64.90%
Sport band	80	38.46%
Smartwatch	74	35.58%
Smart glasses	69	33.17%
Do you use wearables now?		
Yes, on a regular basis.	109	52.40%
No, I gave up using them.	99	47.60%

In terms of the reasons why potential consumers did not purchase wearable devices (RQ 2), almost 38.95% of the respondents were concerned about private information's disclosure, and around 31.58% reckoned that wearable devices were not aesthetically appreciating. Factors mentioned above are two main reasons that prevent consumers from purchasing wearable devices. Besides that, terrible wearing experience, concerns about short battery life, and unawareness of wearable devices are as well worth-mentioning factors weighing 30.53%. Other reasons and their weights are shown in Table 2.

Table 2 Reasons prevent consumers from purchasing wearable devices

Item	Frequency	Percentage
What prevent you from purchasing wearables?		
I don't feel interested in wearables.	27	28.42%
I have no idea what wearables are.	29	30.53%
Concern about short battery life.	29	30.53%
Concern about functions insufficiency.	26	27.37%
Concern about Data inaccuracy.	25	26.32%
Concern about privacy disclosure.	37	38.95%
Aesthetic considerations.	30	31.58%
Bad wearing experience (i.e., sweaty, painful).	29	30.53%
High price.	24	25.26%
Others	0	0%

Furthermore, as regards to the consumers who had bought wearable devices but gave up using them (RQ 4), nearly 35.35% had a terrible wearing experience, such as sweaty and painful, and 34.34% of the consumers were bothered by the short battery life. Other reasons by way of example, functions insufficiency, minor personal improvement, aesthetic considerations, and feeling inconvenience all exceeded the proportion of 30%. Table 3 demonstrates all reasons and weights in detail.

Table 3 Reasons for giving up using wearable devices.

Item	Frequency	Percentage
Why you gave up using your wearable(s)?		
Short battery life	34	34.34%
Functions insufficiency	32	32.32%
Aesthetic considerations	31	31.31%
Bad wearing experience (i.e., sweaty, painful)	35	35.35%
Data inaccuracy	29	29.29%
Minor personal improvement	32	32.32%
Inconvenience	30	30.30%
Lost	29	29.29%
Broken	1	1.01%
Others	3	3.03%

5.2 Measurement Validity and Reliability

Structural Equation Modeling (SEM) is used in this research to investigate the specification of relationships established in our theoretical model. As the outcomes of most items that test the constructs in the data are moderately skewed with the absolute number of skewness between 0.5 to 1 (Bulmer, 1979), and the aim of this research is to identify key facilitators constructs, Partial Least Squares Regression (PLS), particularly PLS-SEM here, would be the most appropriate way of obtaining a reasonable distribution in this study (Chin, 1998; Chin et al., 2003; Hair et al., 2011). Moreover, the sample size is small (only 207 respondents) in this research, but the theoretical model is relatively complex, consisting of 8 factors and 24 items. These characters also accord closely with the PLS-related assessment research of Hair (2012) which indicates that the average sample size of PLS-SEM is around 211, the latent variables and total observed variables are respectively about 8 and 30.

In order to conduct a convincing analysis and present reliable outcomes, the assessment of the theoretical model involves a couple of steps: (1) indicator reliability, (2) internal consistency reliability, (3) convergent validity, and (4) discriminant validity. Table 4 presents the demanding elements for the analysis, including factor loadings, composite reliability (CR), Cronbach's alpha, and average variance extracted (AVE).

Table 4 factor loadings, average variance extracted, composite reliability, Cronbach's alpha

Factor	Item	Loading	CR	AVE	Alpha
Perceived ease of use	The use of wearable devices is clear and understandable.	0.843	0.856	0.665	0.748
	It's easy for me to master most of the functions of my wearable devices.	0.810			
	Overall, I find wearable devices easy to use.	0.792			
Perceived usefulness	Wearing this product would improve the quality of my life.	0.788	0.835	0.628	0.705
	Wearing this product would increase my efficiency.	0.785			
	Overall, I find wearable devices useful.	0.805			
Perceived compatibility	This product would coordinate well with the other smart devices I own.	0.812	0.855	0.664	0.747
	Wearing this product would be appropriate for my lifestyle.	0.833			
	Wearing this product would be appropriate for my dressing style.	0.799			
Perceived comfort	Wearing this product would be comfortable.	0.880	0.916	0.785	0.863
	Wearing this product would not hinder my action.	0.890			
	It would be easy to put on or take off this product.	0.889			
Social influence	People around me like to use wearable devices.	0.993	0.945	0.851	0.962
	People around me have encouraged me to use wearable devices.	0.905			
	Wearable devices would enhance my personal image, making me look like a healthy/trendy person.	0.864			
Perceived risks	I believe that the product will perform as described.	0.953	0.962	0.895	0.941
	I believe that the product will work satisfactorily.	0.942			
	I don't think wearing this product will hurt my health.	0.942			
Privacy concerns	There will be unnecessary trouble if I disclose my personal health information to vendors providing wearable devices.	0.935	0.955	0.876	0.953
	It would be risky to disclose my personal health information to vendors providing wearable devices.	0.993			
	There would be uncertainty associated with giving my personal health information to vendors providing wearable devices.	0.876			
Adoption	I will keep using wearable devices.	0.892	0.940	0.838	0.903
	I will likely buy new models if I'm in a decent financial situation.	0.939			
	I intend to buy another one if my wearable device is lost or broken.	0.915			

5.2.1 Indicator Reliability

As is demonstrated, the factor loadings of all items exceed the threshold value of 0.7, specifying acceptable indicator reliability (Hulland, 1999). This explicitly indicates that different items under each construct assess a similar concept (Srivastava & Teo, 2007).

5.2.2 Internal Consistency Reliability

Internal consistency is widely used to assess the reliability of a model by estimating the intra-scale consistency of the responses to the items of the factors. In this study, it is reliable due to the fact that all the constructs have CR and Cronbach's alphas greater than 0.7 (Cronbach & Meehli, 1955).

5.2.3 Convergent Validity

Regarding convergent validity, all AVEs of the variables had a value greater than 0.5, which reflects that items in the latent variables can explain the variance captured by the construct in a statistically acceptable way (Fornell & Larcker, 1981).

5.2.4 Discriminant Validity

Furthermore, the following step for the analytical approach is to examine the discriminant validity of the constructs, which reveals the differentiation of various variables. Fornell–Larcker criterion and cross-loadings test are serviceable here. The first criterion requires that AVE's square root be greater than the inter-construct correlations (Fornell & Larcker, 1981). As is demonstrated in Table 5, the highlighted bold values are the square root of AVE that verifies the discriminant validity since they are greater than the correlation between two constructs. The other criterion is generally more liberal concerning discriminant validity; it expects a higher loading of each indicator than the cross-loadings (Chin, 1998). Table 6 presented that in this study, all loadings are higher than cross-loadings, as suggested. Consequently, the requirements of the model's measurement were satisfied.

Table 5 Matrix of correlation constructs and the square root of AVE (in bold)

	BI	PC	PR	SI	PU	PEOU	PComf	PComp
BI	**0.916**							
PC	0.040	**0.936**						
PR	0.113	0.356	**0.946**					
SI	0.086	0.339	0.425	**0.922**				
PU	0.811	-0.021	0.046	-0.011	**0.792**			
PEOU	0.761	-0.049	0.082	0.080	0.722	**0.815**		
PComf	0.697	0.116	0.135	0.096	0.648	0.596	**0.886**	
PComp	0.818	-0.012	0.135	0.111	0.793	0.737	0.654	**0.815**

Note: BI: Behavioral Intention, PC: Privacy concerns, PR: Perceived risks, SI: Social influence, PComf: Perceived comfort, PComp: Perceived compatibility.

Table 6 Matrix of loadings (in bold) and cross-loadings

	BI	PC	PR	SI	PU	PEOU	PComf	PComp
BI1	**0.892**	0.049	0.081	0.071	0.727	0.676	0.633	0.730
BI2	**0.939**	0.081	0.173	0.134	0.729	0.714	0.658	0.726
BI3	**0.915**	-0.021	0.056	0.031	0.771	0.699	0.623	0.790
PC1	0.016	**0.935**	0.338	0.298	-0.016	-0.029	0.108	-0.031
PC2	0.047	**0.993**	0.351	0.343	-0.022	-0.054	0.116	-0.005
PC3	0.000	**0.876**	0.308	0.282	-0.054	-0.030	0.075	-0.044
PR1	0.110	0.355	**0.953**	0.398	0.046	0.054	0.126	0.134
PR2	0.106	0.315	**0.942**	0.405	0.078	0.106	0.118	0.137
PR3	0.104	0.339	**0.942**	0.404	0.008	0.073	0.140	0.094
Si1	0.072	0.348	0.420	**0.993**	-0.026	0.068	0.079	0.088
Si2	0.012	0.369	0.445	**0.905**	-0.071	0.031	0.041	0.051
Si3	-0.019	0.380	0.395	**0.864**	-0.109	-0.005	-0.009	-0.021
PU1	0.680	-0.016	-0.013	-0.022	**0.788**	0.592	0.491	0.645
PU2	0.559	-0.058	-0.073	-0.095	**0.785**	0.508	0.458	0.577
PU3	0.677	0.017	0.178	0.077	**0.805**	0.609	0.584	0.657
PEOU1	0.672	-0.114	0.046	0.035	0.656	**0.843**	0.508	0.677
PEOU2	0.583	0.075	0.105	0.164	0.491	**0.810**	0.465	0.557
PEOU3	0.600	-0.064	0.055	0.009	0.607	**0.792**	0.483	0.558
PComf1	0.657	0.124	0.154	0.062	0.589	0.484	**0.880**	0.602
PComf2	0.576	0.114	0.123	0.134	0.558	0.518	**0.890**	0.548
PComf3	0.619	0.073	0.085	0.060	0.577	0.579	**0.889**	0.588
PComp1	0.671	-0.019	0.105	0.140	0.626	0.613	0.443	**0.812**
PComp2	0.685	0.007	0.058	0.076	0.691	0.585	0.607	**0.833**
PComp3	0.642	-0.016	0.155	0.054	0.621	0.605	0.546	**0.799**

Note: BI: Behavioral Intention, PC: Privacy concerns, PR: Perceived risks, SI: Social influence, PComf: Perceived comfort, PComp: Perceived compatibility.
Different numbers following the latent variables represent different items in our quantitative research.

5.3 Hypotheses Testing

Overall, the conceptual model has excellent convergent validity, reliability, and discriminant validity. Hence, the constructs generated from this measurement model are acceptable. All the hypotheses are tested by bootstrapping with 5000 resamples and presented in Table 7. A variety of fit indicators are suggested to be used in testing the model fit (Jackson et al., 2009), chi-square = 759.112, df = 292, RMESA = 0.062 (lower than 0.08 as demanded), the chi-square to df ratio is 2.591 which remains the adequate range between 1 to 3 (Carmines & McIver, 1981). Other fit indices such as NFI and RMS_theta also present acceptable values.

As is illustrated in Table 7, the model explains 72.2% of consumers' adoption of wearable devices. It is considered substantial since the value of R-squared is greater than 0.670 (Sharma & Kim, 2012). Perceived ease of use (beta = 0.360, t-value = 5.803, $p<0.01$) and perceived usefulness (beta = 0.551, t-value = 9.546, $p<0.01$) have significant correlation to consumers' intention to adopt wearable devices, meaning hypotheses H1 and H2 are confirmed. However, hypotheses H6 (Social influence to consumers' adoption), H7 (perceived risks to consumers' adoption), and H8 (privacy concerns to consumers' adoption) do not pass the test. Regarding perceived ease of use, the model explains only 56.2% of it, which shows moderate model validity as the value is between 0.670 and 0.333 (Sharma & Kim, 2012). However, perceived compatibility (beta = 0.607, t-value = 10.424, $p<0.01$) and perceived comfort (beta = 0.200, t-value = 3.417, $p<0.01$) show a positive relationship with perceived ease of use, indicating that hypotheses H4a and H5a are approved. 68.3% of perceived usefulness is explained by the model, which exceeds 0.670 and implies a substantial validity as well. All hypotheses (H3, H4b, and H5b) in this path are validated, with the value of perceived ease of use (beta = 0.257, t-value = 3.716, $p<0.01$), perceived compatibility (beta = 0.489, t-value = 6.598, $p<0.01$), and perceived comfort (beta = 0.175, t-value = 2.853, $p<0.01$).

Table 7 Results for the structural model and hypothesis testing

Path			Beta	t-value	R^2	Hypothesis	confirmation
Adoption					0.722		
	<---	Perceived ease of use	0.360	5.803***		H1	Yes
	<---	Perceived usefulness	0.551	9.546***		H2	Yes
	<---	Social influence	0.036	0.634		H6	No
	<---	Perceived risks	0.026	0.538		H7	No
	<---	Privacy concerns	0.048	0.881		H8	No
Perceived ease of use					0.562		
	<---	Perceived compatibility	0.607	10.424***		H4a	Yes
	<---	Perceived comfort	0.200	3.417***		H5a	Yes
Perceived usefulness					0.683		
	<---	Perceived ease of use	0.257	3.716***		H3	Yes
	<---	Perceived compatibility	0.489	6.598***		H4b	Yes
	<---	Perceived comfort	0.175	2.853***		H5b	Yes

Note: β: standardized coefficients. The constructs are standardized (mean 0 and standard deviation 1).

*** $p < 0.01$.

6. Conclusions and Implications

Notwithstanding the incremental recognition of the fact that various factors may affect consumers' intention to adopt wearable devices, the exact impact has been under-researched heretofore. The acceptance of wearable devices from the consumer's perspective is not well understood, and researchers in the area mentioned above have pointed out a lack of studies and theoretical models. This research intends to shed some light on such a field.

This research makes contributions to the industry of wearable devices in the following aspects. (1) The research introduces a novel conceptual model based on the TAM structure. We measured the impact of a variety of antecedent factors from DOI theory and FEA model on the adoption of wearable devices. Then, we extended the framework with a novel integration of TAM, DOI, FEA, UTAUT, perceived risks and privacy concerns in the research field. Hence, the research allows a more consolidated comprehension of consumers' adoption of wearable devices. (2) We propose a more dedicated model to the wearables field so that wearables designers might have a specific guideline to follow. (3) From what we can tell, this article is one of the very first that studies the factors influencing consumers' adoption of wearable devices in China's market. It is imperative to mention that we indeed have some characteristic findings in China's market; for instance, consumers pay relatively less attention to privacy issues and perceived risks than global markets. These findings present useful and helpful information to all other researchers and wearable devices industry members so that they may have a reliable way to develop a more well-received and consumer-oriented product.

The results showed that the wearable devices adoption model suggested in this research is partially validated, meaning some of the acceptance variables are critical factors while some are insignificant. In terms of TAM variables, the impact of perceived ease of use (H1) and perceived usefulness (H2) on consumers' intention to adopt wearable devices are both validated, in line with the findings from prior studies (Asadi et al., 2019; Tarabasz & Poddar, 2019). Similarly, the result as well supports findings of researches in a variety of other fields, by way of example, smart clothing (Hwang et al., 2016), m-learning acceptance (Tan et al., 2014), and biometrics acceptance (Lancelot Miltgen et al., 2013). Besides that, perceived usefulness is the most potent variable that directly and positively affects consumers' adoption of wearable devices, in consonance with some comparable studies that indicate perceived usefulness is more critical (Chae, 2009; Hwang et al., 2016; Kumar et al., 2008). We can conclude from the results that wearable technology is so easy to use that consumers can utilize it from different age groups. In such a context, perceived ease of use seems not as significant as perceived usefulness, and the latter factor may hold more weight in terms of consumers' intention to adopt wearable devices. Nevertheless, it is worth mentioning that perceived ease of use also significantly impacts perceived usefulness (H3), confirming the previous related researches (Moon & Kim, 2001; Tan et al., 2012). This finding practically implies that consumers are more likely to adopt a specific wearable device if they consider it easy to use such a device. Because when they can efficiently utilize wearable devices, they will also feel the devices more useful and indirectly influence consumers' adoption. Thus, for further development, stakeholders and product developers have to fix attention on the attributes of both PU and PEOU.

In terms of the UTAUT model, the relationship between social influence and consumers' intention to adopt wearable devices is not statistically significant (H6), corresponding to our quantitative research and some previous researches (Lu et al., 2005; Venkatesh et al., 2003). It demonstrates that subjective norms and image is not as important to consumers' adoption as other factors in the model. The reason can be as follows: (1) More than 80% of the quantitative research respondents have a college or higher degree. These consumers have critical and rational thinking and are not easily affected by peer pressure in their social networks. (2) In the context of China's rapid economic development, more and more citizens incline to base their social image on overall quality and personal charm rather than showing off the material abundance.

Regarding perceived risks (H7), the result indicates that it does not exert a vital influence on consumers' intention to adopt wearable devices. However, several previous related articles have different findings proposing that it will be a severe obstacle for consumers to adopt a product if they regard it as insecure or untrustful (Hung et al., 2006; Hwang et al., 2016). This inconsistency may result from the fact that there are more variables in our theoretical model than in the separate seminal theories we adapt, causing perceived risks to become less relevant than other variables. Besides that, wearable devices are not quintessentially cutting-edge technology in China's market nowadays, and consumers have loyalty and trust to prestigious technology companies. Moreover, science proves that wearable devices barely harm the human body in terms of radiation since it's mandatorily lower than the international exposure limits (CDC, 2015). Hence the perceived performance risk and perceived physical risk are both relatively low. Furthermore, it is worth mentioning that perceived risks also do not show a manifest effect in our quantitative research.

According to the results, privacy concerns are an insignificant variable (H8), not aligning with prior studies that suggest it as a negative predictor of consumers' intention to adopt wearable devices (Chellappa & Sin, 2005; Sun et al., 2013). The result illustrates that consumers pay less attention to their privacy disclosure when they use wearable devices. We can explain this phenomenon in a couple of ways. For one thing, information security is a severe issue in nowadays world, and there are no perfect solutions to protect consumers' privacy up till now. Most consumers have to be accustomed to sharing or even disclosing their data to vendors providing wearable devices. For another, wearable devices are generally connected to mobile phones via Bluetooth. Hence, there is minimum anxiety to adopt a wearable device since it makes no notable difference for consumers to use only one mobile device or both devices in terms of information leakage. These two opinions completely suit the interview quote of our quantitative research. Additionally, when it comes to healthcare services, some consumers seem more open to uploading their health information to obtain personalized outcomes and professional analyses.

As regards prior factors related to TAM variables, perceived compatibility and perceived comfort are both tested to be statistically significant to perceived ease of use (H4a; H5a) and perceived usefulness (H4b; H5b). Thus, these prior factors indirectly positively influence consumers' intention to adopt wearable devices. However, perceived compatibility seems to have a more substantial impact than perceived comfort on both PEOU and PU. In conclusion, this result has the practical implication that (1) perceived attributes adapted from DOI theory and the FEA model indeed have connections with TAM as regard to explaining consumer acceptance, and they are indispensable factors that influence consumers' intention. (2) the more consumers find the wearable devices comfortable and compatible with their experience and lifestyle, the more they would perceive wearables as easy to use, flexible, and useful to achieve their goals ideally. (3) it is imperative for stakeholders and product developers to improve the product's functional features of compatibility and comfort in order to simultaneously increase the user's experience and intention to adopt wearable devices.

7. Limitations and Future Research

Although this study contributes to the wearables field's theoretical and practical aspects, it has several limitations. Firstly, this is a non-experimental study, per se. All that we have done is to present correlations among variables but not verify causation. Secondly, the empirical outcomes used to test hypotheses are obtained at a single point in time. However, consumers' perceptions change over time, and the measurement of their adoption of a particular new technology usually requires retrospective analysis. Therefore, further studies can conduct a longitudinal survey to collect more comprehensive understandings and more valid explanations of consumers' intention to adopt wearable devices. Additionally, this study only targets China's market, which means the empirical study samples are confined to Chinese respondents. It will be inaccurate to implement the conclusions presented in this study in other countries' markets because of different cultures and technological development. Hence, to grasp a full perspective of consumers' intention to adopt wearable technology globally, it is imperative to test our findings in a comparative study among countries. Lastly, it is impossible to perform all possible factors as variables in the conceptual model we investigate. Other sorts of factors involving consumers' perceptions can also be tested, such as innovativeness (Asadi et al., 2019; Lancelot Miltgen et al., 2013), aesthetic considerations (Eckman et al., 1990), perceived behavioral control(Tan et al., 2012), and so forth. Given that, it is an alternative way to exclude some invalidated variables and include the above-mentioned additional factors to study consumers' intention to adopt wearable devices.

8. Appendix

Exhibit 1: Individual Depth Interviews (English translation)

1. Beginning
   - Purpose of the interview
   - Brief introduction of the study
   - Confidentiality and Recording
2. Profile
   - Self-introduction (i.e., name, age, job, income)
   - Wearable devices in use
3. Generalization
   - Reasons for purchasing wearables.
   - What aspects did you consider before buying Wearables?
   - Usage scenarios.
   - Key/most valued functions used?
   - What data are collected by the wearables? Are they important and/or helpful?
   - User experience? (Scaled from 1 to 7)
   - Will you use wearables more frequently or less in the following months?
   - Plans for purchasing new models.

4. Variable
   - PEOU: To what extent do you think learning to use such a wearable device would be easy for you?
   - PU: To what extent do you think using such a wearable device would enhance/keep you healthy?
   - Compatibility: To what extent do you think using such a wearable device would fit into your lifestyle?
   - Comfort: To what extent do you think using such a wearable device is comfortable?
   - UTAUT: To what extent do you think using such a wearable device would enhance your social images?
   - PR1: To what extent do you concern that such a wearable device could not function as

you had expected?

- PR2: To what extent do you think using such a wearable device would harm your body?
- PC: To what extent do you think using such a wearable device would lead to a personal information disclosure (either to a hacker or to an unauthorized 3rd-party)

5. Ending
   - Gratitude

Exhibit 2: Surveys (English translation)

An academic survey on factors influencing consumers' adoption of wearables

Forewords

Dear Respondents,

The purpose of this survey is to investigate the factors that affect the consumers' adoption of wearable devices. This is a research project being conducted by Bozhen An at Católica Lisbon School of Business and Economics.

Participation of this survey is voluntary, and your information will remain confidential. It may take you 7-10 minutes. Please feel free to contact eric_an09@hotmail.com if you have any doubts or questions during the research.

Finally, your participation is sincerely appreciated and have a nice day!

Part I Consumer Profile

1. Do you currently/regularly live in China?
   - Yes
   - No (will close the questionnaire)
2. Gender
   - Male
   - Female
   - Other

3. Age

- Under 24
- 25 - 34
- 35 - 44
- 45 - 54
- Over 55

4. Education

- High school or less
- College degree
- University degree
- Postgraduate degree
- Tech/trade school

5. Employment (multiple choice)

- Student
- Full-time
- Part-time
- Not employed

6. Income per month (CNY)

- Under 3,000
- 3,000 - 12,000
- 12,000 -25,000
- 25,000 - 35,000
- 35,000 - 55,000
- Over 55,000

7. Have you ever used wearable devices?

- Yes
- No (will jump to Q35)

8. What wearables have you used?

- Bluetooth set
- Sport band
- Smartwatch
- Smart glasses

- Others

9. Do you use wearables now?

- Yes, on a regular basis.
- No, I gave up using them.

10. Why you gave up using your wearables? (multiple choice)

- Short battery life
- Functions insufficiency
- Aesthetic considerations
- Bad wearing experience (i.e., sweaty, painful)
- Data inaccuracy
- Minor personal improvement
- Inconvenience
- Lost
- Broken
- Others

35. What prevent you from purchasing wearables? (multiple choice)

- I don't feel interested in wearables
- I have no idea what wearables are
- Concern about short battery life
- Concern about functions insufficiency
- Concern about Data inaccuracy
- Concern about privacy disclosure
- Aesthetic considerations
- Bad wearing experience (i.e., sweaty, painful)
- High price
- Others

Part II Please rate the following statements related to wearable devices.
(1 = Totally disagree, 7 = Totally agree)

11. The use of wearable devices is clear and understandable.

12. It's easy for me to master most of the functions of my wearable devices.
13. Overall, I find wearable devices easy to use.
14. Wearing this product would improve the quality of my life.
15. Wearing this product would increase my efficiency.
16. Overall, I find wearable devices useful.
17. This product would coordinate well with the other smart devices I own.
18. Wearing this product would be appropriate for my lifestyle.
19. Wearing this product would be appropriate for my dressing style.
20. Wearing this product would be comfortable.
21. Wearing this product would not hinder my action.
22. It would be easy to put on or take off this product.
23. People around me like to use wearable devices.
24. People around me have encouraged me to use wearable devices.
25. Wearable devices would enhance my personal image, making me look like a healthy/trendy person.
26. I believe that the product will perform as described.
27. I believe that the product will work satisfactorily.
28. I don't think wearing this product will hurt my health.
29. There will be unnecessary trouble if I disclose my personal health information to vendors providing wearable devices.
30. It would be risky to disclose my personal health information to vendors providing wearable devices.
31. There would be uncertainty associated with giving my personal health information to vendors providing wearable devices.
32. I will keep using wearable devices.
33. I will likely buy new models if I'm in a decent financial situation.
34. I intend to buy another one if my wearable device is lost or broken.

References

Ackerman, E. (2013). Google gets in your face: Google Glass offers a slightly augmented version of reality. *IEEE Spectrum*, *50*(1). https://doi.org/10.1109/MSPEC.2013.6395302

Agarwal, R., & Karahanna, E. (1998). On the multi-dimensional nature of compatibility beliefs in technology acceptance. *DIGIT*.

Agarwal, R., & Prasad, J. (1998). A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology. *Information Systems Research*, *9*(2). https://doi.org/10.1287/isre.9.2.204

Apple Inc. (2019). *Annual Report 2019*. https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_AAPL_2019.pdf

Asadi, S., Abdullah, R., Safaei, M., & Nazir, S. (2019). An Integrated SEM-Neural Network Approach for Predicting Determinants of Adoption of Wearable Healthcare Devices. *Mobile Information Systems*, *2019*. https://doi.org/10.1155/2019/8026042

Awad, N. F., & Krishnan, M. S. (2006). The personalization privacy paradox: An empirical evaluation of information transparency and the willingness to be profiled online for personalization. *MIS Quarterly: Management Information Systems*, *30*(1). https://doi.org/10.2307/25148715

Babbie, E. R. (2011). *The practice of social research* (Print: English: 13th).

Bansal, G., Zahedi, F. M., & Gefen, D. (2010). The impact of personal dispositions on information sensitivity, privacy concern and trust in disclosing health information online. *Decision Support Systems*, *49*(2). https://doi.org/10.1016/j.dss.2010.01.010

Barakah, D. M., & Ammad-Uddin, M. (2012). A survey of challenges and applications of wireless Body Area Network (WBAN) and role of a virtual doctor server in existing architecture. *Proceedings - 3rd International Conference on Intelligent Systems Modelling and Simulation, ISMS 2012*. https://doi.org/10.1109/ISMS.2012.108

Bazeley, P. (2006). Teaching Mixed Methods. *Qualitative Research Journal*, 117–126.

Beemer, B. A., & Gregg, D. G. (2010). Dynamic interaction in knowledge based systems: An exploratory investigation and empirical evaluation. *Decision Support Systems*, *49*(4). https://doi.org/10.1016/j.dss.2010.04.007

Bialoskorski, L. S. S., Westerink, J. H. D. M., & Van Den Broek, E. L. (2009). Mood Swings: Design and evaluation of affective interactive art. *New Review of Hypermedia and Multimedia*, *15*(2), 173–191. https://doi.org/10.1080/13614560903131898

Black, T. R. (1999). Doing Quantitative Research in the Social Sciences: An Integrated Approach to Research Design, Measurement and Statistics. In *British Educational Research Journal* (Vol. 26).

Bonato, P. (2005). Advances in wearable technology and applications in physical medicine and rehabilitation. In *Journal of NeuroEngineering and Rehabilitation* (Vol. 2). https://doi.org/10.1186/1743-0003-2-2

Bryman, A., & Bell, E. (2015). Business Research Methods. Methods. In *4th edition*.

Buenaflor, C., & Kim, H. C. (2013). Six human factors to acceptability of wearable computers. *International Journal of Multimedia and Ubiquitous Engineering*, *8*(3).

Bulmer, M. G. (1979). *Principles of Statistics*. Dover.

Cakir, A. (2011). Smart clothing – technology and applications. *Behaviour & Information Technology*, *30*(2). https://doi.org/10.1080/0144929X.2011.556868

Carmines, E., & McIver, J. (1981). Analyzing models with unobserved variables: Analysis of covariance structures. In *Social measurement: Current issues*.

Carter, L., & Bélanger, F. (2005). The utilization of e-government services: Citizen trust, innovation and acceptance factors. *Information Systems Journal*, *15*(1). https://doi.org/10.1111/j.1365-2575.2005.00183.x

Cassell, C., & Symon, G. (2004). *Essential Guide to Qualitative Methods in Organizational Research*. SAGE Publications Ltd. https://doi.org/10.4135/9781446280119

CDC. (2015). *Wearable Computers and Wearable Technology*. Https://Www.Cdc.Gov/Nceh/Radiation/Wearable.Html#:~:Text=Wearable%20devices%20expose%20the%20user%20to%20lower%20amounts%20of%20RF,Driving%20or%20using%20dangerous%20equipment.

Chae, J.-M. (2009). Consumer Acceptance Model of Smart Clothing according to Innovation. *INTERNATIONAL JOURNAL OF HUMAN ECOLOGY*, *10*(1).

Chan, M., Estève, D., Fourniols, J. Y., Escriba, C., & Campo, E. (2012). Smart wearable systems: Current status and future challenges. *Artificial Intelligence in Medicine*, *56*(3). https://doi.org/10.1016/j.artmed.2012.09.003

Chang, H. S., Lee, S. C., & Ji, Y. G. (2016). Wearable device adoption model with TAM and TTF. *International Journal of Mobile Communications*, *14*(5). https://doi.org/10.1504/IJMC.2016.078726

Chellappa, R. K., & Sin, R. G. (2005). Personalization versus privacy: An empirical examination of the online consumer's dilemma. *Information Technology and Management*, *6*(2–3). https://doi.org/10.1007/s10799-005-5879-y

Chin, W. W. (1998). Issues and opinion on structural equation modeling. In *MIS Quarterly: Management Information Systems* (Vol. 22, Issue 1).

Chin, W. W., Marcelin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research*, *14*(2). https://doi.org/10.1287/isre.14.2.189.16018

Choi, J., & Kim, S. (2016). Is the smartwatch an IT product or a fashion product? A study on factors affecting the intention to use smartwatches. *Computers in Human Behavior*, *63*. https://doi.org/10.1016/j.chb.2016.06.007

Chuah, S. H. W., Rauschnabel, P. A., Krey, N., Nguyen, B., Ramayah, T., & Lade, S. (2016). Wearable technologies: The role of usefulness and visibility in smartwatch adoption. *Computers in Human Behavior*, *65*. https://doi.org/10.1016/j.chb.2016.07.047

Cicek, M. (2015). Wearable Technologies And Its Future Applications. *International Journal of Electrical, Electronics and Data Communication*, *3*(4), 45–50. https://doaj.org/article/20c02d34d6054679874a26a196d13406

Cronbach, L. J., & Meehli, P. E. (1955). *Psychological Bulletin CONSTRUCT VALIDITY IN PSYCHOLOGICAL TESTS*.

Dahlman, E., Mildh, G., Parkvall, S., Peisa, J., Sachs, J., Selén, Y., & Sköld, J. (2014). 5G wireless access: Requirements and realization. *IEEE Communications Magazine*, *52*(12). https://doi.org/10.1109/MCOM.2014.6979985

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, *35*(8). https://doi.org/10.1287/mnsc.35.8.982

Dehghani, M., & Dangelico, R. M. (2017). Smart wearable technologies: Current status and market orientation through a patent analysis. *Proceedings of the IEEE International Conference on Industrial Technology*. https://doi.org/10.1109/ICIT.2017.7915602

Demir, K. (2006). Rogers' theory of the diffusion of innovations and online course registration. *Educational Administration: Theory and Practice*, *47*.

Dinev, T., & Hart, P. (2004). Internet privacy concerns and their antecedents -measurement validity and a regression model. In *Behaviour and Information Technology* (Vol. 23, Issue 6). https://doi.org/10.1080/01449290410001715723

Dishaw, M. T., & Strong, D. M. (1999). Extending the technology acceptance model with tasktechnology fit constructs. *Information and Management*, *36*(1). https://doi.org/10.1016/S0378-7206(98)00101-3

Duan, W., Ji, Y., Zhang, Y., Zhang, G., Frascolla, V., & Li, X. (2020). *5G Technologies Based Remote E-Health: Architecture, Applications, and Solutions*. 1–16. http://arxiv.org/abs/2009.02131

Dubey, H., Goldberg, J. C., Abtahi, M., Mahler, L., & Mankodiya, K. (2015). EchoWear: Smartwatch technology for voice and speech treatments of patients with Parkinson's disease. *Proceedings - Wireless Health 2015, WH 2015*. https://doi.org/10.1145/2811780.2811957

Eckman, M., Damhorst, M. L., & Kadolph, S. J. (1990). Toward a Model of the In-Store Purchase Decision Process: Consumer Use of Criteria for Evaluating Women's Apparel. *Clothing and Textiles Research Journal*, *8*(2). https://doi.org/10.1177/0887302X9000800202

Eisenstein, E. M. (2008). Identity theft: An exploratory study with implications for marketers. *Journal of Business Research*, *61*(11). https://doi.org/10.1016/j.jbusres.2007.11.012

english.gov.cn. (2020, September 25). *China to facilitate more people to exercise*. Http://English.Www.Gov.Cn/Premier/News/202009/25/Content_WS5f6d83c4c6d0f7257693cab0.Html.

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, *18*(1). https://doi.org/10.2307/3151312

Future Markets, I. (2020). *The Global Market for Wearable Technology in Healthcare*. https://www.researchandmarkets.com/reports/5142681/the-global-market-for-wearable-technology-in?utm_source=GNOM&utm_medium=PressRelease&utm_code=8dxtk9&utm_campaign=1437164+-+Global+Wearable+Technology+in+Healthcare+(Medical%2C+Healthcare+and+Wellness)+Market+2020-2027&utm_exec=chdo54prd

Gao, Y., Li, H., & Luo, Y. (2015). An empirical study of wearable technology acceptance in healthcare. In *Industrial Management and Data Systems* (Vol. 115, Issue 9, pp. 1704–1723). https://doi.org/10.1108/IMDS-03-2015-0087

Gefen, D., & Straub, D. (2000). The Relative Importance of Perceived Ease of Use in IS Adoption: A Study of E-Commerce Adoption. *Journal of the Association for Information*

Systems, *1*(1). https://doi.org/10.17705/1jais.00008

gov.cn. (2006, December 25). 每天锻炼一小时 健康工作五十年 幸福生活一辈子. Http://Www.Gov.Cn/Zhibo43/Content_478075.Htm.

Grewal, D., Gotlieb, J., & Marmorstein, H. (1994). The Moderating Effects of Message Framing and Source Credibility on the Price-Perceived Risk Relationship. *Journal of Consumer Research*, *21*(1). https://doi.org/10.1086/209388

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2). https://doi.org/10.2753/MTP1069-6679190202

Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, *40*(3). https://doi.org/10.1007/s11747-011-0261-6

Hsu, C. L., & Lu, H. P. (2004). Why do people play on-line games? An extended TAM with social influences and flow experience. *Information and Management*, *41*(7). https://doi.org/10.1016/j.im.2003.08.014

Huawei Ltd. (2019). *Annual Report 2019*. https://www.huawei.com/en/annual-report/2019

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal*, *20*(2). https://doi.org/10.1002/(sici)1097-0266(199902)20:2<195::aid-smj13>3.0.co;2-7

Hung, S. Y., Chang, C. M., & Yu, T. J. (2006). Determinants of user acceptance of the e-Government services: The case of online tax filing and payment system. *Government Information Quarterly*, *23*(1). https://doi.org/10.1016/j.giq.2005.11.005

Hwang, C., Chung, T. L., & Sanders, E. A. (2016). Attitudes and Purchase Intentions for Smart Clothing: Examining U.S. Consumers' Functional, Expressive, and Aesthetic Needs for Solar-Powered Clothing. *Clothing and Textiles Research Journal*, *34*(3), 207–222. https://doi.org/10.1177/0887302X16646447

IDC. (2019). *Wearables market report in China*. https://www.idc.com/getdoc.jsp?containerId=prCHE46857120

IMF. (2020). World Economic Outlook Database. *Www.Imf.Org*.

Jackson, D. L., Gillaspy, J. A., & Purc-Stephenson, R. (2009). Reporting Practices in Confirmatory Factor Analysis: An Overview and Some Recommendations. *Psychological Methods*, *14*(1). https://doi.org/10.1037/a0014694

Jeong, K. (2009). Electro-textile interfaces textile-based sensors and actuators. *Smart Clothing: Technology and Applications*.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher*, *33*(7). https://doi.org/10.3102/0013189X033007014

Jones, R. W., & Katzis, K. (2018). 5G and wireless body area networks. *2018 IEEE Wireless Communications and Networking Conference Workshops, WCNCW 2018*, 373–378. https://doi.org/10.1109/WCNCW.2018.8369035

JUNAEUS, S. (2015). *The rise of fitness wearables*. Https://Www.Centercode.Com/Blog/2015/10/the-Rise-of-Fitness-Wearables.

Kadir, E. A., Shamsuddin, S. M., Rahman, T. A., & Samad Ismail, A. (2015). Big Data Network Architecture and Monitoring Use Wireless 5G Technology. *Int. J. Advance Soft Compu. Appl*, *7*(1), 1–14.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly: Management Information Systems*, *23*(2). https://doi.org/10.2307/249751

Kim, C., Mirusmonov, M., & Lee, I. (2010). An empirical examination of factors influencing the intention to use mobile payment. *Computers in Human Behavior*, *26*(3). https://doi.org/10.1016/j.chb.2009.10.013

Kim, H. W., Chan, H. C., & Gupta, S. (2007). Value-based Adoption of Mobile Internet: An empirical investigation. *Decision Support Systems*, *43*(1). https://doi.org/10.1016/j.dss.2005.05.009

Kim, K. J., & Shin, D. H. (2015). An acceptance model for smart watches: Implications for the adoption of future wearable technology. *Internet Research*, *25*(4). https://doi.org/10.1108/IntR-05-2014-0126

Ko, E., Sung, H., & Yun, H. (2009). Comparative analysis of purchase intentions toward smart clothing between Korean and U.S. consumers. *Clothing and Textiles Research Journal*, *27*(4). https://doi.org/10.1177/0887302X08327086

Koenig-Lewis, N., Palmer, A., & Moll, A. (2010). Predicting young consumers' take up of mobile banking services. *International Journal of Bank Marketing*, *28*(5). https://doi.org/10.1108/02652321011064917

Kumar, N., Mohan, K., & Holowczak, R. (2008). Locking the door but leaving the computer vulnerable: Factors inhibiting home users' adoption of software firewalls. *Decision Support Systems*, *46*(1). https://doi.org/10.1016/j.dss.2008.06.010

Kwee-Meier, S. T., Bützler, J. E., & Schlick, C. (2016). Development and validation of a technology acceptance model for safety-enhancing, wearable locating systems. *Behaviour and Information Technology*, *35*(5). https://doi.org/10.1080/0144929X.2016.1141986

Lal, K. N., & Kumar, A. (2017). E-health application over 5G using Content-Centric networking (CCN). *IEEE International Conference on IoT and Its Applications, ICIOT 2017*. https://doi.org/10.1109/ICIOTA.2017.8073614

Lamb, J. M., & Kallal, M. J. (1992). A Conceptual Framework for Apparel Design. *Clothing and Textiles Research Journal*, *10*(2). https://doi.org/10.1177/0887302X9201000207

Lancelot Miltgen, C., Popovič, A., & Oliveira, T. (2013). Determinants of end-user acceptance of biometrics: Integrating the "big 3" of technology acceptance with privacy context. *Decision Support Systems*, *56*(1), 103–114. https://doi.org/10.1016/j.dss.2013.05.010

Ledger, D. (2014). *Inside Wearables Part 2: Key developments for adoption and engagement*.

Lee, H.-M. (2009). A Study on the Acceptance of Wearable Computers based on the Extended Technology Acceptance Model. *The Research Journal of the Costume Culture*, *17*(6). https://doi.org/10.29049/rjcc.2009.17.6.1155

Lee, S. Y., & Lee, K. (2018). Factors that influence an individual's intention to adopt a wearable healthcare device: The case of a wearable fitness tracker. *Technological Forecasting and Social Change*, *129*. https://doi.org/10.1016/j.techfore.2018.01.002

Lee, Y. D., & Chung, W. Y. (2009). Wireless sensor network based wearable smart shirt for ubiquitous health and activity monitoring. *Sensors and Actuators, B: Chemical*, *140*(2). https://doi.org/10.1016/j.snb.2009.04.040

Li, Han, Gupta, A., Zhang, J., & Sarathy, R. (2014). Examining the decision to use standalone personal health record systems as a trust-enabled fair social contract. *Decision Support Systems*, *57*(1). https://doi.org/10.1016/j.dss.2012.10.043

Li, He, Wu, J., Gao, Y., & Shi, Y. (2016). Examining individuals' adoption of healthcare wearable devices: An empirical study from privacy calculus perspective. *International Journal of Medical Informatics*, *88*. https://doi.org/10.1016/j.ijmedinf.2015.12.010

López-Nicolás, C., Molina-Castillo, F. J., & Bouwman, H. (2008). An assessment of advanced mobile services acceptance: Contributions from TAM and diffusion theory models. *Information and Management*, *45*(6). https://doi.org/10.1016/j.im.2008.05.001

Lu, J., Yao, J. E., & Yu, C. S. (2005). Personal innovativeness, social influences and adoption of wireless Internet services via mobile technology. *Journal of Strategic Information Systems*, *14*(3). https://doi.org/10.1016/j.jsis.2005.07.003

Lunney, A., Cunningham, N. R., & Eastin, M. S. (2016). Wearable fitness technology: A structural investigation into acceptance and perceived fitness outcomes. *Computers in Human Behavior*, *65*. https://doi.org/10.1016/j.chb.2016.08.007

MacKenzie, A., & Wajcman, J. (1998). *The social shaping of technology* (J. W. Donald Angus MacKenzie (Ed.); 2nd edView).

McCann, J., & Bryson, D. (2009). Smart Clothes and Wearable Technology. In *Smart Clothes and Wearable Technology*. https://doi.org/10.1533/9781845695668

Mills, A. J., Watson, R. T., Pitt, L., & Kietzmann, J. (2016). Wearing safe: Physical and informational security in the age of the wearable device. *Business Horizons*, *59*(6). https://doi.org/10.1016/j.bushor.2016.08.003

Mishra, A., & Agrawal, D. P. (2015). Continuous health condition monitoring by 24×7 sensing and transmission of physiological data over 5-G cellular channels. *2015 International Conference on Computing, Networking and Communications, ICNC 2015*, 584–590. https://doi.org/10.1109/ICCNC.2015.7069410

Mondi, M., Woods, P., & Rafi, A. (2008). A "Uses and Gratification Expectancy Model" to predict students' "Perceived e-Learning Experience." *Educational Technology and Society*, *11*(2).

Moon, J. W., & Kim, Y. G. (2001). Extending the TAM for a World-Wide-Web context. *Information and Management*, *38*(4). https://doi.org/10.1016/S0378-7206(00)00061-6

Moore, G. C., & Benbasat, I. (1991). Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation Instrument development—Innovation diffusion—Information technology adoption—Research methodology. *Information Systems Research*, *2*(3).

NanoMarkets. (2014). *Smart clothing market: Opportunities for sensors and smart materials*. Http://Ntechresearch.Com/Market_reports/Smart-Clothing-Markets-Opportunities-for-Sensors- and-Smart-Materials.

Nasir, S., & Yurder, Y. (2015). Consumers' and Physicians' Perceptions about High Tech Wearable Health Products. *Procedia - Social and Behavioral Sciences*, *195*. https://doi.org/10.1016/j.sbspro.2015.06.279

Parra, L., Sendra, S., Jiménez, J. M., & Lloret, J. (2016). Multimedia sensors embedded in smartphones for ambient assisted living and e-health. *Multimedia Tools and Applications*, *75*(21). https://doi.org/10.1007/s11042-015-2745-8

Philip, N. Y., & Rehman, I. U. (2016). Towards 5G health for medical video streaming over small cells. *IFMBE Proceedings*, *57*. https://doi.org/10.1007/978-3-319-32703-7_215

Pwc. (2014). Emerging mHealth: paths for growth. *Pwc*, *June*.

Rauschnabel, P. A. (2018). Virtually enhancing the real world with holograms: An exploration of expected gratifications of using augmented reality smart glasses. *Psychology and Marketing*, *35*(8). https://doi.org/10.1002/mar.21106

Robson, S., & Foster, A. (1989). *Qualitative research in action*. Hodder and Stoughton.

Rogers, E. M. (1962). *Diffusion of Innovations*. The Free Press.

Rogers, E. M. (1995). *Diffusion of Innovations*. The Free Press.

Rogers, E. M. (2003). *Diffusion of Innovations*. Simon & Schuster.

Sazonov, E. S., Fulk, G., Hill, J., Schutz, Y., & Browning, R. (2011). Monitoring of posture allocations and activities by a shoe-based wearable sensor. *IEEE Transactions on Biomedical Engineering*, *58*(4). https://doi.org/10.1109/TBME.2010.2046738

Schiffman, L. G., & Kanuk, L. L. (2000). *Consumer behavior* (7th ed.).

Selem, E., Fatehy, M., & El-Kader, S. M. A. (2019). E-Health applications over 5G networks: Challenges and state of the art. *ACCS/PEIT 2019 - 2019 6th International Conference on Advanced Control Circuits and Systems and 2019 5th International Conference on New Paradigms in Electronics and Information Technology*, 111–118. https://doi.org/10.1109/ACCS-PEIT48329.2019.9062841

Shanley, L. A., Slaten, B. L., & Shanley, P. S. (1993). Military Protective Clothing: Implications for Clothing and Textiles Curriculum and Research. *Clothing and Textiles Research Journal*, *11*(3). https://doi.org/10.1177/0887302X9301100308

Shareef, M. A., Kumar, V., & Kumar, U. (2014). Predicting mobile health adoption behaviour: A demand side perspective. *Journal of Customer Behaviour*, *13*(3), 187–205. https://doi.org/10.1362/147539214x14103453768697

Sharma, P. N., & Kim, K. H. (2012). Model selection in information systems research using partial least squares based structural equation modeling. *International Conference on Information Systems, ICIS 2012*, *1*(2), 420–432.

Shen, C. C., & Chiou, J. S. (2010). The impact of perceived ease of use on Internet service adoption: The moderating effects of temporal distance and perceived risk. *Computers in Human Behavior*, *26*(1). https://doi.org/10.1016/j.chb.2009.07.003

Sinha, N., & Gupta, M. (2019). Taxonomy of Wearable Devices. *International Journal of Technology Diffusion*, *10*(2). https://doi.org/10.4018/IJTD.2019040101

Sontag, M. S. (1985). Comfort Dimensions of Actual and Ideal Insulative Clothing for Older Women. *Clothing and Textiles Research Journal*, *4*(1).

https://doi.org/10.1177/0887302X8500400102

Southgate, N. (2003). Coolhunting with Aristotle Welcome to the hunt. *International Journal of Market Research*, *45*.

Spagnolli, A., Guardigli, E., Orso, V., Varotto, A., & Gamberini, L. (2014). Measuring user acceptance of wearable symbiotic devices: Validation study across application scenarios. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *8820*. https://doi.org/10.1007/978-3-319-13500-7_7

Spil, T., Sunyaev, A., Thiebes, S., & Van Baalen, R. (2017). The Adoption of Wearables for a Healthy Lifestyle: Can Gamification Help? *Proceedings of the 50th Hawaii International Conference on System Sciences (2017)*, 3617–3626. https://doi.org/10.24251/hicss.2017.437

Srivastava, S. C., & Teo, T. S. H. (2007). E-government payoffs: Evidence from cross-country data. *Journal of Global Information Management*, *15*(4). https://doi.org/10.4018/jgim.2007100102

Stafford, T. F., Stafford, M. R., & Schkade, L. L. (2004). Determining uses and gratifications for the internet. *Decision Sciences*, *35*(2). https://doi.org/10.1111/j.00117315.2004.02524.x

statista.com. (2020). *Wearables market outlook in China*.

Suh, M., Carroll, K., & Cassill, N. (2010). Critical review on smart clothing product development. *Journal of Textile and Apparel, Technology and Management*, *6*(4).

Sultan, N. (2015). Reflective thoughts on the potential and challenges of wearable technology for healthcare provision and medical education. *International Journal of Information Management*, *35*(5). https://doi.org/10.1016/j.ijinfomgt.2015.04.010

Sun, Y., Guo, X., & Peng, J. Z. (2013). Understanding the acceptance of mobile health services: A comparison and integration of alternative models. *Journal of Electronic Commerce Research* .

Talukder, M. S., Chiong, R., Bao, Y., & Hayat Malik, B. (2019). Acceptance and use predictors of fitness wearable technology and intention to recommend: An empirical study. *Industrial Management and Data Systems*, *119*(1). https://doi.org/10.1108/IMDS-01-2018-0009

Tan, G. W. H., Ooi, K. B., Leong, L. Y., & Lin, B. (2014). Predicting the drivers of behavioral intention to use mobile learning: A hybrid SEM-Neural Networks approach. *Computers in Human Behavior*, *36*. https://doi.org/10.1016/j.chb.2014.03.052

Tan, G. W. H., Ooi, K. B., Sim, J. J., & Phusavat, K. (2012). Determinants of mobile learning adoption: An empirical analysis. In *Journal of Computer Information Systems* (Vol. 52, Issue 3). https://doi.org/10.1080/08874417.2012.11645561

Tarabasz, A., & Poddar, G. (2019). Factors influencing adoption of wearable devices in Dubai. *Journal of Economics and Management*, *36*(2), 123–143. https://doi.org/10.22367/jem.2019.36.07

Venkatesh, V., & Davis, F. D. (2000). Theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, *46*(2). https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly: Management Information Systems*, *27*(3). https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly: Management Information Systems*, *36*(1). https://doi.org/10.2307/41410412

Vijayalakshmi, K., Uma, S., Bhuvanya, R., & Suresh, A. (2018). A demand for wearable devices in health care. In *International Journal of Engineering and Technology(UAE)* (Vol. 7, Issue 1). https://doi.org/10.14419/ijet.v7i1.7.9377

Walker, R. (1985). *Applied qualitative research*. Gower.

Wang, Y. S., & Liao, Y. W. (2008). Assessing eGovernment systems success: A validation of the DeLone and McLean model of information systems success. *Government Information Quarterly*, *25*(4), 717–733. https://doi.org/10.1016/j.giq.2007.06.002

Williams, R., & Edge, D. (1996). The social shaping of technology. *Research Policy*, *25*(6). https://doi.org/10.1016/0048-7333(96)00885-2

World Bank. (2020). *World development indicators | data*. World Development Indicators.

Worldometers. (2020). *Countries in the World by population*. Worldometers.

Wu, J. H., & Wang, S. C. (2005). What drives mobile commerce? An empirical evaluation of the revised technology acceptance model. *Information and Management*, *42*(5). https://doi.org/10.1016/j.im.2004.07.001

Wu, L. H., Wu, L. C., & Chang, S. C. (2016). Exploring consumers' intention to accept smartwatch. *Computers in Human Behavior*, *64*. https://doi.org/10.1016/j.chb.2016.07.005

Xinhua. (2020, November 15). *China leads world 5G development with 700,000 base stations*.

Http://English.Www.Gov.Cn/Statecouncil/Ministries/202011/15/Content_WS5fb0919ac6d0f7257693fc37.Html.

Yang, H., Yu, J., Zo, H., & Choi, M. (2016). User acceptance of wearable devices: An extended perspective of perceived value. *Telematics and Informatics*, *33*(2). https://doi.org/10.1016/j.tele.2015.08.007

Yi, M. Y., Jackson, J. D., Park, J. S., & Probst, J. C. (2006). Understanding information technology acceptance by individual professionals: Toward an integrative view. *Information and Management*, *43*(3). https://doi.org/10.1016/j.im.2005.08.006