JÖNKÖPING UNIVERSITY
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# User Acceptance in mHealth industry

A quantitative study of mHealth application in China based on UTAUT2 Model

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# Master Thesis in Business Administration

Title: User acceptance in mHealth industry A study of mHealth application in China based on UTAUT2 Model

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Key terms: mHealth, mHealth application, user acceptance, UTAUT2 model

## Abstract

**Background:** The market of mHealth has been growing steadily over last years, but in China, the market is not very mature, and the low level of popularity negative impact on the development. But it should be noted that the market has great potential with positive development background, the policy support by government, the widely used of smartphone and the Internet and especially the huge demand of mHealth in China.

**Purpose:** The purpose of the study was to reveals Chinese mHealth industry, to measure and understand the relationship between different factors that influencing the acceptance of mHealth apps in the case of Chinese users.

**Method:** This study was based on the UTAUT2 Model and a quantitative methodology was followed. The author excluded price value and habit from the original UTAUT and added privacy and security factor. A primary data collection was conducted through a questionnaire in this research. Suitable respondents were those individuals who needed healthcare services, and due to the budget and time limitation, a convenience sampling technique was used.

**Conclusion:** The findings show that social influence makes the strongest contribution to explaining users' acceptance of mHealth app in China. The whole ranking of the factors (from strong to weak) is social influence > privacy and security > facilitating condition > performance expectancy. And except privacy and security, other factors are all positively affect the acceptance of Chinese mHealth app users. Organisations can use these findings to improve the design of mHealth apps in the future.

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# 1. Introduction

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*The market of mHealth has been growing steadily over last years, but in China, the low level of popularity had negative impact on the desired development of mHealth industry. This chapter introduce the detailed background information which motive the purpose and question of this research. It is presented with eight sections: background, problem discussion, research questions, methodology, delimitation, expected contribution, research path and key words definitions.*

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## 1.1 Background

In today's life, health issues have been garnering significant attention at an increasing pace (Gustafson, 2017), people are trying to address this problem by providing effective solutions with the advanced technology in numerous ways. What's more, the smartphone plays a central role in making this resolution a reality and is becoming more accessible for millions around the world, even developing countries (Mayes & White, 2016).

According to Statista (2016), the number of mobile phone users in the world is expected to pass the five billion mark by 2019. And the number of mobile phones subscriptions is almost same with the population in the world. According to the ICT (Information Communications Technology) Facts and Figures report stated by ITU (International Telecommunication Union) (2013), in 2016, an estimated 62.9 percent of people in the world owned a mobile phone; the mobile phone penetration is forecasted to continue to grow, which led by China and India, rounding up to 67 percent by 2019 (Statista, 2016). By 2019, China is expected to reach almost 1.5 billion mobile connections and India almost 1.1 billion (Statista, 2016). When it comes to the Internet, as the data stated by ITU (2015), 3.2 billion people all over the world are using the Internet by end 2015. In 2016, seven billion people (95% of the global population) live in an area that is covered by a mobile-cellular network (ITU, 2016).

Based on the popularization of smartphone and the Internet, the market for mHealth has been growing steadily over the last years and continues to do so. According to the mHealth report from World Health Organization (2011), mobile health, also known as mHealth, is defined as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices by The Global Observatory for eHealth (GOe). The Mobile health devices and applications has the potential to save resources, increase outreach, and improve health outcomes (Ventola, 2014), especially in developing countries that have limited medical and healthcare resources (Mayes & White, 2016). According to a recent report by Grand View Research (2017), the mHealth app market size was valued at USD 4.19 billion in 2016 and is projected to grow at a CAGR of 44.2% over the forecast period. In 2017, there are 325,000 health apps (health & fitness and medical apps) available on all major app stores (Research2Guidance, 2017), with more than 200 health apps being added each day (IQVIA, 2017). The Demand for apps grew by 35% in 2015, which showed the increasing user interest in healthcare service through smartphones (Grand View Research, 2017).

According to mHealth app Economics report conducted by Research2Guidance (2017), the countries with best market conditions for mobile health solutions are the USA, the UK and Germany. The USA (67%) is leading far ahead. In China, although mHealth has the potential to improve health care, the current use of mHealth interventions in health care remains relatively low (All Tech Asia, 2017). There is still plenty of room for improvement to fully maximize the potential benefit of mHealth.

According to a CNNIC (2018), there are 802 million Internet users in China, of this 802 million people, 788 million are mobile internet users. 2016 Global health care outlook (Deloitte, 2016) stated that China's healthcare expenditure is growing fast, with annual expenditures projected to reach $896.7 billion by 2019, up from an estimated $579.7 billion in 2014. Its citizens are more willing to spend more on quality medical service. In 2020, the market size of mHealth would reach 90 billion yuan and this prompted many leading companies such as Baidu, Tencent, Alibaba, and Ping An Insurance, to invest billions of dollars in mHealth industry (All Tech Asia, 2017). The most widely used mHealth apps in China are Spring Ring, Guahao, PingAn Doctor and Dingxiang doctor

(Sootoo institute, 2017). The main business of these apps includes quick consultation, health plan, hospital registration, physical check-up appointment, etc.

The problem is, the low level of popularity had negative impact on the desired development of the industry. According to a recent survey in Beijing by MorningPost (2016), only 9.09% of people trust digital health and 46.97% of people said they never used any mHealth application before, 27.27 percent of people worry their mobile health apps to be hacked, 50 percent of people don't believe the quality of online treatment. In some degree, mHealth technology faces the same issues as other digital health innovation.

### 1.2 Problem Discussion

Under this circumstance, it is therefore important to understand the factors that influence users' acceptance of mHealth in Chinese market, which might conduce suggestions for further direction of improvement. Although there are lots of research papers in the field of technology acceptance, previous research suggests that different technologies would have different factors affecting user acceptance (Gupta, Dasgupta & Gupta, 2008), which infers that factors that affect the user acceptance of mHealth might not be in line with other technologies. Besides, compare with other western countries (the USA, the UK, Germany), the mHealth industry in China are not very mature, so far, there are barely research that have studies the China's user acceptance towards mHealth apps. Some researches still rest on exploring the value of mHealth market in China, which provide little idea about the way or reasons of Chinese users' behavior.

### 1.3 Research question

In this case, this study aims to reveals the users' acceptance of mHealth applications in China. In order to achieve this goal, this research plan to answer the following research questions:

*RQ1: What are the factors and which factors are the most significant factors that influence the users' behavior intention of mHealth apps in the case of Chinese users?*
This question aims to quantify the perceived user acceptance of mHealth app in China in

terms of the chosen factors in the research framework. The factors are performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation and privacy and security. In addition, this question aims to study the importance of different factors towards mHealth app in China, try to investigate whether there are one or more factors influence user acceptance than others and which factors take the most important role when measuring user acceptance of Chinese mHealth apps.

*RQ2: how do these factors influence users' behavior intention towards mHealth apps within Chinese market?*

This question intent to understand and explore the relationship between these factors and users' acceptance, whether it is negative, positive or no association.

### 1.4 Research method

In terms of research typologies, this research is a causal research that manages to explore the relationship between the chosen factors form UTAUT2 model and user acceptance of mHealth in China. The primary data was collected in forms of questionnaire. And deductive was applied as the research approach. The medium, contrasts, measurement scale, and pilot study was introduced so as to provide the effective information of questionnaire to achieve the research purpose. In the end, the SPSS was used to process the raw data with correlation and regression analysis. This study aims to test the hypothesizes and examine whether the proposed model fits with this context or not.

### 1.5 Delimitations

Delimitations are the characteristics that limit the scope and describe the boundaries of the study (Suresh, 2014). This study was delimited to the following aspects. Firstly, this study will focus on the mHealth applications and not consider other types of technology in mHealth industry, because of the given time and the huge potential of smartphone and mobile health application. Secondly, the target group in this study will be the general users, patients. The healthcare providers, including physicians and hospital will not be considered. Since there are lots of studies have looked at the factor constrains the effectiveness of treatment from physicians' perspective (Sezgin, Özkan-Yildirim &

Yildirim, 2018; Waegemann, 2010; Becker, Miron-Shatz, Schumacher, Krocza, Diamantidis & Albrecht, 2014). This study will focus on users' perspective. In addition, this thesis will only look into the mHealth application operating in the geographical area of China, because the room of improvement and the potential of the market. Lastly, this thesis will base on the factors in line with the UTAUT2 model with some small adjustments, will not consider other theorical technology acceptance models. Reasons for these delimitations are stated in literature review chapter.

### 1.6 Expected Contribution

From theoretical perspective, this study is expected to examine the generalizability of the UTAUT2 model, whether it is suitable for users' acceptance of mHealth in China. The results might provide evidence and can act as the basis for future research in different sectors within mHealth in different countries and different age groups.

From a managerial perspective, for technology companies, the result might help them improve products and narrow down the gap between customers' expectation and their actual use experience. The relationship between factors and user acceptance could help app developers to choose whether enhance or avoid these elements. Besides, it could help entrepreneurs within the field of mHealth industry to better understand market and users in China, to help them make decision before they invest.

### 1.7 Research path

This thesis will be divided into five chapters: introduction, literature review, methodology, empirical findings and discussion, and conclusion.

The introduction part aims to lead the reader get involved to the research topic from the broader context, clarify the research purpose, perspective and possible contribution.

The literature review chapter involved an overview of previous work and a clear theoretical foundation for both designing and analyzing the empirical study. The contents

in this part include mHealth industry, mHealth application, technology acceptance theories and the progress of the hypothesis development.

Next chapter is methodology. This part presents details about how the empirical work was conducted and how the research purpose has been met. It starts with research philosophy, then is about the pros and cons of research approach selection, both data collection and analysis. The detailed design process was included in this chapter as well, such as sample, measurement and scale, data quality, ethical considerations and limitations, etc.

Then is empirical finding and discussion chapter. This part will be divided into two parts. First part is the findings of the empirical data. Factor analysis, correlation and regression analysis will be used to conduct the data and examine the hypothesizes. Table and figure will be used frequently in this part to explain the distribute, mode and relations to answer the research questions. Second part is discussion, which will compare the results of empirical findings with research questions, combine it with theorical model, and generate implications from research and practice perspective of this study.

The conclusion part will provide an overview of this research, compare the findings and research questions to evaluate whether it could be answered or not. In addition, this chapter will present the implication, limitations and the future research direction.

### 1.8 Key words

**mHealth:** The Global Observatory for eHealth (GOe) defined mHealth or mobile health as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices. (World Health Organization, 2011).

**mHealth application:** Application refers to the program that has been installed on mobile devices. mHealth application (app) refers to the application within the field of health industry. Android and Apple are the two primary platforms that host majority of the apps.

**User Acceptance:** in this research, the focus is users' behavior intention towards mHealth apps. Users in this thesis equals patients, healthcare providers will not be considered, including individual (physicians, nurses) or institution (hospitals, clinics and others).

**UTAUT2:** the extended unified theory of the acceptance and use of technology (UTAUT2) is a technology acceptance model proposed by Venkatesh et al. (2012). It set up on the foundation of unified theory of the acceptance and use of technology (UTAUT) (Venkatesh et al., 2003). UTAUT2 extended the generalizability of UTAUT from organizational to consumer context and explained variables that affect the behavior intention to use technology and the subsequent actual use.

# 2. Literature Review

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*The present chapter provides a review of relevant literature regarding user acceptance in the mHealth industry. It starts with a brief introduction of mHealth industry, mHealth technology, followed by a detailed discussion of various technology acceptance theories. Then, it reviews empirical studies regarding the factors that influence users' acceptance of mHealth technology. Based on this, research gaps are identified, and the chapter develops six research hypotheses based on the UTAUT2 model.*

---

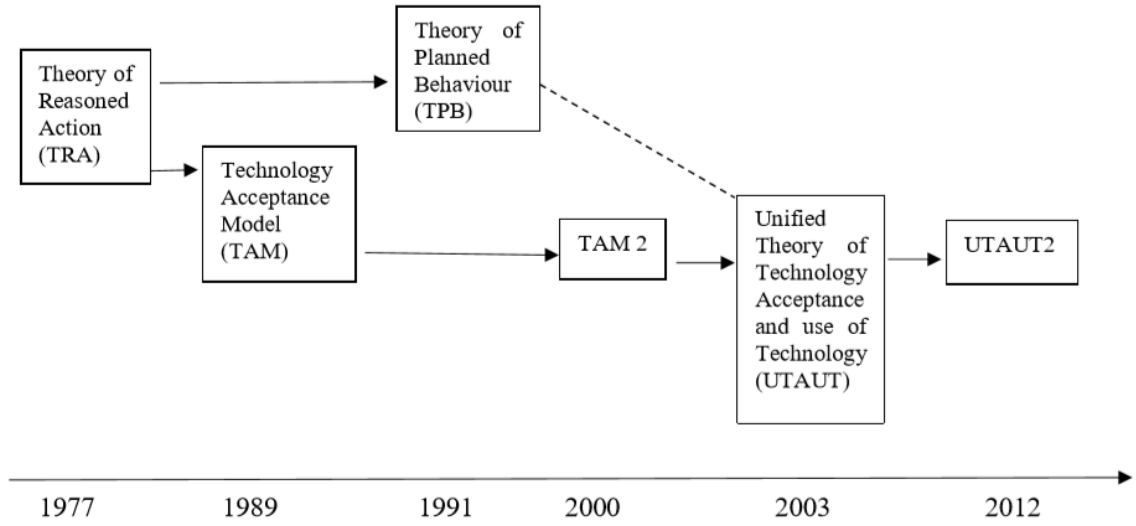
## 2.1 Consumer behaviour in ICT

Information and communication technology (ICT) is a general term which includes any communication device or application, such as mobile phones, computer and network hardware, software, the Internet, satellite systems, and so on (Schiliro & Choo, 2017). Based on the popularization of smartphone and the Internet, the research about ICT adoption has become more and more important. According to Robertson (n. d.), the two levels of human characteristics in ICT are technology acceptance and Socio-Economic level. Since ICT is a fast-changing market, market stakeholders need to know the knowledge of consumer behaviour, why and which consumers adopt technologies, to be able to forecast the market better. And based on the research of Marangunić & Granić, (2015), users' technological acceptance is regarded as a key driver of the development of new technologies because new technologies are always facing a lot of barricades in the early stage of development (Marangunić & Granić, 2015). When it turns to mHealth industry, because of the significant benefits of mHealth technology, scholars globally have explored why users are willing or unwilling to adopt mHealth technologies in order to facilitate the development of these technologies.

## 2.2 Technology acceptance models

There are a variety of theories for technology adoption models used in ICT literature, this study will apply UTAUT2 (Venkatesh et al., 2012) to shed light on the factors that influence the acceptance of mHealth apps in the case of Chinese users. This chapter illustrates the development of the model (Figure1)

**Figure 1 the development of technology acceptance models**




Technology Acceptance Model (TAM) developed by Davis (1989) is the most influencing theory in the field of technology acceptance because it was not only adopted by various empirical studies (such as Chen & Lin (2018), Choi et al. (2018), Dou et al. (2017), and Zhang et al. (2017)), but also influenced subsequent technology acceptance theories. TAM posits that users' intention to adopt a new technology is mainly determined by two beliefs, i.e., Perceived Ease of Use (PEOU) and Perceived Usefulness (PU). The former refers to the extent to which an individual believes that using a specific technology will be free of efforts while the latter refers to the extent to which an individual believes that using a specific technology will enhance its performance of accomplishing a certain task (Davis, 1989).

The antecedent of TAM is the Theory of Reasoned Action (TRA) pioneered by Fishbein & Ajzen (1977). TRA suggested that an individual' attitude is the key determinant of its behavioral intention and the attitude is determined by the beliefs of the outcomes of the behavior and subjective norm (i.e., perceived social pressure). Hence, PEOU and PU can be viewed as two key beliefs that influence attitude (Sun et al., 2013).

Subsequently, since Venkatesh & Davis (2000) realized that the determinants of perceived usefulness have been relatively overlooked in TAM, they incorporated social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and

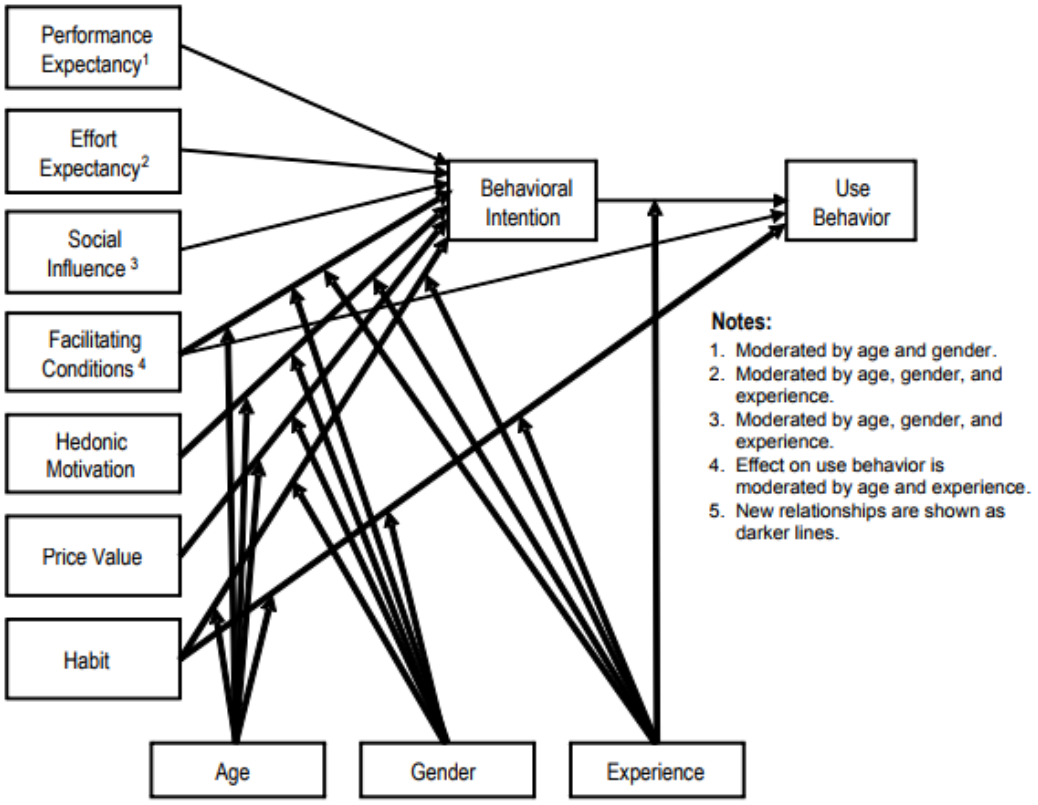
perceived ease of use) into TAM, thus building TAM2.

Another extension of TRA is the Theory of Planned Behavior (TPB) developed by Ajzen (1991). TPB adds perceived behavioral control (PBC) into the previous theory and suggests that individuals' perceived ability, resources, and constraints are also influencing their attitudes and behavioral intention (Ajzen, 1991). Based on a richer understanding of the use of TRA, TPB has been widely used to understand technology adoption (Lu, Zhou, & Wang, 2009; Leng, Lada, Muhammad, Ibrahim, & Amboala, 1970; Sentosa & Mat, 2012).

Evidently, every technology acceptance model has its merits, demerits, and range of application. Hence, Venkatesh et al. (2003) integrated 8 relevant models and established the unified theory of acceptance and use of technology (UTAUT). These eight models are: Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behaviour (TPB), Combined TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SOT). The UTAUT was designed by employing three variables that influence the behavioral intentions to use (performance expectancy, effort expectancy, social influence), one variable that influences action (facilitating conditions), and four control variables that influence the effects of the process accordingly (gender, age, experience and voluntariness of use).

However, the UTAUT model focuses on technology acceptance in an organizational context, which reduces its range of application. In view of this, Venkatesh et al. (2012) made an update and developed the new UTAUT2, shown in Figure 2 In the model, they comprehensively considered various factors that affect users' technological acceptance within a consumption context. Performance expectancy, effort expectancy, social influence, and facilitating conditions are similar constructs to PU, PEOU, subjective norm, and PBC suggested by previous technology acceptance theories (Williams et al., 2015; Venkatesh et al., 2012). Additionally, Venkatesh et al. (2012) considered the roles of demographics, hedonic motivation, habit, and price value. The detail explanation of each variables can be found in section 2.5.

**Figure 2 UTAUT2 model**




**Source: Venkatesh et al. (2012)**

Recently, the UTAUT2 has been used extensively in research in various and diverse fields. More specifically, Yuan, et al. (2015) adopted the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2) Model to examine the predictors of the users' intention to adopt health and fitness apps, Kessler & Martin (2017) applied UTAUT2 to the Artificial Intelligence (AI) industry specialising in voice assistants, Nair, et al. (2015) explained the factors influencing students' acceptance and usage of a lecture capture system (LCS) – ReWIND – in a Malaysian university and Gharaibeh, et al., (2018) used the UTAUT2 Model to determine Factors affecting the adoption of Mobile Banking Services. Besides, the application of UTAUT2 in mHealth industry will be analysed in section 2.4.

In conclusion, based on the overview of several technology acceptance models, as a theoretical framework for this master thesis, the UTAUT 2 (Venkatesh, et. al, 2012) will be used to better explain users' acceptance of mHealth application. The detailed reasons will be clarified in Section 2.6. Since the information about mHealth in introduction chapter is insufficient, following section will present detailed knowledge about mHealth

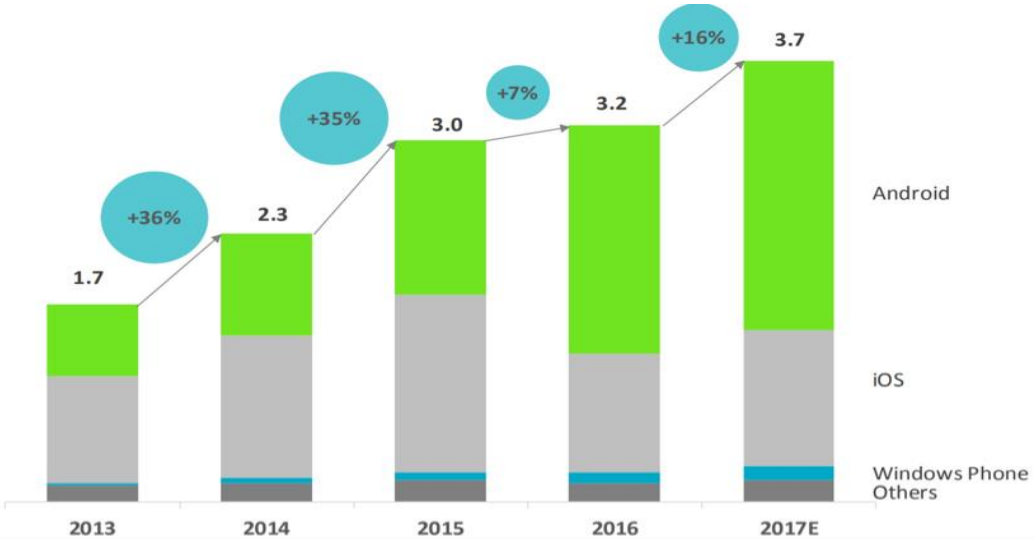
technology and the state quo of Chinese mHealth market.

### 2.3 mHealth technology

The mHealth technology refers to a set of healthcare technology services provided by mobile platforms and these services can be classified into three types, including diagnostic services, preventive services, and procedural services (Zhang et al., 2017). mHealth apps can provide most of these services and hence serve as an important platform of mHealth technologies (Chen & Lin, 2018), which were chosen to be the focus of this research.

Nowadays, the use of mHealth apps has been widely promoted in recent years, between 2013 and 2014. Smartphone users worldwide reached 182 million, with 134 million apps downloaded in the first three months of 2013 (Stoyanov et al, 2015). In 2017, about 325,000 health-related apps are available through major app stores (Research 2 Guidance, 2017). From 2013 to 2017, the number of downloads of mHealth apps is also increasing (Figure 3). And as the data was mentioned in introduction chapter, in 2017, there are 325,000 health apps available on all major app stores (Research2Guidance, 2017), with more than 200 health apps being added each day (IQVIA, 2017).

**Figure 3 Total downloads of apps of mHealth**




**Source: Research2Guidance, (2017).**

Since there are many kinds of mHealth apps and different stakeholders use these apps for different purposes, the healthcare industry generally is highly complex. Knowing who

their stakeholders are and clarifying the target group of this research in the initial stage is necessary.

According to Malvey & Slovensky (2014), the major users of mHealth includes consumers/patients, providers/health systems, and physicians (Table 1). Consumers are the starting point, followed by providers—health systems and physicians. Patients want more health information and choices; physicians want more valuable evidence and clear professional guidance to confidently recommend applications to patients; health systems want to use mHealth tools to reduce management cost, from patient management to clinical (Malvey, & Slovensky, 2014).

**Table 1 mHealth stakeholder analysis**

| **Stakeholders** | **Information needs** |
|---|---|
| **Consumer/ patient** | How mHealth can save money, time and improve health outcomes and satisfaction |
| **Health-care providers/ physicians and other clinicians** | How mHealth can help providers do their work more efficiently and enhance quality outcomes |
| **Health-care providers/ institutions (hospitals, physician practices)** | How to manage the patient and identify incentives for physicians and patients |

**Source: adapted form Malvey, & Slovensky, (2014).**

In this research, the target group is delimited to patients. According to Ventola, (2014), the services that mHealth application provide to patients can be divided into five categories: time and information management, consultation and communication, health status recording and acquisition, medical information acquisition and health education. The detailed information can be found in figure 4.

**Figure 4 Uses for mHealth apps**

**Source: Ventola, (2014).**

In conclusion, this section introduced mHealth in general. Due to the complexity of mHealth technology users, this research will only focus on patient group other than physician and hospital. Next section the author will present the adequate knowledge about Chinese mHealth market.

### 2.4 mHealth in China

With the rapid development of Internet technology, the integration of information technology and medical and health services has become more and more close, and mobile health has developed vigorously, reflecting a far-reaching development prospect. mHealth refers to health diagnosis and treatment through network technology and mobile communication (Istepanian & Pattichis, 2006). At present, mHealth has been widely promoted due to its own advantages such as convenience, mobility, low cost and so on (Akter et al, 2010). Globally, mobile health has developed rapidly. The World Health Organization conducted a global survey in 2011 and 114 countries participated in the survey, it was found that many countries have established mobile medical bases (Jing et al, 2016). At present, mHealth has achieved great success in Western countries. The United States is the leader in mHealth application development, accounting for about 50% of the world's total, Europe about 20%, while the Asia-Pacific region accounts for only 4% (Li et al, 2014).

Although the development in developing countries is in initial stage, there are big market potential in these countries (Mamplekou et al, 2010). When it comes to China, mHealth

is an extremely potential market which has great prospects for development in China. In 2014, China's mHealth market grew rapidly at a 29% growth rate. At that time, people predicted that the growth rate would reach 49% by 2015 (Statista, 2014). The market size of mHealth was also very large. In 2016, the market size reached 718 million yuan, and in 2017, mHealth would reach 1.25 billion yuan (Yu et al, 2014).

Table 2 showed the most widely used mHealth apps in China, all of these are free to download. The author tested all of these apps and analyzed the main contents of each app. According to the data conducted by Sootoo institute (2017), As of the first half of 2017, the number of downloads of Ping An Good Doctor and Chun Yu Doctors exceeded 100 million, respectively, with a total of 140.05 million and 120.36 million. The downloads of micro-medicines, and DingXiang doctor are all around 10 million, 19.62 million and 9.86 million. And the downloads of Haodaifu Zaixian are 32.07 million. The download link of each app could be found in Appendix 1.

**Table 2 Examples of mHealth app in China**

| **Name** | | **Main contents** |
|---|---|---|
| **Chun Yu Doctors (Chunyu Yisheng)** | | Quick inquiry, health consultation, medicine purchasing |
| **micro-medicines, (Wei yi)** | | Hospital registration, Quick inquiry, health consultation |
| **Ping An Good Doctor (Ping An haoyisheng)** | | Physician inquiry, medicine purchasing, health community, Hospital registration, |

| | | |
|---|---|---|
| **DingXiang doctor (DingXiang yisheng)** | | Medication consultation, health community, healthcare information |
| **Haodaifu Zaixian** | | Quick inquiry, health consultation, Hospital registration, |

**Source: adapted from Apple store (2019)**

This great potential mainly due to positive development background of mHealth in China. Firstly, China has provided policy support for the development of mHealth. With the rapid development of China's economy in recent years, and with the rapid development of China's economy in recent years, "paying attention to people's livelihood and improving life" has become the top priority of national economic policy (China Preparatory Committee, 2012). Among the 4 trillion yuan investment list published in April 2009, 150 billion yuan was invested in the development of social undertakings such as health care and education, accounting for about 4% of the total amount. According to the Opinions of the Central Committee and the State Council of the Communist Party of China on Deepening the Reform of Medical and Health System (i.e. the New Medical Reform), governments at all levels will invest 850 billion yuan in promoting five major reforms in 2009-2011: speeding up the construction of basic medical security system; initially establishing the national essential drug system; improving the basic medical and health service system; promoting the gradual equalization of basic public health services; and promoting the reform of public hospitals.

Secondly, the widely used of smartphone and the Internet. mHealth refers to the delivery of various medical information and services to patients through computers, mobile phones or satellites (Cipresso et al, 2012). And according to the data, 117 million users in China used mobile phones and 80 million people used the Internet in 2014 (Li et al, 2014). They like to browse information through different types of communication equipment and

software, and the development of e-commerce has also provided new impetus for the development of China's network.

The huge demand of mHealth in China could be other support. China's medical field has its own unique background, difficulty in seeing a doctor is a very common phenomenon in China and it is often difficult for patients to get effective medical care (Gao et al, 2001). Firstly, the economic development of different regions in China is very unbalanced, which leads to the imbalance of medical resources allocation in different regions (Jing et al, 2016). For most regions, medical resources, especially high-quality resources, are insufficient. Secondly, for patients, chronic diseases are difficult to treat at home, and medical equipment in many hospitals is insufficient to meet the needs of a large number of patients. The emergence of chronic diseases makes it necessary for people to focus on education and long-term treatment of chronic diseases (Chen et al, 2010).

All of these provide a great space for the development of mHealth in China. Even the mHealth couldn’t be the solution for all these issues with Chinese healthcare system and replace the medical equipment, they probably improve the efficiency of some healthcare activities with proving patients initial judgment and guidance.

### 2.5 Technology Acceptance of mHealth

Because of the significant benefits of mHealth technology and the great potential of mHealth market, scholars globally have explored why users are willing or unwilling to adopt mHealth technologies in order to facilitate the development of these technologies. There are many empirical studies that probed into the factors which influence users’ acceptance of mobile health. Among them, this chapter chooses 8 typical, relevant, and high-quality empirical studies. Only studies published after 2015 are selected because early studies may be invalid to reflect the current development and innovation of mobile health, which is evolving rapidly in recent years.

The key elements in the 8 studies are presented in Table 3 and these studies provide the following implications. First, previous scholars have employed different technological

acceptance models and using different models leads to different hypothesized factors. Generally, the adoption of the UTAUT2 theory leads to the maximized number of hypothesized and confirmed factors because the theory covers more drivers of technological acceptance compared with other theories. Second, even for the same or similar factor, previous studies have drawn inconsistent conclusions. For example, Guo et al. identified the significant effects of demographics whereas Dou et al. (2017) did not; Gao et al. (2015) and Zhang et al. (2017) identified the positive effect of effort expectancy (or PEOU), whereas Cilliers et al. (2018) reported a insignificant effect of perceived effort and Choi et al. (2018) even found a negative effect of PEOU; Gao et al. (2015) documented a negative effect of privacy concern, whereas Choi et al. (2018) and Chen & Lin (2018) found that the effect of insecurity (or perceived security) is insignificant. Hence, there may be not a generalized law about the technological acceptance of different types of mobile health technologies and users. Further investigations are still needed. Third, very limited studies (such as Chen & Lin (2018)) probed into the technology acceptance of mHealth apps and few factors were identified, leaving a large room for the present study.

**Table 3 An overview of empirical studies regarding service users' technological acceptance of mHealth.**

| Authors | Theories | Sample | Dependent Variables | Hypothesized Factors[1] | Confirmed Factors[2] |
|---|---|---|---|---|---|
| **Guo et al. (2015)** | Protection Motivation Theory (PMT) | 428 mobile health target consumers | Intention to adopt mobile health services | Perceived vulnerability, age, gender, attitude, perceived severity, self-efficacy, response efficacy | Age, gender, attitude, perceived severity, self-efficacy, response efficacy |
| **Gao et al. (2015)** | PMT and UTAUT 2 | 462 actual users of healthcare wearable devices in China | Intention to adopt healthcare wearable devices | Effort expectancy, performance expectancy, functional congruence, hedonic motivation, self-efficacy, social influence, perceived vulnerability, privacy concern, perceived severity, | Effort expectancy, performance expectancy, functional congruence, hedonic motivation, self-efficacy, social influence, perceived vulnerability, |

| | | | | | |
|---|---|---|---|---|---|
| | | | | product type | privacy concern, perceived severity, product type |
| **Dwivedi et al. (2016)** | UTAUT 2 | Citizens from USA (n= 387), Canada (n = 359), and Bangladesh (n = 375) | Intention to adopt mobile health services | Hedonic motivation, effort expectancy, self-concept, performance expectancy, waiting time, facilitating conditions, price value, social influence | Effort expectancy, self-concept, performance expectancy, waiting time, facilitating conditions, price value, social influence |
| **Zhang et al. (2017)** | TAM | 650 service users from Hong Kong, China | Intention to adopt mobile health services | Self-efficacy, PEOU, PU, response efficacy | Self-efficacy, PEOU, PU, response efficacy |
| **Dou et al. (2017)** | TAM and Dual-Factor Model | 57 hypertensive patients in China | Intention to use mobile technology for chronic disease management | Demographics, perceived health threat, relationship with doctor, self-efficacy, social influence, usage experience, resistance to change, PEOU, PU | Perceived health threat, relationship with doctor, self-efficacy, social influence, usage experience, resistance to change, PEOU, PU |
| **Chen & Lin (2018)** | TAM, Technology Readiness, Technology Readiness and Acceptance Model (TRAM) | 1104 individual from a fitness community in Taiwan, China | Intention to download and use health Apps | Insecurity, discomfort, optimism, health consciousness, PEOU, PU | Optimism, health consciousness, PEOU, PU |
| **Cilliers et al.** | UTAUT | 202 universit | Intention to use mobile | Perceived effort, PU, social | PU, social influence, |

| | | | | | |
|---|---|---|---|---|---|
| **(2018)** | | y students in South Africa | technology to collect health-related information | influence, mobile experience, attitude towards technology | mobile experience, attitude towards technology |
| **Choi et al. (2018)** | TAM and UTAUT | 400 smartphone users from Korea | Intention to use mobile health for intervening smartphone overuse | Perceived security, PEOU, PU, resistance to change, social norm | PEOU, PU, resistance to change, social norm |

Notes: [1] indicates that the authors hypothesized these factors as the significant predictors of technology acceptance; [2] indicates that these factors are confirmed by statistical analysis as the significant predictors of technology acceptance.

According to the analysis of previous research and the application of technology acceptance in mHealth industry, the proposal research framework of this thesis will be generated in next section.

### 2.6 The proposal research framework

In view of the above analysis, it should be prudent to adopt the UTAUT2 model into the context of the uses' technology acceptance of mHealth apps since the model was developed in a consumption and individual context. The present study makes slight modifications to the model, shown in Figure 5.

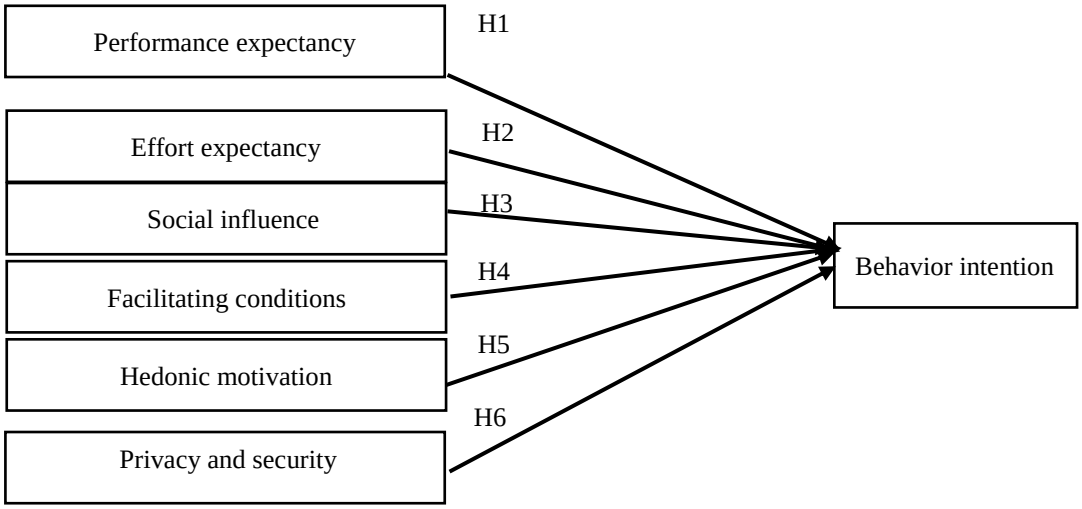
In this research, the focus is behavior intention. Due to the time horizon, the gap between the behavior intention and actual use will not be explored in this study. The content of user acceptance in this study is the users' behavior intention towards mHealth apps in China.

It should be noted that this study drops "*price value*" from the original UTAUT2 model because it is not likely that adopting mHealth Apps will bring substantial monetary costs to users (most of these Apps are free of charge). "*habit*" was dropped as well. In the context of technological acceptance, habit refers to the degree to which individuals incline to perform repetitive behaviors spontaneously because of learning (Kim et al., 2005; Venkatesh et al., 2012).Since the dependent variable in this study is behavior intention,

there is no sense to measure the intention of people who are framing heavy use of the apps and have this habit already.

Meanwhile, this study also adds privacy and security into the model because the use of network technologies may lead to the leakage of individuals' privacy and security concerns (Yousafzai et al., 2010). The following section will clarify the detail reasons of this and develop research hypotheses regarding Chinese users' technological acceptance of mHealth apps on the basis of the UTAUT2 theory.

**Figure 5 The proposal research framework**




## 2.7 Hypotheses Development

There are six hypotheses in this study to answer the research questions. The variables include performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), hedonic motivation (HM), and behavior intention (BI). Following paragraphs are the development progress of each hypothesis.

### 2.7.1. Performance Expectancy

Performance expectancy refers to the extent to which users perceive that using a new technology will enhance their effectiveness of performing specific tasks (Venkatesh et al., 2003). Sun et al. (2013) suggested that the effectiveness of mHealth services is mainly reflected in the extent to which they help users to reduce health-relevant threats. If users perceive high effectiveness, they are very likely to adopt the technology because of the

concerns about health-relevant threats. TAM theory also suggested the major motivation for adopting a new technology is to gain benefits and if the technology is perceived as ineffective, the perceived benefits do not exist (Legris et al., 2003). Empirical studies have achieved a consensus that performance expectancy (or PEOU) is a strong and positive predictor of users' acceptance of mHealth services or projects (Chen & Lin,2018; Choi et al., 2018; Cilliers et al., 2018; Dou et al., 2017; Dwivedi et al., 2016; Gao et al., 2015; Guo et al., 2015; Zhang et al., 2017). Hence, the following research hypothesis is formulated:

**H1:** Positive performance expectancies positively influence users' behavior intention towards mHealth app in China.

### 2.7.2. Effort Expectancy

Generally, effort expectancy has widely viewed the extent to which users perceive that adopting a new technology will be free of efforts (Gao et al., 2015; Venkatesh et al., 2012). In this thesis, it means the ease of use mHealth apps. In general, apps are designed to make it simple and convenient for users, the more effort and time users need to invest to an app, the less likely they will continue to use it over time, such as the steps of sign up, the progress of consulting.

Regarding the role of effort expectancy in the technological acceptance of mobile technologies, scholars held divided views. Melas et al. (2011) suggested that healthcare service users prefer easy tools than complicated tools. Dou et al. (2017) also indicated that users prefer to use convenient technologies to manage their chronic disease management. However, Hampshire et al. (2015) indicated that ICT has become an integral part of modern lives and smartphones have been popularized and ubiquitous. As a result, it is not likely that effort expectancy influences users' acceptance of mobile technologies. Moreover, Choi et al. (2018) suggested that the effort expectancy even negatively influences on users' acceptance because easy healthcare services may be perceived by users as less credible and professional. Several empirical studies also documented insignificant (Cilliers et al., 2018) or negative (Choi et al., 2018) influence of effort expectancy (or PEOU) on users' acceptance of mHealth services, but the majority of empirical studies reported a positive influence (Chen & Lin, 2018; Dou et al.,

2017; Dwivedi et al., 2016; Gao et al., 2015; Zhang et al., 2017). In addition, scholars also indicated that PEOU is positively associated with PU and hence PEOU indirectly influences users' acceptance (Chen & Lin, 2018; Zhang et al., 2017)). Since the divided views, this variable still needs to be tested in this research. Followed the majority of empirical studies, the following research hypothesis is formulated:

**H2:** Effort expectancies (free of efforts) positively influence users' behavior intention towards mHealth app in China.

### 2.7.3. Social Influence

Social influence reflects the extent to which individuals' decision-making is affected by social factors, such as subjective norm and significant others' expectations (Venkatesh & Morris, 2000). Dwivedi et al. (2016) noted that users' adoption of mHealth service is visible by others and hence others' evaluation has a normative pressure on users. Meanwhile, individuals' decision making is always affected by their reference groups and they tend to comply with the expectancies of these reference groups (Bearden & Etzel, 1982). Moreover, individuals in a collectivist society (e.g., China) are under strong social pressure (or subjective norms) than individuals in an individualist society because individuals' identities in a collectivist society are defined by other group members, rather than themselves (Triandis, 1988; Zhang et al., 2007). The positive role of social influence (or subjective norm) in driving users' acceptance of mHealth services has been documented by empirical studies (Cilliers et al., 2018; Dwivedi et al., 2016; Gao et al., 2015). Hence, it can be inferred that if a Chinese user perceives a strong social pressure about the use of an mHealth app, its intention to adopt the app will be enhanced and the following research hypothesis is developed correspondingly:

**H3:** Social influence positively influence users' behavior intention towards mHealth app in China.

### 2.7.4. Facilitating Conditions

Facilitating conditions refer to the conditions which are perceived by users as the facilitators or constraints of performing a certain action (Venkatesh et al., 2003). It is similar to the concept of TPB, which reflects individuals' perception of their internal ability and external resources that affect their performance of a certain behavior (Ajzen,

1991; Yang & Farn, 2009). Gelders et al. (2009) pointed out that facilitating conditions in ICT are critical to mitigate users' concerns for privacy, reliability, and security, which persuade them to accept new technology. The positive facilitating conditions also includes training or the knowledge of individuals obtained. The empirical study of Dwivedi et al. (2016) also demonstrated the positive influence of facilitating conditions on users' adoption of mobile health services. In view of this, the following research hypothesis in this research is formulated:

**H4:** Facilitating conditions positively influence users' behavior intention towards mHealth app in China.

### 2.7.5. Hedonic Motivation

Hedonic motivation refers to the enjoyment or pleasure derived from using a new technology (Venkatesh et al., 2012). Brown & Venkatesh (2005) indicated that users inherently hold hedonic motivation and hence they expect that a new technology will bring more enjoyment than existing technologies. Meanwhile, individuals' decision-making is not only driven by their cognition but also their emotions and hence the positive emotions elicited by the enjoyment of a new technology positively influence their decision-making towards a new technology (Ha & Stoel, 2009). In the healthcare market, there are various alternative services for consumers and entertainment helps a healthcare service for differentiation (Dwivedi et al., 2016). This is also true in China's e-health app market where users have a lot of choices. However, empirical studies produced mixed results. Dwivedi et al. (2016) reported that hedonic motivation positively influences Bangladeshi citizens' intention to adopt mobile health services but insignificantly influences Canadian and U.S.'s citizens' intention. Gao et al. (2015) found that hedonic motivation is a strong and positive predictor of Chinese users' intention to adopt healthcare wearable devices. Hence, the role of hedonic motivation needs more investigation and the following research hypothesis is presented:

**H5:** hedonic motivation positively influences users' behavior intention towards mHealth app in China.

### 2.7.6. Privacy and Security

All the above-hypothesized factors are positive drivers of mHealth app and it is necessary

to consider some negative factors because the adoption of new technologies may bring risks and/or damages to users (Turner et al., 2010). This study considers the role of privacy and security. Indeed, the use of network technologies may lead to the leakage of individuals' privacy and security concerns (Yousafzai et al., 2010). However, existing studies of e-health services produced mixed findings. Chen & Lin (2018) and Choi et al. (2018) reported an insignificant influence of perceived security on users' technological acceptance. Ketelaar & Van Balen (2018) also indicated that that the negative influence of privacy concerns on intention to use is reduced by their PU, i.e., users who perceive that a technology is easy to use will tolerate the privacy problems. Gao et al. (2015) disagreed and indicated that healthcare issues are rather sensitive to users and hence they perceive a risk of leaking the information about these sensitive issues, they are unwilling to use. So that in this study, it assumed that if respondents perceive that potential breaches in mHealth app might be negatively loaded, they will reject to use it. To reconcile the inconsistencies in previous literature, the following research hypothesis is developed:

**H6:** Negative Privacy and security issues negatively influence users' behaviour intention towards mHealth app in China.

# 3. Research Methodology

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*This chapter constructs the methodological framework and the research method of the empirical study. The methodological framework is the instruction and guide for the choices of research methods and consists of philosophical assumptions, logical reasoning paths, and criteria of evaluating research results (Scotland, 2012). On the basis of positivism, deductive approach, and quantitative method, this chapter designs a questionnaire survey. The measurement scales are designed based on previous empirical studies; the procedures of data collection and analysis are discussed; the data quality is evaluated; ethical issues are fully addressed. This chapter closes with a reflection of methodological limitations.*

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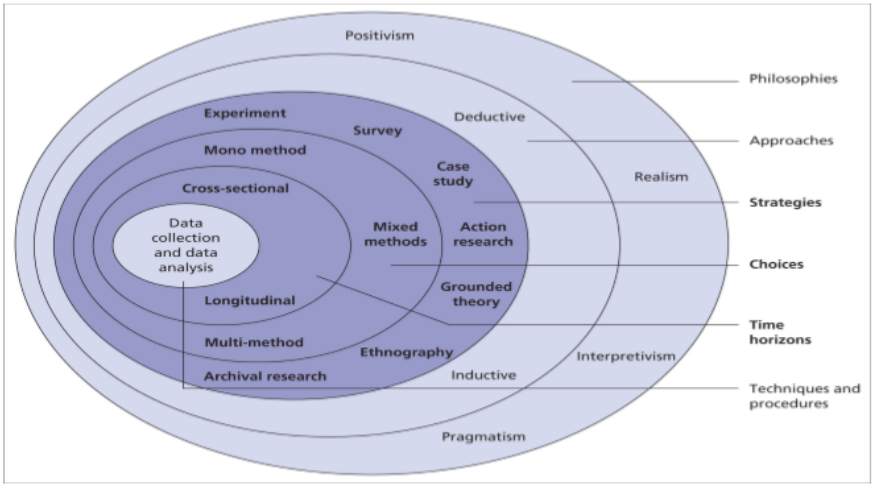
## 3.1 Research Philosophy

In social research, researchers' choices of research methods, criteria, and procedures are substantially affected by their basic assumptions, including epistemology, ontology, and axiology. The divergences in these assumptions lead to different research philosophies. In 2012, Saunders et al created the "Research Onion" which is one of the general guidelines for designing research processes and strategies (Figure 6). Follow the 'Research Onion', the first step of constructing a methodological framework is to choose the research philosophy according to the nature of research questions (Saunders et al, 2012).

**Figure 6 Research Onion**



**Source: adapted from Saunders et al, (2012)**

In consumer behavior research, two research philosophies occupy the dominant roles, i.e., positivism and interpretivism. The two philosophies vary greatly in terms of their epistemological, ontological, and axiological assumptions (Hunt, 1991). Positivism holds a "positive" assumption of the existence of the external world, i.e., the world exists independently and objectively from people's thoughts (epistemology). Therefore, the positivism advocates an objective perspective to probe into the external features of social phenomena. Meanwhile, the positivism believes that only observable facts can be used to construct accredited knowledge (ontology). Moreover, because of the objectivity, positivism adopts the principle of value-free, i.e., the researcher is separated from its research and serve as a complete outsider (Saunders, 2011). As a result, positivism is applicable if the researcher views its research objects as objective existences and seeks to identify the objective laws in social phenomena (Collis & Hussey, 2013).

By contrast, interpretivism suggests that the existence of the world is interpreted by people's thoughts and is hence characterized by both subjectivity and objectivity (epistemology). Meanwhile, knowledge can be constructed by subjective meanings because the nature of social phenomena is subjective, multiple, and changeable (ontology). In view of this, it is important for researchers to be involved in their studies in order to interpret social phenomena and construct knowledge. In this way, researchers are parts of their studies (Saunders, 2011). Therefore, interpretivism is applicable if the researcher views its research objects as subjective existences and intend to understand the rich and in-depth connotations of social phenomena (Collis & Hussey, 2013).

In this study, the positivism philosophy was applied. The reason is that the positivism philosophy refers to applying existing theories and depends on quantifiable observations which lead to statistical analysis (Saunders, 2011). The UTAUT2 model was applied to develop hypothesis in this research, which limited researcher to do interpretation in an objective way. In view of this, positivism is adopted by this study.

## 3.2. Research approach

At the first stage of research design, the research method choice is the primary task. This part will conclude three classification ways, exploratory, descriptive or causal research, quantitative or qualitative research, deductive or inductive research (Table 4). The detailed selection process will be presented as below.

**Table 4 Research typologies**

| Type of research | Basis of classification |
|---|---|
| Exploratory, descriptive or causal research | Purpose of the research |
| Quantitative or qualitative research | Process of the research |
| Deductive or inductive research | Logic of the research |

### 3.2.1 Exploratory, Descriptive or Causal Research

According to Babin & Zikmund (2016), the research method includes exploratory, descriptive or causal research. The exploratory research always be used to define problem and clarify research in initial stage without conclusive evidence which needs additional research (Babin & Zikmund, 2016). The descriptive study is to provide an accurate and valid presentation of the variables pertaining to the research question (Jackson, 2011). It describes characteristics of people, objects, groups or environments and is more structured than the exploratory research. Accuracy is critically important in descriptive research. However, such research does not provide causality and direct evidence which need further research. The causal study is employed when causal inferences are needed to be made (Babin & Zikmund, 2016). It could be a continuation of exploratory or descriptive research (Williams, 2007). In this research, since this research intended to identify the causal relations between the choosing factors from UTAUT2 model and user acceptance, causal research was used.

### 3.2.2 Qualitative & quantitative research

Research methods in social research can be generally classified into three types, i.e., the quantitative method, the qualitative method, and the mixed method. The distinctions in these methods are not simply the expression of research data, i.e., numbers or texts, but the different philosophical assumptions (Östlund et al., 2011). Positivism advocates the

use of the quantitative method because numbers have single, concrete, objective, and accurate meanings, which is consistent with the epistemology and ontology of positivism. Meanwhile, the meanings of numbers cannot be discretionarily interpreted by researchers and hence using numbers ensures the value-free principle insisted by positivism (Saunders, 2011). The use of numbers can accurately describe the external characteristics of social phenomena, such as extent, level, size, and strength. As a result, the quantitative method is conducive for the identification of the relationship between different things because the relationship is an external characteristic (McCusker & Gunaydin, 2015). Evidently, the seven research hypotheses describe the relationship between users' technological acceptance and seven factors. Hence, the quantitative method is applicable to test these hypotheses.

By contrast, the qualitative method is underpinned by interpretivism which emphasizes the multiplicity, subjectivity, complexity, and dynamics of social phenomena. Texts have multiple, subjective, complex, and flexible meanings and are hence applicable to describe social phenomena from an interpretivist perspective (McCusker & Gunaydin, 2015). This study does not adopt the qualitative method because it does not allow the researcher to test its research hypotheses in an objective, accurate, and rigorous manner.

### 3.2.3 Deductive or inductive research

There are two opposite logical thinking approaches, by which researchers connect theories with observations, including deduction and induction. As a result, empirical research can be generally divided into deductive research and inductive research (Heit & Rotello, 2010). Deductive research is applicable to test the previously established theories in a specific context. Commonly, research hypotheses are developed based on theories and subsequently, the researcher collects empirical evidence to verify whether these hypotheses are true in a specific context. In this way, the generally applicable laws (i.e., theories) are reduced to specific laws (disconfirmation or confirmation of hypotheses) (Yvonne Feilzer, 2010). By contrast, an inductive approach is applicable to explore new phenomena or construct new theories. The empirical observation is commonly not constrained by research hypotheses. Instead, it is guided by specific research questions. In this way, the researcher extracts the commonalities from a set of observations and

develops new hypotheses or theories (Yvonne Feilzer, 2010).

In the present study, it uses the UTAUT2 theory to explain Chinese users' technology acceptance of mHealth Apps and hence develops 7 research hypotheses, moves from the general to specific. Testing these research hypotheses will fully address the research questions raised in introduction chapter. In view of this, a deductive approach is workable to this study. This study does not adopt an inductive approach because of two reasons. First, developing new theories or hypotheses falls outside the scope of this study. Second, the conclusions drawn from an inductive research lack of logical rigor and objectivity (Heit & Rotello, 2010).

## 3.1 Research strategy

### 3.3.1. Questionnaire Survey

As shown in Table 3, all the 8 empirical studies pertaining to users' technological acceptance of mHealth used a questionnaire survey to collect their primary data. The questionnaire survey refers to a structured and standardized method of interviewing a large group of individuals in order to understand their thoughts, beliefs, attitudes, experiences, backgrounds (Collis & Hussey, 2013). Hence, it is an appropriate strategy to measure the variables involved in the seven research hypotheses on a large scale.

Using a questionnaire survey brings the following benefits to this study. First, it best maximizes the objectivity of the data. In the data collection process, researchers are separated from research subjects, which avoids the interferences from researchers. Besides, unlike an in-depth interview, the data collection process was less likely to be influenced by researchers because the survey questions are highly structured and standardized (Fricker & Schonlau, 2002). Second, because the survey data are in a standardized and structured form, data analysis is convenient and the application of statistical tools further mitigates the interference from researchers (Melkert & Vos, 2010). Third, the questionnaire survey allows researchers to interview a large number of research subjects simultaneously and collect a large sample with relatively cheap costs (Collis & Hussey, 2013).

It should be noted that a questionnaire survey also has the following disadvantages. First, the standardized data collection process provides very limited flexibility and it is hence difficult for researchers to collect in-depth information. Research subjects only passively answer a set of fixed questions and hence they are not free to express their true thoughts (Couper, 2008). Second, the response rate, validity, and reliability of the survey data are difficult to ensure. It is difficult to use a set of structured questions to reflect the essence of social phenomena. Moreover, respondents may not take the questionnaire seriously or inaccurately understand the meanings of questions (Hoonakker & Carayon, 2009). In view of this, it is important to carefully and prudently design the measurement scales in order to enhance the data quality.

### 3.3.2. Measurement Scale

According to the overview of previous empirical studies presented in Table 3, all the variables included in the theoretical model of this study have been covered by previous studies. Hence, the measurements used in these studies can be borrowed by this thesis after slight modifications. The design of the draft questionnaire followed the following procedures. First, the author reviewed the questionnaire scales used in previous empirical studies. Second, the author extracted relevant questionnaire scales from these studies. Third, the author carefully compared the different measurements of the same variables and chose the most appropriate ones. Finally, the author made modifications to these measurements according to the research context of this study.

As shown in Table 5, the questionnaire involves 11 variables, including 1 dependent variable (i.e., user's acceptance towards mHealth App), 6 independent variables (i.e., factors that influence technological acceptance), and 4 control variables (gender, age, education, and experience). Each dependent and independent variable was measured by multiple Likert-7-Point items, i.e., respondents were asked to self-report their degrees of agreements from 1 (totally disagree) to 7 (totally agree) towards a set of statements, which describe their attitudes and experiences towards mHealth apps. In this way, these 7 variables were transferred into numbers ranging between 1 and 7. The 4 control variables were measured by single choice questions.

After the draft questionnaire was accomplished, the author translated it into standardized Chinese and asked two professional bilinguals to scrutinize and polish the Chinese translation.

**Table 5 Variables and measurements**

| Variables | | Items | Adapted from |
|---|---|---|---|
| **Dependent Variable** | Intention to use mHealth apps | I intend to use mobile health Apps in the next 3 months.<br>I predict I will use mobile health Apps in the next 3 months.<br>I plan to use mobile health Apps in the next 3 months. | Sun et al. (2013), Zhang et al. (2017) |
| **Independent Variables** | Performance Expectancy | Using mobile health Apps will improve the quality of my life.<br>Using mobile health Apps will mean more health-care conveniences.<br>Using mobile health Apps will make my life more effective.<br>Generally, I find mobile health Apps to be useful in my life. | Sun et al. (2013), Venkatesh et al. (2012), Zhang et al. (2017) |
| | Effort Expectancy | Learning to operate the mobile health Apps will be easy for me.<br>I can easily become skillful at using mobile health Apps.<br>I can get mobile health Apps to do what I want.<br>Generally, mobile health Apps are easy to use. | Sun et al. (2013), Venkatesh et al. (2012), Zhang et al. (2017) |
| | Social Influence | People who are important to me would think that I should use mobile health Apps.<br>People who influence me would think that I should use mobile health Apps.<br>People whose opinions are valued to me would prefer that I should use mobile health Apps. | Gao et al. (2015), Sun et al. (2013) |
| | Facilitating Conditions | I have the secured and trusted resources necessary to use mobile health Apps.<br>I gathered the knowledge necessary to use mobile health Apps.<br>I can get reliable help from medical professionals when I have difficulties using mobile health Apps. | Dwivedi et al. (2016), Gao et al. (2015) |
| | Hedonic Motivation | Using mobile health Apps is fun.<br>Using mobile health Apps is enjoyable. | Gao et al. (2015), |

| | | | |
|---|---|---|---|
| | | Using mobile health Apps is entertaining. | Venkatesh et al. (2012) |
| | Privacy and Security | It would be risky to disclose my personal health information to firms providing mobile health Apps.<br>There would be a high potential for loss associated with disclosing my personal health information to firms providing mobile health Apps.<br>There would be too much uncertainty associated with giving my personal health information to firms providing mobile health Apps.<br>Mobile health Apps sufficient security to transmit personal information. | Choi et al. (2018), Gao et al. (2015) |
| **Control Variables** | Gender | Gender (male and female) | Self-administrated |
| | Age | Age (from 18 ~ 30 years to above 51 years) | Self-administrated |
| | Education | Educational Level (from primary school to graduate school) | Self-administrated |
| | Experience | Mobile Device Usage Experience (from less than 2 years to more than 10 years) | Self-administrated |

3.3.3. Pilot Test

As suggested by Couper (2008), the pilot test is critical for the success of a questionnaire survey. A pilot test helps the researcher to correct the mistakes and improve the quality of the questionnaire design. The researcher cannot clarify the concerns of every respondent face-to-face in the formal survey and respondents' concerns may reduce data quality. Hence, the pilot survey can mitigate these concerns before the formal survey. Moreover, the questionnaire was designed based on English versions of scales and hence it is necessary to evaluate whether the Chinese version of the questionnaire would be workable in the formal survey with Chinese people. In view of this, the author recruited 14 initial respondents to take part in a pilot test.

During the pilot test, the following things have been done. First, the author preliminarily analyzed the data and found that the reliability was basically acceptable, and the results largely matched with expectations. Second, the author modified the expression and wording of the questionnaire content and confirmed that the content can be easily and accurately understood by respondents. Third, the author confirmed that respondents

generally felt comfortable towards the questionnaire content and there was no sensitive information. After the pilot test was accomplished, the author carried out the formal data collection.

### 3.4. Data collection

Primary data refers to the process of conducting researches by the researcher to meet specific and unique needs, while the secondary data is to use previously completed studies and apply the results to own situation. However, if the researcher wants to study a specific research question, the secondary data may not meet the needs of the researcher and cannot cover the precise and specific information that required to answer the research questions (Johnston, 2017). In this view, primary data will be applied in this study, so that the researcher has control over what their data set contains.

In this research, a primary data collection was conducted through a questionnaire. Suitable respondents were those individuals who needed healthcare services, i.e., the target users of mHealth apps. In order to identify and get in touch with these individuals, the author joined several social media health related communities, where members frequently discussed and interacted healthcare information. The questionnaire was uploaded on a Chinese survey website (www.wjx.cn) and the questionnaire URL and QR code were shared in these healthcare communities and other social media (QQ and Wechat) groups. Using smartphones or personal computers, members can either click the link or scan the QR code to get access to and answer the questionnaire.

Therefore, due to the budget and time limitation, this study used a convenience sampling technique, which is a non-random sampling method where research subjects are selected because of their convenient proximity and accessibility to the research (Fink, 2003). Although this technique cannot secure the equivalent probability by which each research subject is selected (Fink, 2003), it helped the author to accurately locate and get access to suitable respondents.

### 3.5. Data Analysis

After the data were returned, the author organized the data in Excel and input them into

SPSS software. First, in order to outline the characteristics and the distribution of the sample, frequency statistics were implemented on the four control variables (i.e., gender, age, education, and experience).Second, in order to evaluate and purify the quality of the Likert-7-Point scale data, a Reliability analysis (Cronbach's alpha test) was implemented on the measurement of each variable. Also, factor analysis was used to access the factorability of the data (Bartlett's) and make variables more suitable for managing number of factors. Items with insufficient reliability were dropped. Third, a descriptive analysis on the 7 variables was implemented in order to evaluate the levels of respondents' intention to adopt and evaluations of mHealth apps. Fourth, the Pearson Correlation Analysis was employed to identify and check the bivariate correlations of 7 variables. In this way, the relationships between different variables and the potential collinearity can be evaluated. Finally, the hypotheses tested in this study was based on multivariable regression analysis. In previous studies, scholars used two different statistical techniques to test their research hypotheses, including multivariable regression analysis (Cilliers et al., 2018; Guo et al., 2015) and structural equation model (Chen & Lin, 2018; Choi et al., 2018; Dou et al., 2017; Dwivedi et al., 2016; Gao et al., 2015; Zhang et al., 2017). Although structural equation model is superior to multivariable regression analysis because it allows the use of multiple dependent variables, this study has only one dependent variable and hence multivariable regression analysis is sufficient to examine the research hypotheses.

### 3.6. Data Quality

This study employed the following methods to guarantee data quality. First, all the measurement scales were designed on the basis of previous scales, which had been verified by previous studies as reliable and valid. Second, this study carried out a pilot survey to refine the quality of the questionnaire design and ensure the questionnaire would work well in the formal survey. Third, this study used Cronbach's alpha test to evaluate the reliability of the survey data and purify survey items. In this way, data reliability was guaranteed.

In the survey process, the author set a threshold question to ensure all the respondents had the experiences of using mobile health Apps. Meanwhile, the author sampled from social

media health related communities and hence the majority of respondents were target customers of healthcare services.

### 3.7. Ethical Issues

Since this study sampled human participants, it is critical to address ethical issues in order to prevent the potential ethical violation, damages on participants and researchers, and correct the ethical operation of researchers (Collis & Hussey, 2013). The following measures were used by this study to address ethical issues. First, in the web version of the questionnaire, there was no space for respondents to fill their names or other identifying information. In this way, the author was entirely unknown about who accompanied the questionnaire and hence the anonymity of the respondents was fully protected. Second, in the recruitment advertisements posted on social media healthcare communities, the author introduced the purposes, procedures, and matters needing attention to respondents. Therefore, they were entirely informed. Meanwhile, because the survey was implemented online, the author cannot inflict any pressures on respondents. Thus, participation was fully voluntary. Third, the primary information collected by this study were strictly and carefully handled to avoid information leakage. The author removed the online data on the survey website immediately after the survey data returned. Moreover, the author stored the digital data in a secret and safe place and protected them by passwords. Finally, this study involved no commercial interests and was fully self-funded by the author.

### 3.8. Limitations

There are the following methodological limitations in the present study. First, adopting positivism brings several problems. Positivism views' individuals' behavioral patterns as fully rational, ignoring the subjective and unobservable factors that affect their behaviors. Moreover, positivism focuses on group characteristics, ignoring individual differences (Collis & Hussey, 2013). Second, adopting the deductive approach leads to the fact that it is difficult for this study to contribute new knowledge because the research hypotheses are fully covered by existing knowledge and theories (Yvonne Feilzer, 2010). Third, the quantitative method provides less in-depth understandings towards social phenomena than the qualitative method because numbers are unavailable to describe the complicated and rich connotations of social phenomena (McCusker & Gunaydin, 2015). Fourth, the

questionnaire survey employed a convenience sampling technique, which may lead to sampling biases and insufficient representativeness (Fink, 2003). Finally, this study did not use statistical tools to assess the validity of the data.

# 4. Findings

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*This chapter reports the empirical findings generated by the questionnaire survey. It starts with an introduction of the demographic profile of the survey respondents. Following this, it used the Exploratory Factor Analysis (EFA) on the 29 survey items in order to evaluate and improve the data validity. Meanwhile, the data reliability was tested by a Cronbach's α test. After the survey data is verified to be valid and reliable, this study used descriptive analysis to outline and evaluate the 7 variables and employed Pearson Correlation analysis to check the bivariate correlations between these 7 variables. Finally, regression analysis was implemented in order to test the 6 research hypotheses.*

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## 4.1. Profile of Respondents

Table 6 presents the demographic profile of the 121 respondents. The percent of female (53.7%) slightly exceeded male (46.3%) and the sample was basically gender balanced. Young respondents accounted for a small proportion of the sample and the majority of respondents were middle-aged. Only a small proportion of respondents had received higher education and the majority of respondents received the education from junior high schools and senior/vocational high schools. In terms of the mobile device usage experience, the majority of respondents had more than 6 years of experience.

**Table 6 Demographical profile of respondents**

| **Demographics** | | **Frequency** | **Percent** |
|---|---|---|---|
| **Gender** | Male | 56 | 46.3 |
| | Female | 65 | 53.7 |
| **Age** | 18 ~ 30 years | 5 | 4.1 |
| | 31 ~ 40 years | 40 | 33.1 |
| | 41 ~ 50 years | 43 | 35.5 |
| | Above 51 years | 33 | 27.3 |
| **Educational Level** | Primary school | 0 | 0 |
| | Junior high school | 27 | 22.3 |

| | | | |
|---|---|---|---|
| | Senior /vocational high school | 51 | 42.1 |
| | University/college | 41 | 33.9 |
| | Graduate school | 2 | 1.7 |
| **Mobile Device Usage Experience** | Less than 2 years | 0 | 0 |
| | 2 ~ 4 years | 3 | 2.5 |
| | 4 ~ 6 years | 12 | 9.9 |
| | 6 ~ 8 years | 49 | 40.5 |
| | 8 ~ 10 years | 40 | 33.1 |
| | More than 10 years | 17 | 14.0 |

### 4.2. Factor Analysis

The questionnaire contained 29 Likert-7-point items and it is questionable about whether these items validly measured the variables they intended to measure. Hence, this study employed an Exploratory Factor Analysis (EFA) on these 29 items. EFA is a commonly adopted technique of evaluating the validity of survey data. It examines the extent to which the variance in a variable is explained by its measurement items, thus reflecting the validity of each item. Moreover, it compresses multivariable data into the simplest components according to the internal structure of data (Osborne et al., 2008). Therefore, using EFA not only helped this study to verify the data validity but also compressed the data of 29 items into several variables, which facilitated the data analysis process.

First, this study carried out the Kaiser-Meyer-Olkin (KMO) and Bartlett's test to evaluate the adequacy of using EFA. According to Hayton et al. (2004), there are preconditions of using EFA and not all data are applicable to an EFA. The KMO value should be higher than 0.6 while Bartlett's Test of Sphericity is significant at the 0.05 level (Pallant, 2005). Otherwise, the internal correlations of data are not strong enough, resulting in the failure of extracting common components. The results of such test are presented in Table 7. The KMO value is 0.784, while the significant is at the 0.00 level. Hence, EFA can be carried out.

**Table 7 KMO and Bartlett's Test**

| | |
|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | .784 |

| | | |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1518.253 |
| | Df | 406 |
| | Sig. | .000 |

After the evaluation of the factorability of the data and the adequacy of the sampling, next step is to measure whether need to reduce a big number of items to smaller and more suitable for managing number of factors in this study. There are mainly four methods can help to measure the usefulness of factors, eigenvalues number, cumulative percentage, scree plot and the loading values.

First this study employed the Principal Component Analysis on the data of 29 items and the results are presented in Table 8. This table shows the eigenvalues number and cumulative percentage. If one of the components with eigenvalues less than 1.000, it means this component is less explained to the data than a single item which should be eliminated. The cumulative percentage represents the amount of the total variance explained by these components. In Table 8, 8 components with eigenvalues higher than 1.000 were extracted. Meanwhile, the 8 components cumulatively explain 66.799% of the variance in the 29 items, suggesting good explanatory power. So that during this step, the first 8 components should be kept. However, it was expected that 7 components should be extracted from the 29 items because these 29 items measured 7 variables (see Table 5 for details). Eight components with eigenvalues higher than 1.000 were extracted, which was inconsistent with expectancy. In order to find out the problems of the insufficient construct validity, the study further carried out other analysis.

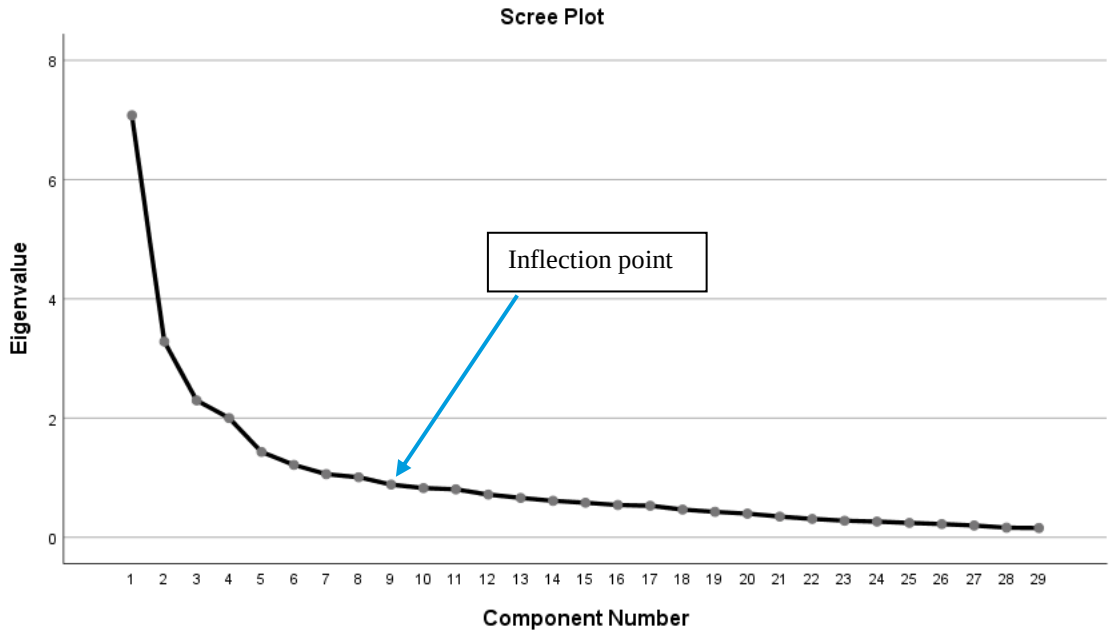
**Table 8 Total Variance Explained**

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 7.078 | 24.406 | 24.406 | 6.616 | 22.814 | 22.814 |
| 2 | 3.283 | 11.319 | 35.726 | 2.881 | 9.933 | 32.747 |
| 3 | 2.296 | 7.917 | 43.643 | 1.801 | 6.212 | 38.959 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 2.001 | 6.900 | 50.542 | 1.515 | 5.223 | 44.182 |
| 5 | 1.432 | 4.940 | 55.482 | 1.021 | 3.521 | 47.703 |
| 6 | 1.215 | 4.189 | 59.671 | .754 | 2.599 | 50.302 |
| 7 | 1.059 | 3.653 | 63.324 | .624 | 2.150 | 52.453 |
| 8 | 1.008 | 3.476 | 66.799 | .605 | 2.087 | 54.540 |
| 9 | .885 | 3.052 | 69.851 | | | |
| 10 | .827 | 2.850 | 72.701 | | | |
| 11 | .805 | 2.775 | 75.476 | | | |
| 12 | .717 | 2.473 | 77.950 | | | |
| 13 | .661 | 2.279 | 80.229 | | | |
| 14 | .612 | 2.109 | 82.338 | | | |
| 15 | .580 | 1.999 | 84.337 | | | |
| 16 | .542 | 1.869 | 86.206 | | | |
| 17 | .530 | 1.828 | 88.033 | | | |
| 18 | .465 | 1.604 | 89.638 | | | |
| 19 | .428 | 1.474 | 91.112 | | | |
| 20 | .397 | 1.369 | 92.481 | | | |
| 21 | .348 | 1.201 | 93.682 | | | |
| 22 | .308 | 1.063 | 94.745 | | | |
| 23 | .279 | .962 | 95.707 | | | |
| 24 | .264 | .910 | 96.617 | | | |
| 25 | .241 | .832 | 97.450 | | | |
| 26 | .223 | .768 | 98.218 | | | |
| 27 | .199 | .685 | 98.902 | | | |
| 28 | .162 | .558 | 99.461 | | | |
| 29 | .156 | .539 | 100.000 | | | |
| Extraction Method: Alpha Factoring. | | | | | | |

Next is the scree plot. This figure (Figure 7) indicates that after 8 components are extracted, the curve of eigenvalues becomes flat. It suggested that the first 7 components should be kept.

**Figure 7 Scree plot**




Third, this study further carried out the rotation of Varimax with Kaiser Normalization to explore the extent to which each item explains the variable it intended to measure. According to Hayton et al. (2004), the rotated factor loading value is an indicator of the explanatory power of each measurement item. If the loading value is less than 0.5, the item explains less than 25% of the variance in the variable it explains and should be hence dropped from the data. And additionally, according to Hair et al. (2014), the recommended factor loading for a quantitative research consisting of 120 samples is 0.5.

The loading values of the 29 items are presented in Table 9 and there are the following values. **First**, SI1 ~ SI5 were loaded on component 1 with loading values ranging between 0.565 and 0.871, suggesting that they validly measured social influence. Meanwhile, the loading value of SI6 on component 1 was only 0.306, suggesting that SI6 was insufficient to explain the variance in social influence. Therefore, this study dropped SI6 from the 29 items. **Second**, PS1 ~ PS4 were loaded on component 2 which loading values ranging between 0.671 and 0.827, suggesting that they validly measured privacy and security. **Third**, PE1 ~ PE4 were loaded on component 3 which loading values ranging between 0.690 and 0.774, suggesting that they validly measured performance expectancy (PE). **Fourth**, HM1, HM2, HM3, and HM5 were loaded on component 4 with loading values ranging between 0.634 and 0.831, suggesting that they validly measured hedonic motivation. Meanwhile, HM4 were loaded on component 8 was 0.602. **Fifth**, EE1 ~ EE4

were loaded on component 5 which loading values ranging between 0.646 and 0.798, suggesting that they validly measured effort expectancy (EE). **Sixth,** BI1 ~ BI3 were loaded on component 6 which loading values ranging between 0.525 and 0.754, suggesting that they validly measured user acceptance (UA) mHealth apps. **Eighth,** FC1 ~ FC3 were loaded on component 7 which loading values ranging between 0.619 and 0.732, suggesting that they validly measured facilitating conditions (FC).

As we can see from Table 9, when we extract the first 8 principal components, the data structure is still complicated. There are cases where two principal components simultaneously explain one item. For example, the first component and the eighth component simultaneously interpret the S13 item. In this case, it's better to extract the principal component that does not repeat the interpretation of any items, that is, extract the first 7 components in this study. Meantime, in this case, HM4 were dropped from the 29 items. The extraction is also followed the suggestion from scree plot (Figure 7). Finally, this study dropped component 8, meanwhile the items of SI6, HM4 were dropped from the data.

**Table 9 Rotated Component Matrixa.**

| | Component | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| SI1 | .871 | | | | | | | |
| SI4 | .831 | | | | | | | |
| SI2 | .793 | | | | | | | |
| SI3 | .589 | | | | | | | .478 |
| SI5 | .565 | | | | | .320 | | |
| PS1 | | .827 | | | | | | |
| PS2 | | .802 | | | | | | |
| PS3 | | .720 | | | | | | |
| PS4 | | .671 | | | | | | |
| PE2 | | | .774 | | | | | |
| PE4 | | | .759 | | | | | |
| PE1 | | | .730 | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| PE3 | | | .690 | | | | | |
| HM5 | | | | .831 | | | | |
| HM3 | | | | .711 | | | | |
| HM1 | .304 | | | .708 | | | | .374 |
| HM2 | | | | .634 | | | | .316 |
| EE2 | | | | | .798 | | | |
| EE3 | | | | | .784 | | | |
| EE4 | | | | | .689 | | | |
| EE1 | | | | | .646 | | | |
| BI3 | .305 | | | | | .754 | | |
| BI2 | | | | | | .633 | | |
| BI1 | | -.369 | | | | .525 | | |
| FC2 | | | | | | | .732 | |
| FC1 | | | | | | | .707 | |
| FC3 | | | | | | .415 | .619 | |
| ~~HM4~~ | | | | | | | | ~~.602~~ |
| ~~SI6~~ | ~~.306~~ | | ~~.308~~ | | | ~~.360~~ | | ~~.558~~ |
| Extraction Method: Principal Component Analysis.<br>Rotation Method: Varimax with Kaiser Normalization. | | | | | | | | |
| a. Rotation converged in 7 iterations. | | | | | | | | |

After the 2 items were dropped, this study carried out the EFA again. It was found that 7 components with eigenvalues higher than 1 were extracted from the 27 items and these 7 components cumulatively explained 65.513% of the variance in the 27 items. Meanwhile, the loading values of all 27 items exceeded 0.5 on the components they were assigned to, while predefined model was strictly followed. Therefore, the validity of the Likert-7-point item data was qualified after SI6 and HM4 were dropped.

### 4.3 Reliability analysis

After the validity of data was examined and improved, this study moved forward to examine the reliability of the data which aims to ensure the consistency of the research's findings. The reliability statistics and Item-Total statistics are two important measurement

of reliability.

First, the reliability statistics which include Cronbach's Alpha. The Cronbach's α is an indicator of the international consistency reliability of data and it reflects the extent to which the multiple measurements of the same variable generate consistent results. Normally, a Cronbach's α higher than 0.7 suggests an acceptable level of reliability (Petrick & Backman, 2002). Illustratively speaking, this study used 3 ~ 5 items to measure each variable. These items have similar meanings and hence their results should be highly consistent. Otherwise, the data is not reliable. Table 10 showed the Cronbach's Alpha in this study is 0.817 which exceeded 0.7, which means no need to remove any items during this step.

**Table 10 Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .817 | 27 |

Next is the Item-Total statistics. Kerlinger (1979) indicated that Cronbach's α if item deleted is important indicator of the reliability of items. If the Cronbach's α is improved significantly after an item is deleted, the item should be dropped to improve the reliability of data (Kerlinger, 1979).

The results of Item-Total statistics are presented in Table 11. The results of Cronbach's α if item deleted indicate that all the 27 items should be retained. By and large, the reliability of the data is basically acceptable and therefore further analysis was carried out.

**Table 11 Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| PE1 | 126.273 | 242.417 | .422 | .807 |
| PE2 | 126.058 | 241.538 | .439 | .806 |
| PE3 | 126.083 | 248.526 | .334 | .811 |
| PE4 | 126.298 | 244.761 | .397 | .809 |
| EE1 | 125.719 | 253.470 | .232 | .815 |
| EE2 | 125.421 | 252.496 | .298 | .813 |

| | | | | |
|---|---|---|---|---|
| EE3 | 125.471 | 253.035 | .271 | .814 |
| EE4 | 125.645 | 254.764 | .230 | .815 |
| SI1 | 126.124 | 237.610 | .532 | .802 |
| SI2 | 126.099 | 238.473 | .593 | .801 |
| SI3 | 126.264 | 238.696 | .575 | .801 |
| SI4 | 125.909 | 241.017 | .551 | .803 |
| SI5 | 125.901 | 238.440 | .595 | .801 |
| FC1 | 125.240 | 259.434 | .185 | .816 |
| FC2 | 125.099 | 259.190 | .191 | .816 |
| FC3 | 125.182 | 252.767 | .357 | .811 |
| HM1 | 126.851 | 238.794 | .537 | .802 |
| HM2 | 126.777 | 237.075 | .516 | .803 |
| HM3 | 126.967 | 239.182 | .517 | .803 |
| HM5 | 126.868 | 240.916 | .461 | .806 |
| PS1 | 126.612 | 261.006 | .058 | .824 |
| PS2 | 126.702 | 264.094 | -.017 | .830 |
| PS3 | 126.686 | 266.651 | -.053 | .830 |
| PS4 | 126.744 | 268.759 | -.089 | .829 |
| BI1 | 125.190 | 248.189 | .483 | .807 |
| BI2 | 125.083 | 250.893 | .431 | .809 |
| BI3 | 125.083 | 250.276 | .466 | .808 |

### 4.4. Descriptive Analysis

In this study, a descriptive analysis on the 7 variables was implemented in order to evaluate the levels of respondents' intention to adopt and evaluations of mHealth apps. The basic characteristics of the 7 variables are presented in Table 12.

**First**, the value of performance expectancy ranges between 1.75 and 7.00 with a mean of 4.618, suggesting that respondents were generally neutral about the performance of mHealth apps in terms of improving quality of life and facilitating healthcare services. **Second**, the value of effort expectancy ranges between 2.25 and 7.00 with a mean of 5.2955, suggesting that respondents generally believed that mHealth apps were easy to be used. **Third**, the value of social influence ranges between 2.00 and 7.00 with a mean of 4.8000, suggesting that respondents generally perceived a medium level of social pressure that influenced their uses of mHealth apps. **Fourth**, the value of facilitating condition ranges between 3.67 and 7.00 with a mean of 5.6860, suggesting that

respondents generally perceived abundant resources (such as knowledge and mobile Internet) that facilitated their uses of mHealth apps. **Fifth**, the value of hedonic motivation ranges between 1.25 and 6.50 with a mean of 3.9938, suggesting that respondents held a neutral evaluation of the enjoyment or pleasure derived from using mHealth apps. **Sixth**, the value of privacy and security ranges between 3.00 and 7.00 with a mean of 4.1729, suggesting that respondents held a neutral attitude towards the privacy and security of using mHealth apps. **Finally**, the value of behavior intention of mHealth apps ranges between 3.00 and 7.00 with a mean of 5.7410, suggesting that respondents were generally willing to use mHealth apps.

**Table 12 Descriptive statistics.**

| | Min | Max | Mean | Std. |
|---|---|---|---|---|
| Performance Expectancy | 1.75 | 7.00 | 4.6818 | 1.24038 |
| Effort Expectancy | 2.25 | 7.00 | 5.2955 | 1.03128 |
| Social Influence | 2.00 | 7.00 | 4.8000 | 1.17842 |
| Facilitating Condition | 3.67 | 7.00 | 5.6860 | .80657 |
| Hedonic Motivation | 1.25 | 6.50 | 3.9938 | 1.28228 |
| Privacy and Security | 1.00 | 7.00 | 4.1729 | 1.33460 |
| Behaviour intention of mHealth apps | 3.00 | 7.00 | 5.7410 | .90624 |

### 4.5. Correlation Analysis

Further, this study identified the bivariate correlations between the 7 variables through a Pearson Correlation analysis. The Pearson Correlation coefficient is a useful indicator reflecting the extent to which the numerical values of two variables are associated. The value of the coefficient ranges from -1 to +1. A negative (or positive) value suggests a negative (or positive) association. The absolute size of the coefficient reflects the strength of the association (Bartholomew et al., 2008).

The results of the correlation analysis are shown in Table 13. Users' acceptance positively correlates performance expectancy (r = 0.426; Sig. = 0.000), effort expectancy (r = 0.179; Sig. = 0.049), social influence (r = 0.505; Sig. = 0.000), facilitating condition (r = 0.427; Sig. = 0.000) and hedonic motivation (r = 0.444; Sig. = 0.000). Except effort expectancy at a 0.05 level (2-tailed)., others were all at a 0.01 level (2-tailed). Hence, an individual

who is willing to use mHealth apps is very likely to have high levels of performance, ease of use, facilitating condition, social influence, enjoyment, and habit of using mHealth apps. User acceptance negatively correlates privacy and security (r = -0.362; Sig. = 0.000) at the 0.01 level, suggesting that if an individual concerns about the privacy and security of mHealth apps, the individuals may be unwilling to use mHealth apps.

In conclusion, the correlation coefficients between the 7 variables range from -0.363 (Sig = 0.000) to 0.505 (Sig = 0.000). The results suggest that the seven independent variables are significantly correlated and these features of mHealth apps are associated, rather than separated. Hence, the bivariate correlations between these variables were less likely to lead to multicollinearity because they did not reach the threshold of 0.75 suggested by Bartholomew et al. (2008).

**Table 13 Correlation matrix.**

**Correlations**

| | | Performance Expectancy | Effort Expectancy | Social Influence | Facilitation Condition | Hedonic Motivation | Privacy and Security | Intention to use m-health Apps |
|---|---|---|---|---|---|---|---|---|
| Performance Expectancy | Pearson Correlation | 1 | .292** | .326** | .147 | .319** | -.229* | .426** |
| | Sig. (2-tailed) | | .001 | .000 | .107 | .000 | .011 | .000 |
| | N | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| Effort Expectancy | Pearson Correlation | .292** | 1 | .078 | .143 | .214* | -.123 | .179* |
| | Sig. (2-tailed) | .001 | | .396 | .119 | .019 | .180 | .049 |
| | N | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| Social Influence | Pearson Correlation | .326** | .078 | 1 | .238** | .494** | .070 | .505** |
| | Sig. (2-tailed) | .000 | .396 | | .008 | .000 | .448 | .000 |
| | N | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| Facilitation Condition | Pearson Correlation | .147 | .143 | .238** | 1 | .365** | -.300** | .427** |
| | Sig. (2-tailed) | .107 | .119 | .008 | | .000 | .001 | .000 |
| | N | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| Hedonic Motivation | Pearson Correlation | .319** | .214* | .494** | .365** | 1 | -.156 | .444** |
| | Sig. (2-tailed) | .000 | .019 | .000 | .000 | | .088 | .000 |
| | N | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| Privacy and Security | Pearson Correlation | -.229* | -.123 | .070 | -.300** | -.156 | 1 | -.362** |
| | Sig. (2-tailed) | .011 | .180 | .448 | .001 | .088 | | .000 |
| | N | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| Intention to use m-health Apps | Pearson Correlation | .426** | .179* | .505** | .427** | .444** | -.362** | 1 |
| | Sig. (2-tailed) | .000 | .049 | .000 | .000 | .000 | .000 | |
| | N | 121 | 121 | 121 | 121 | 121 | 121 | 121 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

## 4.6. Regression Analysis

Based on the above analysis, this study conducted regression analysis to examine the 6

research hypotheses developed in Chapter 2, thus identifying the factors that influence user acceptance of mHealth apps. The methods be used in this analysis include Model Summary, ANOVA and Coefficients.

First step is Model Summary (Table 14). The Adjusted $R^2$ reached 46.2%, implying that nearly half of the variance in user acceptance is explained by the 7 independent variables.

**Table 14 Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .699[a] | .489 | .462 | .66456 | 1.954 |
| a. Predictors: (Constant), Privacy and Security, Social Influence, Effort Expectancy, Facilitation Condition, Performance Expectancy, Hedonic Motivation | | | | | |
| b. Dependent Variable: Intention to use mHealth apps | | | | | |

Second is ANOVA test which is an overall test of multiple independent variables. The F value reached 18.192 and was significant at the 0.000 level (＜0.05), implying that this model (model 1)was highly linear. Overall, model 1 (Table 15) has excellent explanatory power and it showed that at least one independent variable can explain the dependent variable in this model.

**Table 15 ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 48.205 | 6 | 8.034 | 18.192 | .000[b] |
| | Residual | 50.347 | 114 | .442 | | |
| | Total | 98.553 | 120 | | | |
| a. Dependent Variable: Intention to use mHealth apps | | | | | | |
| b. Predictors: (Constant), Privacy and Security, Social Influence, Effort Expectancy, Facilitation Condition, Performance Expectancy, Hedonic Motivation | | | | | | |

Then is Regression coefficients (Table 16). It showed which of the variables included in the model contributed to the prediction of the dependent variable. Firstly, for each of these variables, it was necessary to look at the statistical significance. This tells researcher whether this variable is making a statistically significant unique contribution to the

equation. This is very dependent on which variables are included in the equation, and how much overlap there is among the independent variables. If the **Sig**. value is less than 0.05, then the variable is making a significant unique contribution to the prediction of the dependent variable. If greater than 0.05, then you can conclude that that variable is not making a significant unique contribution to the prediction of dependent variable (Pallant, 2005). This may be due to overlap with other independent variables in the model. The findings in this case are as following.

**Table 16 Coefficients**

| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constant) | 2.936 | .640 | | 4.587 | .000 |
| Performance Expectancy | .132 | .056 | .180 | 2.351 | .020 |
| Effort Expectancy | .016 | .062 | .018 | .253 | .801 |
| Social Influence | .289 | .063 | .375 | 4.600 | .000 |
| Facilitation Condition | .221 | .085 | .197 | 2.609 | .010 |
| Hedonic Motivation | .059 | .059 | .083 | 1.004 | .317 |
| Privacy and Security | -.185 | .050 | -.273 | -3.693 | .000 |

a. Dependent Variable: Intention to use mHealth Apps

***H1:*** *Positive performance expectancies positively influence users' behavior intention towards mHealth app in China*

Positive performance expectancy is positively associated with the user acceptance of mHealth apps (Sig. = 0.020＜0.05), suggesting that an individual who holds a high level of performance expectancy is very likely to adopt mHealth apps, which supports H1.

***H2:*** *Effort expectancies (free of efforts) positively influence users' behaviour intention towards mHealth app in China.*

Effort expectancy is insignificantly associated with the user acceptance of mHealth apps (Sig. = 0.801＞0.05), suggesting that an individual who holds a high level of effort expectancy is not necessarily willing to adopt mHealth apps, which rejects H2.

***H3:*** *Social influence positively influences users' behaviour intention towards mHealth*

*app in China.*

Social influence is positively associated with the user acceptance of mHealth apps (Sig. = 0.000＜0.05, suggesting that an individual who perceives a high level of social pressure is very likely to adopt mHealth apps, which supports H3.

***H4:*** *Facilitating conditions positively influence users' behaviour intention towards mHealth app*

Facilitating condition is positively associated with the user acceptance of mHealth apps (Sig. = 0.010＜0.05, suggesting that an individual who perceives a high level of facilitating condition is very likely to adopt mHealth apps, which supports H4.

***H5:*** *Hedonic motivation positively influences users' behavior intention towards mHealth app in China.*

Hedonic motivation is insignificantly associated with the user acceptance of mHealth apps (Sig. = 0.317＞0.05), suggesting that an individual who holds a high level of hedonic motivation is not necessarily willing to adopt mHealth apps, which rejects H5.

***H6:*** *Negative Privacy and security issues negatively influence users' behaviour intention towards mHealth app in China.*

Negative privacy and security is negatively associated with the user acceptance of mHealth apps (Sig. = 0.000＜0.05), suggesting that an individual who concerns the privacy and security of mHealth apps is less likely to adopt mHealth apps, which supports H6.

Besides the significant, the Beta value showed the contribution of each independent variable. Comparing the beta value, the strengths of the influences of these 4 significant independent variables can be compared. The ranking of the factors (from strong to weak) is social influence (Beta = 0.375) > privacy and security (Beta = -0.273) > facilitating condition (Beta = 0.197) > performance expectancy (Beta = 0.180). This means that this variable makes the strongest unique contribution to explaining the dependent variable (user acceptance of mHealth app), when the variance explained by all other variables in the model is controlled for.

# 5. Discussion

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*This chapter discusses the empirical findings based on relevant theories and literature. It begins with summarizing the hypotheses testing outcomes, followed by an evaluation of the theoretical model established by this study. Based on this, it discusses the 7 factors which were examined in the empirical study in details.*

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## 5.1. Hypotheses Testing Outcomes

The above analysis fully tested the seven research hypotheses developed in Chapter 2 and Table 17 summarizes the hypotheses testing outcomes. H1, H3, H4, and H6 were supported, whereas H2 and H5 were rejected. These findings are discussed as follows.

**Table 17 A summary of the hypotheses testing outcomes.**

| No. | Hypotheses | Outcomes | Sig. |
|---|---|---|---|
| H1 | Positive performance expectancies positively influence users' behavior intention towards mHealth app in China | Supported | .020 |
| H2 | Effort expectancies (free of efforts) positively influence users' behavior intention towards mHealth app in China. | Rejected | .801 |
| H3 | Social influence positively influences users' behavior intention towards mHealth app in China. | Supported | .000 |
| H4 | Facilitating conditions positively influence users' behavior intention towards mHealth app. | Supported | .010 |
| H5 | Hedonic motivation positively influences users' behavior intention towards mHealth app in China. | Rejected | .317 |
| H6 | Negative Privacy and security issues negatively influence users' behavior intention towards mHealth app in China. | Supported | .000 |

## 5.2. Technological Acceptance of mHealth apps

In general, respondents showed a relatively high level of technological acceptance of mHealth apps (Mean = 5.7410; Std. = 0.90624) and 46.2% of the variance can be

explained by the regression model which built on the basis of UTAUT2 model (Venkatesh et al., 2012). This study demonstrated that the UTAUT2 model has satisfactory construct validity. After the 2 items were dropped from the 29 items, the construct validity of the data fitted the expected structure. Meanwhile, the results of EFA and factor loading values demonstrated that the 6 independent variables used to predict user acceptance were different but related constructs.

It should be noted that this study slightly modified the original UTAUT2 model according to the context of mHealth apps. Specifically, it excluded price value and habit from the original UTAUT and added privacy and security into the model. Adding privacy and security to the model has significant implications because it was proved that privacy and security is the second strongest factor that influences the users' behavior intention of mHealth apps.

Moreover, the adjusted $R^2$ of 46.2% suggests that there is still a considerable proportion of variance in user acceptance of mHealth apps cannot be explained by the modified UTAUT2 model shown in Figure 5. Hence, the present study did not exhaust all the important factors that influence users' acceptance of mHealth apps. The following paragraph discusses the 6 factors which were examined by this study.

### 5.3. Performance Expectancy

This study evidenced that the performance expectancy of mHealth apps positively associates with the user acceptance, i.e., if individuals perceive that using mHealth apps will enhance their performance of improving quality of life and facilitating healthcare services, they will be willing to use mHealth apps. This finding is consistent with a lot of empirical studies on the technological acceptance of mHealth service (Chen & Lin,2018; Choi et al., 2018; Cilliers et al., 2018; Dou et al., 2017; Dwivedi et al., 2016; Gao et al., 2015; Guo et al., 2015; Zhang et al., 2017). Hence, mHealth App developers can attract more users through enhancing the performance of their Apps perceived by users.

### 5.4. Effort Expectancy

It was found that the association between effort expectancy and user acceptance of

mHealth apps is insignificant, i.e., individuals are not necessarily willing to accept mHealth apps even though they perceive that mHealth apps are easy to be used. Indeed, previous studies had produced mixed findings of the relationship between effort expectancy (or PEOU) and technological acceptance of mHealth service. The majority of them concluded a positive association (Chen & Lin, 2018; Dou et al., 2017; Dwivedi et al., 2016; Gao et al., 2015; Zhang et al., 2017), whereas several studies concluded an insignificant association (Cilliers et al., 2018) and negative association (Choi et al., 2018). Hence, this study agreed with Cilliers et al.'s (2018) study on the user acceptance of mobile technology to collect health-related information.

The insignificant association can be well-explained by previous scholars' views. According to Hampshire et al. (2015), ICT has become an integral part of modern lives and smartphones have been popularized and ubiquitous. Therefore, the ease of use is no longer a problem when users choose ICT applications. Choi et al. (2018) also argued that healthcare services which are easy to be used may be perceived by users as less professional and credible. Moreover, this study inferred that health status is a significant issue to individuals and hence the low effort expectancy of mHealth apps is not likely a problem that hinders individuals' use of these Apps. In other words, individuals are willing to put efforts to use mHealth apps if they can improve their health status and life quality.

Moreover, scholars also noted that effort expectancy can indirectly influence users' acceptance because effort expectancy can increase users' perception of the performance of the technology (Chen & Lin, 2018; Zhang et al., 2017)). This study did not examine the indirect effect, but it can be inferred that even though the indirect effect exists, the effect is very likely to be weak. To be specific, the correlation analysis indicates that the positive association between low effort expectancy and performance expectancy is at a moderately low level ($r = 0.292$; Sig. = 0.001). Meanwhile, the positive association between performance expectancy and user acceptance of mHealth apps is not as strong as expected. The Beta value of performance expectancy ranks 3rd among the 4 significant factors.

### 5.5. Social Influence

The empirical results fully demonstrated that social influence is a strong and positive predictor of the user acceptance of mHealth apps, i.e., individuals under strong social pressure are very likely to use mHealth apps. For example, if an individual finds that its important friends are using mHealth apps or is recommended to use mHealth apps by its important friends, he or she is very likely to use mHealth apps as well. This finding supported the empirical studies of Cilliers et al. (2018), Dwivedi et al. (2016), and Gao et al. (2018). Among the seven factors examined by this study, the influence of social influence is strongest because its Beta value exceeded all other factors. Indeed, China's society is characterized by a high level of collectivist value and therefore individuals in the society are very likely to be influenced by their reference groups (Triandis, 1988; Zhang et al., 2007). Hence, there decision making is commonly affected by social influence. Studies on Chinese consumers' acceptance of other technologies also concluded a strong effect of social influence (or subjective norm) on consumers' technological acceptance (Gao, L., & Bai, 2014; Lee & Wan, 2010). As a result, in order to promoting mHealth apps in China, marketers should fully utilize social influence. For example, they could provide incentive to users who recommend this app to their friends, which is the common way in China to do promotion.

### 5.6. Facilitating Conditions

It was proved that there is a positive association between facilitating condition and the user acceptance of mHealth apps, i.e., individuals who perceive abundant resources (such as knowledge and mobile Internet) that facilitated their uses of mHealth apps, are very likely to adopt mHealth apps. In fact, facilitating condition was less examined in the context of mHealth service, the existing study of Dwivedi et al. (2016) documented a positive association, which was consistent with the present study. Moreover, this study agreed on previous views about mHealth services. For example, Kumar et al. (2013) noted that creating facilitating conditions for the smooth and effective interaction between users and providers is a key goal for mHealth service. In addition, this study argued that facilitating condition is important for mHealth apps because healthcare services are rather sensitive, and the improper use of these services may be harmful to individuals' health. Hence, facilitating conditions, such as help from medical professionals, knowledge,

compatibility, as well as secured and trusted resources are important to users' acceptance. In view of this, mHealth App developers should create the above conditions for users in order to motivate their uses.

### 5.7. Hedonic Motivation

It was found that the relationship between hedonic motivation and the user acceptance of mHealth apps is insignificant, i.e., individuals who hold high levels of hedonic motivation are not necessarily willing to adopt mHealth apps. Previous studies on technological acceptance of mHealth services concluded a positive association. Gao et al. (2015) reported a positive association among users of healthcare wearable devices; Dwivedi et al. (2016) found that the association was affected by culture. Specifically, the association between mHealth service and hedonic motivation was significantly positive among Bangladeshi citizens but was insignificant among Canadian and U.S.'s citizens.

This study argued that hedonic motivation is insignificant to the adoption of mHealth apps. It can be inferred that individuals use mHealth apps for the purpose of healthcare, rather than entertainment, relation, or pleasure. Healthcare wearable devices studied by Gao et al. (2015) characterized by entertainment elements, but mHealth apps are more functional. Meanwhile, according to Choi et al. (2018), it can be inferred that an mHealth app which contains many entertainment elements may be perceived by users as less credible and professional. The data of this thesis proved that in China people focus on the functionality rather than the entertainment function within the mHealth apps. Hence, it is not wise for mHealth app developers to add too many entertainment elements into apps.

### 5.8. Privacy and Security

Finally, this study reported a negative association between privacy and security and the user acceptance of mHealth apps, i.e., individuals who are concerned the privacy and security of mHealth apps and perceive that potential breaches in mHealth app might be negatively loaded are less likely to adopt mHealth apps. That means negative privacy and security issues would lead to the avoidance of mHealth apps. Hence, this study fully supported on the study of Ketelaar & Van Balen (2018) and was inconsistent with Chen & Lin (2018) and Choi et al. (2018) who reported a negative association. Meanwhile, the

strength of the influence of privacy and security exceeds performance expectancy because the Beta value of privacy and security is larger (-0.264 vs. 0.201). Hence, privacy and security are important factors that hinder users' acceptance of mHealth apps. As a result, this study agreed on Gao et al.'s (2015) view that healthcare issues are rather sensitive to users and hence they perceive a risk of leaking the information about these sensitive issues, they are unwilling to use. In view of this mHealth app developers should make serious efforts to protect users' privacy and security. Otherwise, their apps are very likely to be repelled by users.

# 6. Conclusion

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*This chapter includes an overview of this study which reflect the outcome of research purpose and questions. Furthermore, the implication, limitation and future research direction will be analyzed as followed.*

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## 6.1 Purpose and Research Questions

This research aims to measure and understand the relationship between different factors that influencing the acceptance of mHealth apps in the case of Chinese users. In order to carry out this purpose, this study slightly modified the original UTAUT2 model according to the context of mHealth apps. Specifically, it excluded *price value* and *habit* from the original UTAUT and added privacy and security into the model. The primary data was collected by questionnaire and finally it received 121 valid responses. In general, the results showed a relatively high level of technological acceptance of mHealth apps (Mean = 5.7410) and 46.2% of the variance can be explained by the regression model which built on the basis of UTAUT2 model (Venkatesh et al., 2012). Therefore, it can be argued that UTAU2 model can explain Chinese people's acceptance of mHealth apps. The following is the answer of the research questions.

*RQ1: What are the factors and which factors are the most significant factors that influence the users' behavior intention of mHealth apps in the case of Chinese users?*
According to the results of this research, performance expectancies, social influence, facilitating conditions and privacy and security are the factors influencing users' acceptance towards mHealth apps in China. And the effects of effort expectancy, hedonic motivation, habit towards user acceptance of mHealth apps is insignificant. Moreover, the outcomes of the statistical analysis showed that social influence makes the strongest contribution to explaining users' acceptance of mHealth app in China. The whole ranking of the factors (from strong to weak) is social influence > privacy and security > facilitating condition > performance expectancy.

*RQ2: How do these factors influence users' behavior intention towards mHealth apps*

*within Chinese market?*

The findings of this study suggested that except privacy and security, other factors are all positively affect the acceptance of Chinese mHealth app users. In terms of privacy and security factors, it means that individual who concern the privacy and security of mHealth apps are less likely to adopt mHealth apps. When it comes to another three factors, the effects would be like this: If individuals perceive that using mHealth apps will enhance their performance of improving quality of life and facilitating healthcare services, they will be willing to use mHealth apps; individuals under strong social pressure are very likely to use mHealth apps; individuals who perceive abundant resources (such as knowledge and mobile Internet) that facilitated their uses of mHealth apps, are very likely to adopt mHealth apps.

## 6.2 Implication for practice

Based on the answers of research questions, the results provide useful suggestions for the mHealth app developers and marketers in China. First, this study evidenced that the performance expectancy of mHealth apps positively associates with the user acceptance. From this point of view, mHealth app developers can attract more users through enhancing the performance of their apps perceived by users, such as adding demanding functions, improving the information quality. And the most important thing here for marketers is to know which kind of performance users are exactly expected. The author suggests creating ways to collect feedback from users to learn their needs, then follow their lead to adopt the app.

Second, the empirical results fully demonstrated that social influence is a strong and positive predictor of the user acceptance of mHealth apps, if an individual finds that its important friends are using mHealth apps or is recommended to use mHealth apps by its important friends, he or she is very likely to use mHealth apps as well. From this perspective, it is better for marketers in Chinese mHealth app companies to know how to fully utilize the social influence to promote their products. For example, providing incentive to users who recommend their friends and share the link on social media, improving social media influence, applying Key opinion leader (KOL) in marketing campaign, etc.

Third, in view of facilitating conditions which refer to consumers' perceptions regarding the resources, knowledge, and the support available when performing a behavior. It's important for mHealth app developers to provide enough app literacy to users to improve their awareness of mHealth apps; and increase the way to download to increase the availability and accessibility of this kind of app, then motivate their uses. In addition, app developers can simplify the progress or provide several options of sign up, which could let users meet the requirements to use mHealth apps easily.

Next, this study rejected the association between hedonic motivation and the adoption of mHealth apps. in some degree, an mHealth app which contains many entertainment and enjoyable elements may be perceived by users as less credible and professional. Hence, it is not advisable for mHealth app developers to add too many entertainment elements into their apps. It cannot be considered as an attraction of mHealth app users.

Last, healthcare issues are rather sensitive to users and hence they perceive a risk of leaking the information about these sensitive issues, they are unwilling to use. In view of this mHealth App developers should make serious efforts to protect users' privacy and security. For instance, provide users their promises and commitments for data protection, and give users opportunity and power to manage their data. Otherwise, their apps are very likely to be repelled by users.

### 6.3 Limitation

First, due to the time constraints, the original aim of 200 respondents was not accomplished. According to Hair et al. (2014), the recommended factor loading for a quantitative research consisting of 120 samples is 0.5. Since the loading values of all 30 items exceeded 0.5 on the components they were assigned to, the 121 respondents in this research could regarded as acceptable.

However, it should be noted that the use of Factor Analysis in this study was not rigorous. According to Thompson (2007), an important prediction of carrying out the Exploratory Factor Analysis is an adequate sample size. Specifically, the sample size should be 5 ~ 25 times the number of items. Hence, the minimum acceptable sample size of the study should be 135 because there were 27 items. However, the sample size of this study was

only 121. In view of this, the results of the EFA in this study were not robust.

Another limitation is the generalization of this result. Since China has a big population, this small sample size could limit the generalization of this result. A larger sample may be recommended for more accurate depictions.

Moreover, the results showed that there is still a considerable proportion of variance in user acceptance of mHealth apps cannot be explained by the modified UTAUT2 model shown. A potential reason is that this study omitted several factors which are out of UTAUT2 model. It can be solved in future research.

### 6.4 Future research

First, further research should collect more larger sample to ensure more accurate depictions. In addition, compare with younger and middle-aged people, elderly people are more demanding of healthcare service. The expectation and attitudes towards the usage of these mHealth apps in the case of elderly people should be explored in the future.

Secondly, the price value of UTAUT2 model was not considered in this study, it is recommended to be included in further studies. Even though most of mHealth apps in China are free to download, there still have some purchasing inside the apps and you need to pay for pro version or no advertisement. Future research could explore the users purchase intention towards mHealth apps.

Hence, the present study did not exhaust all the important factors that influence users' acceptance of mHealth apps beyond UTAUT2 model. It could be another place can be improved. According to previous studies, there are a variety of factors that influence the technology acceptance of mHealth services. Aside from the 6 factors tested by this study, there are other significant factors, such as self-efficacy (Gao et al., 2015; Guo et al., 2015; Zhang et al., 2017), response efficacy (Guo et al., 2015; Zhang et al., 2017), functional congruence (Gao et al., 2015), perceived vulnerability (Gao et al., 2015), perceived severity (Gao et al., 2015), perceived health threat (Dou et al., 2017), and health consciousness (Chen & Lin, 2018). These could be considered in future research.
Then, after this quantitative research, a series of qualitative research should be carried in

the future. Researchers could use focus or depth interviews to explore the way of app development, to examine a continuous process of potential modifications and refinements. In this study, the result showed the importance of social influence, privacy and security, facilitating condition and performance expectancy towards Chinese users' intention. It would be useful for app developers and marketers to know what is expected by the users. For instance, which kind of performance are they most care about, what are they opinions and experience towards current mHealth apps, which difficult are they facing when using mHealth apps, etc.

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## Appendix 1 Download links of some Chinese mHealth app

| Name | Download link (ios) |
|---|---|
| **Chun Yu Doctors (Chunyu Yisheng)** | https://itunes.apple.com/cn/app/%E6%98%A5%E9%9B%A8%E5%8C%BB%E7%94%9F-%E5%9C%A8%E7%BA%BF%E5%92%A8%E8%AF%A2%E8%B4%AD%E8%8D%AF%E5%B9%B3%E5%8F%B0/id478834039?mt=8 |
| **micro-medicines, (Wei yi)** | https://itunes.apple.com/cn/app/%E5%BE%AE%E5%8C%BB-%E6%8C%82%E5%8F%B7%E7%BD%91-%E4%B9%8C%E9%95%87%E4%BA%92%E8%81%94%E7%BD%91%E5%8C%BB%E9%99%A2/id595277934?mt=8 |
| **Ping An Good Doctor (Ping An haoyisheng)** | https://itunes.apple.com/cn/app/%E5%B9%B3%E5%AE%89%E5%A5%BD%E5%8C%BB%E7%94%9F-%E5%9C%A8%E7%BA%BF%E5%92%A8%E8%AF%A2%E6%8C%82%E5%8F%B7%E8%B4%AD%E8%8D%AF%E5%B9%B3%E5%8F%B0/id923920872?mt=8 |
| **DingXiang doctor (DingXiang yisheng)** | https://itunes.apple.com/cn/app/%E4%B8%81%E9%A6%99%E5%8C%BB%E7%94%9F-%E5%81%A5%E5%BA%B7%E9%97%AE%E9%A2%98%E5%9C%A8%E7%BA%BF%E5%92%A8%E8%AF%A2%E5%8C%BB%E7%94%9F/id911261462?mt=8 |
| **Haodaifu Zaixian** | https://itunes.apple.com/cn/app/%E5%A5%BD%E5%A4%A7%E5%A4%AB%E5%9C%A8%E7%BA%BF-%E5%9C%A8%E7%BA%BF%E5%92%A8%E8%AF%A2%E5%8C%BB%E7%94%9F%E6%8C%82%E5%8F%B7%E5%B9%B3%E5%8F%B0/id919502358?mt=8 |

## Appendix 2 Questionnaire

*Questionnaire about users' acceptance towards mHealth app in China*

1. Have you used mobile health Apps before?

If ☐ **Yes**, please proceed; if ☐ **No**, skip to the end.

2. **Gender:** ☐ Male ☐ Female

3. **Age:** ☐ 18 ~ 30 years ☐ 31 ~ 40 years ☐ 41 ~ 50 years ☐ Above 51 years

4. **Educational Level:** ☐ Primary school ☐ Junior high school ☐ Senior /vocational high school ☐ University/college ☐ Graduate school

5. **Mobile Device Usage Experience:** ☐ Less than 2 years ☐ 2 ~ 4 years ☐ 4 ~ 6 years ☐ 6 ~ 8 years ☐ 8 ~ 10 years ☐ more than 10 years

**The following statements describe your attitude and experience towards mobile health Apps. Please rate the level of your agreement towards each of them (5=strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree).**

| N. | Statements | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **UA1** | I intend to use mobile health Apps in the next 3 months. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **UA2** | I predict I will use mobile health Apps in the next 3 months. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **UA3** | I plan to use mobile health Apps in the next 3 months. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PE1** | Using mobile health Apps will improve the quality of my life. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PE2** | Using mobile health Apps will mean more health-care conveniences. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PE3** | Using mobile health Apps will make my life more effective. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PE4** | Generally, I find mobile health Apps to be useful in my life. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **EE1** | Learning to operate the mobile health Apps will be easy for me. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **EE2** | I can easily become skillful at using mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EE3** | I can get mobile health Apps to do what I want. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **EE4** | Generally, mobile health Apps are easy to use. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SI1** | People who are important to me would think that I should use mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SI2** | People who influence me would think that I should use mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SI3** | People whose opinions are valued to me would prefer that I should use mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SI4** | My friends could influence my decision to use mHealth apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SI5** | My families could influence my decision to use mHealth app. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SI6** | The media attention mHealth app receives affects my willingness to use the service. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **FC1** | I have the secured and trusted resources necessary to use mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **FC2** | I gathered the knowledge necessary to use mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **FC3** | I can get reliable help from medical professionals when I have difficulties using mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **HM1** | Using mobile health Apps is fun. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **HM2** | Using mobile health Apps is enjoyable. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **HM3** | Using mobile health Apps is entertaining. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **HM4** | Contacting with physician online make me feel more relaxed. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **HM5** | Using mHealth app is not tedious and boring. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PS1** | It would be risky to disclose my personal health information to firms providing mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PS2** | There would be a high potential for loss associated with disclosing my personal health information to firms providing mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PS3** | There would be too much uncertainty associated with giving my personal health information to firms providing mobile health Apps. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PS4** | Mobile health Apps sufficient security to transmit personal information. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |