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The reasons why elderly mobile users adopt ubiquitous mobile social service

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ABSTRACT

Ubiquitous mobile social service allows users to interact and communicate with others at any time and place, which is different from the mobile social service in the past. It has become the mobile service most widely used by consumers since various mobile applications (abbreviated as "apps") were introduced into the market. Recently, the number of elderly users of ubiquitous mobile social service aged over 60 has largely increased. However, the needs and the adoption motivations of the elderly people for this service seemed to have been neglected in the development of mobile devices or services, even in the academic research. For the purpose of understanding what factors make the elderly mobile users willing to adopt ubiquitous mobile social service, this study conducted an empirical research the integrating uses and gratification theory and the media richness theory. Totally, 226 effective questionnaires were obtained, among these questionnaires, there are 193 samples over the age of 60. The analysis results indicated that social, enjoyment and fashion motivations have influences on elderly mobile users' adoption of ubiquitous mobile social service. Furthermore, users' perceived interactive richness and apps self-efficacy also have strong influences on elderly mobile users' adoption of the service. However, the required high expenses make the elderly mobile users keep using their habitual ways to socialize with others, and therefore have a negative influence on elderly mobile users' intention to adopt ubiquitous mobile social service.

1. Introduction

The popularity of mobile devices, such as smartphones, tablet computers, and the quick development of wireless networks, such as 3/4G and Wi-Fi, together give the mobile devices extremely high portability and mobility, which not only enables more convenient exchange and acquisition of information and knowledge, but also brings people closer together when they communicate using mobile devices (Lee, Park, Kim, & Lee, 2012). The value of mobile devices in terms of their global applicability has created huge business opportunities for the mobile application market. Among the large number of mobile applications (abbreviated as "Apps"), mobile social service can be deemed as one App that is most widely used by users and has very close relations with users' daily life (Hu et al., 2014). According to Schubert and Hampe (2005), mobile social is the interaction and communication of individuals with one another for talking about some common topics under the aid of mobile technology. It combines techniques of social science and wireless communications for mobile device (Kayastha, Niyato, Wang, & Hossain, 2011).

In recent years, due to the popularity of the internet, people in different countries or areas can interact and communicate with one another via a wide range of social service software, such as Skype, ICQ, Yahoo! Messenger, so long as their computers have been connected to the internet; and this is why the concept of virtual community gradually forms. Mobile social service is developed by combining virtual communities, mobile instant messaging (MIM) and mobile devices with one another (Li, Chen, Cheng, Li, & Chen, 2015). Generally speaking, to use the mobile social service, a user needs only to connect to an available wired network or a wireless network from an internet-accessible computer device, such as a laptop computer, a smartphone or a tablet computer (Kayastha et al., 2011). Presently, there are already many mobile social services flooded in the market of mobile applications (Kayastha, Niyato, Hossain, & Han, 2014). Some of these mobile social services (e.g., Facebook and Google+) are mobile-version social applications developed by traditional social networking sites in response to the trend of mobile service, while other mobile social services (e.g., LINE, WeChat and WhatsApp) are new due to the emergence of mobile service (Yang & Lin, 2016).

The topic of this study, *ubiquitous mobile social service,* is a type of newly emerged IT service. A core concept of this type of service is that a user is *accustomed to using a mobile device* (i.e., smartphone or tablet computer) rather than desktop computers at fixed locations, in combination with his (her) own 3/4G mobile communication subscription rather than free Wi-Fi, to perform social services *at any time and at any*

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place. Through ubiquitous mobile social service, users can carry out various social activities at any time and place, such as sharing current moods at the moment and exchanging text and video/audio messages with others in real time, and even making new friends with people having the same interests and the same topics of conversation (He et al., 2016; Schubert & Hampe, 2006; Thilakarathna, Viana, Seneviratne, & Petander, 2013; Yazji, Scheuermann, Dick, Trajcevski, & Jin, 2014). Ubiquitous mobile social service has not only gradually replaced the traditional ways to social with others, but also completely changed many social habits that people have long been accustomed to. According to an analysis made by Market Intelligence and Consulting Institute (MIC), social communication apps are the mobile services being used by 80.9% of the consumers everyday.[1]

Although the users of ubiquitous mobile social service constantly increase, most of them are young between 20 and 50 years old. However, the number of ubiquitous mobile social service users aged over 50 and even over 60 has also increased recently (Cozza, De Angeli, & Tonolli, 2017; Leme, Amaral, & Zaina, 2014). As indicated by a survey conducted by Foreseeing Innovative New Digiservices (FIND), beginning from year 2014, the biggest source of growth in smartphone ownership came in the age of 50 and over.[2] The survey result in 2016 by InsightXplorer also found that the percentage of mobile social service users aged over 55 increases year by year. From these surveys, it can be inferred that elderly mobile users might become a potential group of ubiquitous mobile social service adopters. However, the current mobile services mainly target at younger age groups (i.e. adults and/or students), and the elderly mobile users' requirements are commonly not given sufficient consideration (Chen, Chan, & Tsang, 2013). Actually, most of the elderly mobile users are ready to attempt new types of various mobile services (Mikkonen, Va, Ikonen, & Heikkila, 2002). Nevertheless, it might be unclear to service providers whether the functions of the newly emerged mobile services meet the needs of elderly mobile users (Ehmen et al., 2012).

In literature, many of the recent academic researches on mobile social service explored users' intention to use mobile social service (Gao & Bai, 2014; Shambare, 2014; Zhou & Li, 2014). Among others, there are also researches discussed users' satisfaction and loyalty to mobile social service (Park, Oh, & Lee, 2011; Suki, 2012; Zhou, Li, & Liu, 2010). However, most of these researches mainly targeted at younger users, such as students or young adults, and only a few of the researches discussed elderly mobile users' adoption of mobile technology/service. For example, van Biljon and Renaud (2008) applied technology acceptance model (TAM) to analyze the elderly mobile users' acceptance toward mobile technology. Mallenius, Rossi, and Tuunainen (2007) conducted a pilot study for identifying factors affecting the adoption and usage of mobile services and devices by elderly mobile users. Chen et al. (2013) investigated the usage of smartphone by elderly mobile users and indicated that these users showed little interest in additional smartphone features other than communication and information seeking. It has been found from past studies, elderly mobile users seemed to have been a neglected group in the development of mobile devices or mobile services (Mallenius et al., 2007), and researches about the motivations of elderly mobile users to adopt mobile social service are extremely rare.

In recent years, due to the advances in medical technology, global population aging has become an unavoidable trend. In Taiwan, the elderly occupy 14% of the country's total population and this elderly population density is ranked third in Asia.[3] The aging population also brings many issues on, for example, healthcare and the like. Among others, the most concerned issue is social isolation, which can only be fought by satisfying the elderly persons' social needs (Coelho & Duarte, 2016). In other words, "socialization" is of very important to the elderly persons' living quality (Gabriel & Bowling, 2004). This is why more and more elderly persons, particularly the retired elderly, use mobile social services to maintain affection and close relationship with their family members and friends and even to develop new social circles, and make these activities as an emphasis in their daily life (Petrovčič, Fortunati, Vehovar, Kavčič, & Dolničar, 2015). Further, elderly persons are encouraged to go outside for taking regular walks, visiting friends, or viewing exhibitions for maintaining physical function (Shimada et al., 2010; Volkers & Scherder, 2011). The free Wi-Fi provided by many public organizations and stores are not widespread or might be not reliable. Thus, the "ubiquitousness" of mobile services, which enables users to more easily grasp the most updated activities and locations for facing any possible emergent situations or preventing elderly persons from getting lost, become indispensable. Therefore, to understand the elderly mobile users' real needs and motivations for using the ubiquitous mobile social service would be an issue worthy of further understanding and in-depth discussions.

In light of the above discussion, this study applies the "uses and gratification theory" and "media richness theory" as a basis to explore what needs or motivations make the elderly mobile users willing to adopt the ubiquitous mobile social service and to find out whether the elderly mobile users' perceived interactive richness has an influence on their adoption of the service. In addition, based on the "social cognitive theory", this study also tries to understand whether the elderly mobile users' self-efficacy in the use of mobile devices or applications and their inertia of using traditional desktop computers and phones also have impacts on the intention to adopt the ubiquitous mobile social service.

2. Literature review and hypothesis inferences

2.1. Uses and gratification theory

In the field of mass communication, uses and gratification theory is an approach to understand the motivations that drive audiences to actively choose some specific media to satisfy their needs (Severin & Tankard, 2010). Audiences' motivations and needs for using media vary from person to person, but generally include fashion motivation, sociability motivation, entertainment motivation, information-seeking motivation, utilitarian motivation, etc. (Cheung, Chiu, & Lee, 2011; Kim, Kim, & Wachter, 2013; Leung, 2001; Leung & Wei, 2000; Xu, Ryan, Prybutok, & Wen, 2012). Following the development of scientific technologies, new types of media have been continuously introduced into people's life. Therefore, uses and gratification theory has been gradually applied to explore users' motivations and needs for using different new media, such as mobile devices (Leung & Wei, 2000), instant messaging software (Leung, 2001), social networking sites (Park, Kee, & Valenzuela, 2009; Xu et al., 2012) and mobile technology (Kim et al., 2013).

Generally speaking, when facing a new and unfamiliar scientific technological product/service, users usually need sufficient motivations to adopt it. To elderly mobile users, the ubiquitous mobile social service is absolutely a new scientific technological service that has emerged in recent years (Coelho & Duarte, 2016). Comparing with younger persons, elderly people generally have less knowledge of information technology and other scientific technologies; so they particularly need sufficient motivations to adopt such a new service.

2.1.1. Sociability and fashion motivations

There were many earlier researches that applied the uses and gratification theory to explore users' motivations for adopting various mobile communications and social service media. For example, Leung (2001) conducted a research of users' motivations for using instant messaging software ICQ for online chat and pointed out that sociability

[1] MIC, https://mic.iii.org.tw/IndustryObservations_PressRelease02.aspx?sqno=423, 2017.

[2] FIND, http://focustaiwan.tw/news/aall/201407180025.aspx, 2017.

[3] Liberty Times Net, http://news.ltn.com.tw/news/life/breakingnews/2391182, 2018.

motivation and fashion motivation are major motivations for users to use ICQ. Like the instant messaging software ICQ, the ubiquitous mobile social service is one of the presently hottest mobile services developed by the mobile technological field after years of evolution. To many elderly mobile users, the use of the ubiquitous mobile social service not only enables them to socialize with family members and friends at any time and place, but also helps them more quickly send and receive information to and from others, making them stay on fashion trend and feel they have never fallen behind the times due to being old in age. In literature, Leung and Wei (2000) also indicated that sociability and fashion motivations all have influences on users' consideration of using the mobile communication technology. Kim et al. (2013) reported that sociability motivation has a significant influence on users' intention to adopt mobile products and services. Park, Kee, and Valenzuela (2009) also found that users' gratification motivations for using social networking sites include sociability and fashion motivations. From these earlier researches, it can be found most of the users decide to use various types of mobile communications and social services because of their social needs. In addition, users also think the use of the currently most popular social tools to socialize with other people, especially younger generation, can show that they are keeping up with the trends and times.

2.1.2. Enjoyment motivation

In addition, Kim et al. (2013), Park, Kee, and Valenzuela (2009) and Leung and Wei (2000) all pointed out that users' needs for entertainment is another primary motivation that brings users' intention to use mobile service/technology. The ubiquitous mobile social service can enable the elderly mobile users to acquire many interesting, funny or useful information and news from others, in order to kill time and relax mind. Xu et al. (2012) also proved that, in addition to the sociability motivation, another primary motivation for users to use social networking service is to kill time and relax mind by making new friends and maintaining good human relationship. Hsiao, Chang, and Tang (2016) found that enjoyment motivation has a significant impact on users' satisfaction and continuance intention toward using mobile social apps.

2.1.3. Epistemic motivation

The epistemic value is the perceived utility obtained from an alternative's capacity to provide novelty and to arouse curiosity (Yang & Lin, 2017). Sometimes, people want to try and learn some novel things just because they want to experience novelty instead of utilitarian benefits only (Raacke & Bonds-Raacke, 2008). Some early studies indicated the novelty things indeed have a positive influence on consumers' intention to try or even buy a product (Cotte, Tilottama, Ratneshwar, & Ricci, 2006). The ubiquitous mobile social service can provide elderly mobile users with a platform for communication at any time and place and in different ways, such as video call, group call, sending stickers; further, with the dynamic news service, users can also obtain in real time the daily changes or moods of persons they care about. These novel social functions and the messages/texts sprung up at any time can fully stir up users' curiosity and epistemic motivation, which in turn makes users want to try and adopt the mobile social service (Al-Lozi and Al-Debei 2012; Sullivan & Drennan, 2005). Past research also indicated that people with high epistemic motivation tend to seek more information (Amit & Sagiv, 2013; Lun, Sinclair, Whitchurch, & Glenn, 2007). Thus, it can be conjectured that epistemically motivated elder people might have higher tendency to adopt ubiquitous mobile social service.

The above discussions point out that the ubiquitous mobile social service can provide the convenient way to socialize with others, keep up with the trends, kill time and relax mind, and also experience novelty. Thus, this study identifies “social motivation”, “enjoyment motivation”, “fashion motivation”, and “epistemic motivation” as the elderly mobile users' inspiring motivations using ubiquitous mobile social service to obtain gratification. Four hypotheses [H1] to [H4] are proposed as follows.

H1. The elderly mobile users' social motivation has a positive influence on their adoption of ubiquitous mobile social service.

H2. The elderly mobile users' enjoyment motivation has a positive influence on their adoption of ubiquitous mobile social service.

H3. The elderly mobile users' fashion motivation has a positive influence on their adoption of ubiquitous mobile social service.

H4. The elderly mobile users' epistemic motivation has a positive influence on their adoption of ubiquitous mobile social service.

2.2. Media richness theory

Media richness theory is another important theory in the field of mass communication. In the early stage, audiences' choice of communication media was studied from the viewpoint of information processing (Daft, Lengel, & Trevino, 1987; Daft & Lengel, 1986). According to many past researches, communication media that have more functions can transmit more information to people and accordingly have higher media richness (Daft et al., 1987; Daft & Lengel, 1986; Dennis, Kinney, & Hung, 1999; Kishi, 2008; Rice, Chang, & Torobin, 1992; Trevino et al. 1987, 2000). However, following the progress of scientific technologies, new types of media have been continuously introduced into people's daily life; thus, the number of functions is no longer the only criterion for evaluating the richness of the medium (Markus, 1994). According to Carlson and Zmud (1999), when studying users' behaviour of using communication media, it is necessary to consider users' subjective perception of media richness in addition to the functionality of media. Fernandez, Simo, Sallan, and Enache (2013) indicated in their research that users' perceived social media richness has an influence on their continuous intention of using the media. Ogara, Koh, and Prybutok (2014) also found that users' perceived richness of mobile instant messaging services has an influence on the degree of their satisfaction with these services.

In addition, interactivity is an important factor when evaluating users' perceived social media richness (Downes & McMillan, 2000; Liu, Liao, & Pratt, 2009; Otondo, Van Scotter, Allen, & Palvia, 2008). New social media should be characterized by having interactivity as compared to the traditional media. McMillan and Hwang (2002) indicated that user perceived interactivity of some social medium is an important factor in measuring its future development. Wu (2005) found that the higher a user perceived interactivity of a website, the higher the user's intention to use the website is. Gao, Rau, and Salvendy (2009, 2010) indicated that good interactivity would increase users' intention to use mobile media or services, and they further used perceived interactive richness to explain user acceptance of mobile advertisements.

Ubiquitous mobile social service makes the ways and contents of people's communication and interaction with one another more interesting and diversified, which is an important reason for the widespread acceptance of this service within a very short period of time (Yang & Lin, 2016). This service can provide elderly mobile users with multiple social functions, enabling them to communicate with others in more ways, including the use of pictures, texts, videos and sounds, to largely increase the richness of their interaction with others; and therefrom, elderly people may have the feeling in a real face-to-face communication and perceive high interactivity (Kiousis, 2002; Rau, Gao, & Wu, 2008). Thus, it can be supposed that an increased degree of elderly mobile users' perceived interactivity of ubiquitous mobile social service would increase elderly mobile users' intention to adopt this service.

Based on the above discussions and literature, this study considers the perceived interactive richness as an elderly mobile users' subjective cognitive standard and further proposes the hypothesis [H5] as follows.

H5. The elderly mobile users' perceived interactive richness has a

positive influence on their adoption of ubiquitous mobile social service.

2.3. Social cognitive theory

In the 1970s, Albert Bandura, a famous American psychologist, put forward social cognitive theory based on the general interaction between environment and a person's behaviour to explain human behaviour (Bandura, 1977). According to the theory, self-efficacy is the most important dimension that influences human behaviour. Self-efficacy means an extent to which an individual believes in his or her ability to perform a certain task using the skill he or she has (Bandura, 1982; Bandura & Schunk, 1981). Compeau and Higgins (1995) further proposed the concept of computer self-efficacy based on the social cognitive theory, and defined computer self-efficacy as an individual's belief in his or her ability, judgment and confidence in performing a specific task by using a computer. Presently, many studies were conducted in different contexts and all found computer self-efficacy is one of the important factors that influence people's computer usage behaviour. For example, Coffin and MacIntyre (1999) found that computer self-efficacy influences not only a person's computer learning performance, but also a person's intention to use computer. Hill, Smith, and Mann (1987) also indicated that students with higher computer self-efficacy have stronger intention to learn and use computer systems.

Mobile apps are mobile technological services that have emerged in recent years. There are multiple types of mobile apps, such as tool, game, and social apps. Just like using a computer, users' mobile-apps self-efficacy, i.e., the extent to which users believe they can well understand and operate the mobile apps, should have a great influence on their intention to use any type of app service. However, unlike younger users, most elderly people are not so familiar with information technology and consumer electronics products; and accordingly, they might have no enough confidence in using them (Nägle & Schmidt, 2012). Particularly, it is possible that the elderly people perceive the difficulties in learning or operating newly developed mobile apps and determine not to adopt the new mobile apps. In other words, if an elderly mobile user believes that he/she could become familiar with the operation of mobile apps in a short period of time, he/she would be more willing to adopt the service.

In literature, many researches have used technological product/service self-efficacy to measure users' intention to adopt newly developed technological products/services. For example, Lu and Viehland (2008) and Mahat, Ayub, and Luan (2012) all utilized mobile self-efficacy to evaluate users' acceptance of mobile learning environment. Tsai, Tsai, and Hwang (2010) also utilized mobile self-efficacy to evaluate users' intention to use personal digital assistants. Their researches all proved that users' self-efficacy has an absolute influence on their adoption of novel technological products/services. Furthermore, Yu (2012), Dasgupta, Paul, and Fuloria (2011), and Sripalawat, Thongmak, and Ngramyarn (2011) all indicated that perceived self-efficacy is an important influential factor in people's adoption intention toward mobile banking.

Based on the above discussions and literature, this study considers the apps self-efficacy as an elderly mobile users' subjective cognitive standard and further proposes the hypothesis [H6] as follows.

H6. The elderly mobile users' mobile apps self-efficacy has a positive influence on their adoption of ubiquitous mobile social service.

2.4. Switching costs and inertia

Switching costs are additional costs generally incurred by consumers when they switch between products/services (Klemperer, 1987). Jones, Mothersbaugh, and Beatty (2000, 2002) defined switching costs as the time, efforts and money cognized and spent by consumers when they switch from originally used products/services to similar products/services provided by other brands or suppliers. Burnham, Frels, and Mahajan (2003) classified switching costs into procedural switching costs, relational switching costs and financial switching costs. The procedural switching costs are the time and efforts needed to be paid by individuals, who switch to use other products/services, for searching, assessing, learning and adapting to the new products/services, and these costs are the so-called intangible costs. On the other hand, the financial switching costs are the substantial losses or monetary expenses to be paid when individuals switch to use other products/services, and these costs are the so-called tangible costs. For most users, high switching costs would prevent them from changing their established usage habits to try or use other similar services/products (Keaveney, 1995), and this condition is the so-called inertia. Inertia and new behaviour intention are often opposed to each other in influencing human decision-making behaviour. In other words, the stronger a person is accustomed to something familiar, the less the person is willing to try new things (Triandis, 1979).

In customer relationship management, inertia has a great influence on consumer loyalty to products or brands (Ranaweera & Neely, 2003). Generally speaking, it is inevitable for users to take additional time to learn about and become familiar with newly emerged technological services/products they have never tried before. Sometimes, the users even have to pay a substantial amount of money to use such new services/products. For these reasons, some users would rather choose to maintain their established usage habits than to try new services/products. Heskett and Schlesinger (1994) found in their research that consumers, in view that a lot of efforts and time is needed to know more about and become familiar with the new products/services, tend to maintain the established usage habit and keep using the products/services they are using for the time being. Kim and Yoon (2004) studied users' intention to switch to a new mobile phone dealer and indicated that, because user perceived high costs of switching to a new number provided by another mobile phone dealer and user acquaintance with the currently adopted mobile phone dealers, users' switching intention is low.

The above phenomenon is particularly obvious to elderly people who generally have perceived the learning of new skills as a serious barrier and have been accustomed to old things (Melenhorst, Rogers, & Bouwhuis, 2006). Elderly users might have long been accustomed to interacting and communicating with others by using the voice or short message service provided via cell phones or landline phones. Therefore, it is possible that some elderly mobile users have no intention to adopt the ubiquitous mobile social service because they might not want to change and have feelings of anxiety over unfamiliar technology (Kurniawan, 2008). Further, ubiquitous mobile social service with too many functions will make the operation more complex, which necessitates elderly mobile users who have no sufficient knowledge of information technology to spend a lot of time and make a great effort on learning the use of complex mobile Apps (Chen et al., 2013; Ziefle & Bay, 2005).

In addition, before using the ubiquitous mobile social service, elderly mobile users might have to first abandon their old mobile devices and purchase the relatively expensive smart devices and also need to subscribe 3G/4G internet access. Some of the elderly users are already retired, so they might be more concerned about unnecessary spending. Polites and Karahanna (2012) studied users' behaviour of using new social tools, and the study results indicated the considerably high time and effort costs needed to switch to other new social tools or the great efforts that had been made to learn and get familiar with the original social tools will urge users to keep using the current social tools and reduce users' intention to try or use new social tools.

According to the above discussion, for elderly users, the high tangible switching costs and intangible switching costs will make them choose to maintain their old socializing ways, and thus reject the use of new social tools in their social behaviour, even if they have perceived mobile social service can provide them with more instant and more

convenient ways of socializing. Gounaris and Stathakopoulos (2004) indicated that, due to the established usage habit, customers normally would not automatically search for other similar or alternative products/services; instead, they will still choose to use the products/services provided by the brands they are familiar with, even if they did not really satisfy with the products/services. Blackwell, Miniard, and Engel (2005) also found when a user has a strong inertia to use a certain product/service, the user will ignore information related to other similar products/services because the user tends to follow his or her established usage habits. In the context of this study, the use of ubiquitous mobile social service stands for a brand new way to communicate with others, which is quite different from the old habits for elderly users. Thus, the established habit might prevent their adoption of this new service.

Based on the above discussions and viewpoints, three hypotheses [H7] to [H9] are proposed as follows.

H7. The elderly mobile users' tangible switching costs for the use of ubiquitous mobile social service have a positive influence on their inertia of maintaining social interaction in traditional ways.

H8. The elderly mobile users' intangible switching costs for the use of ubiquitous mobile social service have a positive influence on their inertia of maintaining social interaction in traditional ways.

H9. The elderly mobile users' inertia of maintaining social interaction in traditional ways has a negative influence on their adoption of ubiquitous mobile social service.

According to the above hypotheses [H1] to [H9], this study proposes a research model as shown in Fig. 1.

3. Survey process

3.1. Measurement development

The constructs of the above model were defined and their measurement items were developed. In this study, the possible users' "gratification motivations" for using ubiquitous mobile social service were identified as "social motivation", "enjoyment motivation", "fashion motivation" and "epistemic motivation". Using the above four gratification motivations as a basis, this study further referred to the measurement items in the questionnaire proposed by Xu et al. (2012) to evaluate users' motivations for using social networking sites, as well as the measurement items in the questionnaire proposed by Kim et al. (2013) to evaluate users' motivations for using mobile technology. Then, this study adjusted the contents of the above-mentioned measurement items according to the properties of ubiquitous mobile social service to develop the measurement items for using in this study to evaluate the elderly mobile users' gratification motivations. In total, 19 measurement items were developed for the variable of gratification motivations.

Perceived interactive richness was defined as the extent to which the elderly mobile users perceive ubiquitous mobile social service can make them interact and communicate with surrounding people at any time and place. This study referred to the measurement items in the questionnaire proposed by Lan and Sie (2010) to evaluate the content richness of mobile learning, as well as the measurement items in the questionnaire proposed by Fernandez et al. (2013) to evaluate the perceived media richness of online forums. Then, this study adjusted the contents of the above-mentioned measurement items according to the interactive and communicating properties of ubiquitous mobile social service to develop measurement items for perceived interactive richness. Total 7 measurement items were developed for the variable of perceived interactive richness.

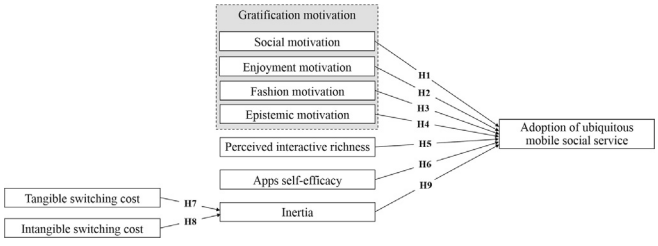

Fig. 1. Research model.

According to the context of this study, this study adjusted the computer self-efficacy as "apps self-efficacy" and defined the apps self-efficacy as the extent to which the elderly mobile users believe they can well understand and operate various mobile apps. Further, referring to the original computer self-efficacy measurement scale (Compeau & Higgins, 1995), as well as the scale for measuring mobile self-efficacy (Mahat et al., 2012), this study developed 6 measurement items for the variable of apps self-efficacy.

Switching costs were defined as the tangible and intangible costs needed to be paid by the elderly mobile users for switching to the use of ubiquitous mobile social service. Inertia was defined as the extent to which the elderly mobile users are accustomed to socialize with others via traditional social tools. In this study, the switching costs were classified into "intangible costs" and "tangible costs"; This study also referred to the questionnaire proposed by Polites and Karahanna (2012) for evaluating users' behaviour of switching to different e-mail tools. Then, this study adjusted the contents of the measurement items in the above-mentioned questionnaire according to the properties of ubiquitous mobile social service and developed 14 measurement items for these variables.

This study defined the adoption of ubiquitous mobile social service as the extent to which the elderly mobile users are willing to adopt mobile social service at any time and place. Referring to the measurement items in the questionnaire (Moon & Kim, 2001) for evaluating internet usage, this study developed 5 measurement items for this construct.

3.2. Pretesting and questionnaire distribution

Although in different countries and different contexts, the definition of "elderly" is different in age. According to the definition of World Health Organization in 2013, 50 years of age and older as the general definition of an elderly person.[4] Besides, the "Research, Development and Evaluation Commission (RDEC)" published the "digital divide report" about internet usage in Taiwan, which also showed the "elderly" is people over the age of 50 (Lian & Yen, 2014).

Based on the measurements developed, this study first conducted a questionnaire pretest, and the respondents of the pretest were smartphone users over the age of 50, and have not applied for 3/4G mobile internet access or have not been using ubiquitous mobile service frequently. Totally, 35 questionnaires were collected from the respondents in the pretest. This study also conducted several preliminary tests to examine the reliability and validity of the questionnaire. According to the test results, some improper question items were deleted or modified and the final questionnaire were obtained for formal administration. The final questionnaire used in this study is shown in Appendix A.

The final questionnaire was posted online for two weeks in December 2017. Several online survey platforms were selected for posting the questionnaire hyperlinks, including several Taiwan's mobile-service-related online forums and social network sites (e.g. Facebook and Google Plus). A qualified questionnaire respondent must meet the following conditions: (a) being aged over 50 years old, (b) having owned any smartphone or tablet computer, and (c) either

[4] World Health Organization, http://www.who.int/healthinfo/survey/ageingdefnolder/en/#, 2018.

having not had a 3/4G mobile internet subscription, or having not been accustomed to using ubiquitous mobile social service frequently. These conditions were set for filtering out those who have had already been users of ubiquitous mobile social service.

Total 236 questionnaires were collected from the final questionnaire administration in two weeks. Since the collection period was short, there is no need to conduct the test of early and late response. Any of the collected questionnaires showing incomplete or blind filling shall be considered invalid. Finally, total 226 effective questionnaires were obtained. As a qualitative supplement, about ten after-survey interviews were also conducted for understanding the needs of the elder users deeply. Many interviewees mentioned that vivid stickers are regarded by mobile social service users as a highly attractive function. Furthermore, the retired or people who are about to retire often participated in travel itineraries, and they were willing to make new friends with people traveling in tour groups via mobile social apps. In addition, some interviewees also stated that a friendly app operation guideline and neat app interface design could save they a lot of time for learning the operation of a new app and can therefore increase their intention to adopt the app.

4. Data analysis

4.1. Descriptive statistics analysis

The detailed demographic information of the 226 qualified respondents in the final survey is shown in Table 1. In the samples, the percentages of male and female respondents are about 32.30% and 67.70%, respectively. Besides, 85.40% of the respondents are over age 60. Furthermore, 78.76% of the respondents have an educational background of college level or higher, indicating the survey samples are persons of relatively high education levels.

Among these respondents, 45.58% (103 respondents) had not yet applied for 3/4G mobile Internet access at the time being surveyed. Though some of them had already tried mobile social services (e.g., LINE, Facebook, Messenger and WeChat), they only used these apps at fixed places with free Wi-Fi, e.g. at home or in school/workplace. Thus, it would be impossible for them to have the experience of enjoying ubiquitous mobile social service. The other 54.42% (123 respondents) had 3/4G subscription, but they also stated that they only opened or used these mobile social service apps at fixed places and fixed time; some of them had not even installed such types of apps in their smartphones. That is, they had not been accustomed to using ubiquitous mobile social service frequently. According to the feedback from these respondents, they are valid samples for exploring their future intentions to adopt ubiquitous mobile social service.

Table 1
Demographic of respondents.

Profiles	Sample Composition	Frequency	Percentage
Gender	Male	73	32.30%
	Female	153	67.70%
Age	50–55	10	4.42%
	56–60	23	10.18%
	61–65	117	51.77%
	66–70	61	26.99%
	Over 70	15	6.64%
Educational background	Senior high/Vocational school and lower	48	21.24%
	College	129	57.08%
	Graduate school and above	49	21.68%
Occupation	Service industry	22	9.74%
	Freelancer	21	9.29%
	Information Industry	6	2.66%
	Mfg. Industry	9	3.98%
	Public service or educational circles	78	34.51%
	Housewife or retired persons	90	39.82%

Table 2
Reliability and validity analyses.

Variable	Sub-variable	Factor loadings		Cronbach's α	CR	AVE
Social motivation	Motivation of making new friends	Sm1	0.914	0.878	0.903	0.546
		Sm2	0.931			
	Motivation of keeping in touch with friends and family	Sm3	0.892			
		Sm4	0.885			
		Sm5	0.719			
		Sm6	0.734			
		Sm8	0.805			
Enjoyment motivation	–	Em1	0.948	0.842	0.904	0.762
		Em2	0.926			
Fashion motivation	–	Fm1	0.969	0.958	0.973	0.722
		Fm2	0.962			
		Fm3	0.950			
Epistemic motivation	–	Pm1	0.856	0.91	0.932	0.732
		Pm3	0.934			
		Pm4	0.792			
		Pm5	0.862			
Perceived interactive richness	–	Int1	0.881	0.907	0.927	0.647
		Int2	0.854			
		Int3	0.877			
		Int4	0.872			
		Int5	0.802			
Apps self-efficacy	–	Ase1	0.921	0.943	0.955	0.780
		Ase2	0.919			
		Ase3	0.902			
		Ase4	0.807			
		Ase5	0.925			
		Ase6	0.816			
Inertia	–	Ine1	0.809	0.903	0.922	0.703
		Ine2	0.777			
		Ine3	0.878			
		Ine4	0.899			
		Ine5	0.869			
Tangible switching cost	–	Tco1	0.940	0.892	0.949	0.803
		Tco2	0.950			
Intangible switching cost	–	Ico3	0.890	0.888	0.851	0.591
		Ico4	0.823			
Adoption of ubiquitous mobile social service	–	Ado1	0.847	0.883	0.830	0.622
		Ado2	0.898			
		Ado3	0.906			

4.2. Measurement model analysis

Before the hypotheses analysis starts, the measurement items must be subjected to reliability and validity tests first. According to Kerlinger (1999), the reliability test is able to measure the consistency and stability of a measurement questionnaire. Generally, the measurement items under each variable should have an overall Cronbach's α value greater than 0.6 and a composite reliability (CR) value greater than 0.7 to represent the measurement questionnaire has a required degree of reliability (Hair, Hult, Ringle, & Sarstedt, 2016). As can be seen in Table 2, in this study, all the variables have a Cronbach's α value and a CR value greater than 0.7, indicating the questionnaire scale used in this study meets the criteria of reliability test.

With respect to the validity, this study conducted both convergent validity test and discriminant validity test. In the convergent validity test, factor analysis was conducted to examine whether multiple question items under the same variable will converge into the same one factor. According to Hair et al. (2016), the factor loading of each of the measurement items under the same variable should be greater than 0.5. As can be seen in Table 2, all the measurement items in this study have a factor loading greater than the threshold value. It is worth mentioning

Table 3
AVE values and correlation coefficients.

	Sm	Em	Fm	Pm	Int	Ase	Ine	Tco	Ico	Ado
Sm	0.739									
Em	0.669	**0.873**								
Fm	0.612	0.671	**0.960**							
Pm	0.538	0.614	0.782	**0.856**						
Int	0.639	0.596	0.389	0.475	**0.805**					
Ase	0.642	0.534	0.502	0.493	0.546	**0.883**				
Ine	0.078	0.142	0.114	0.372	0.112	0.213	**0.838**			
Tco	0.184	0.080	0.038	0.136	0.081	0.115	0.301	**0.950**		
Ico	0.122	0.131	0.327	0.427	0.163	0.126	0.151	0.183	**0.769**	
Ado	0.652	0.646	0.523	0.442	0.659	0.650	−0.011	0.046	0.079	**0.836**

Note:
(1) Sm: Social motivation; Em: Enjoyment motivation; Fm: Fashion motivation Pm: Epistemic motivation; Int: Perceived interactive richness; Ase: Apps self-efficacy; Ine: Inertia; Tco: Tangible switching cost; Ico: Intangible switching cost; Ado: Adoption of ubiquitous mobile social service.
(2) The values in bold type shown along the diagonal are respectively square roots of the AVE of specific variables, while all other values are respectively correlation coefficients between two variables.

that through the result of factor analysis, the variable of social motivation is composed of two sub-factors. Therefore, this study named these two sub-factors as “motivation of making new friends” and “motivation of keeping in touch with friends and family”. Such findings are consistent with Yang and Lin (2017), whose social value includes “social relationship creation” and “social relationship maintenance”. In addition, in the convergent validity test, the convergent validity must also be measured using average variance extracted (AVE). According to Fornell and Larcker (1981), the average variance extracted (AVE) value of each variable should be greater than 0.5 to ensure that the measurement items have acceptable convergent validity. As shown in Table 2, all the variables in this study have AVE values satisfying the threshold value, indicating the questionnaire scale used in this study has good convergent validity.

The purpose of discriminant validity test is to measure whether different variables can be discriminated from one another to represent different concepts respectively. According to Fornell and Larcker (1981) and Hair et al. (2016), the square root of the AVE of a variable should be greater than the correlation coefficients between the variable and another variable in the same hypothesis model. As shown in Table 3, the square root of the AVE value of any variable used in this study is greater than the correlation coefficients between the variable and all other variables in the same column or row, indicating the variables used in this study meet the required discriminant validity.

The questionnaire items of the variables in the model were measured on a five-point Likert scale, ranging from “strongly disagree” (1) to “strongly agree” (5). Thus, this study also conducted one-sample *t*-test to examine whether the mean of every variable is significantly different from the middle value 3. As shown in Table 4, the means of tangible switching cost and intangible switching cost are significantly lower than 3; on the other hand, the means of all other variables are significantly higher than 3. It indicates that the respondents have high social, enjoyment, fashion, and epistemic motivations, perceived interactive richness, apps self-efficacy, inertia and adoption intention, and low tangible switching cost and intangible switching cost.

Common method variance (CMV) is one of the measurement errors, and it is a potential problem in behavioral research (Podsakoff & Organ, 1986). Common method variance leads to fictitious relationships between measurements, and may cause incorrect result of the research (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). This study implemented the Harman's single-factor test to examine the common method variance. Podsakoff et al. (2003) claimed that if all items load on a single factor or one factor explains for more than 50% of the variance, common method variance may be a problem. In this study, since the largest variance explained by an individual factor was 33.69% of the total variance, the common method variance was not significant. As another test, Korsgaard and Roberson (1995) claimed that if common method variance is significantly influential for the relationship among the variables, the one-factor confirmatory factor analysis would fit the data well. In this study, a confirmatory factor analysis was also performed, by modelling all items as the indicators of a single factor, and the results showed a poor fitness. Thus, the common method variance should not be a significant problem.

4.3. Structural model analysis

After all the variables in the measurement model were found to satisfy the specific threshold in the reliability and validity tests, the research hypotheses in the structural model were further examined. In view of the results of the factor analysis, social motivation is comprised of two motivations, namely, “motivation of making new friends” and “motivation of keeping in touch with friends and family”. In other words, the model proposed in this study includes both formative constructs and reflective constructs, which could not be analyzed using the traditional structural equation modelling (SEM). Conversely, the partial least squares (PLS) is able to handle both reflective and formative constructs (Chin, 1998). Furthermore, Hair, Black, Babin, and Anderson (2009) suggested that when applying SEM to conduct hypothesis testing, the samples size should be as large as 300. The PLS makes fewer demands regarding sample size than SEM (Hair, Ringle, & Sarstedt, 2011; Urbach & Ahlemann, 2010). For the above reasons, this study applied the method of PLS to test the research hypotheses. The results of hypothesis testing are shown in Fig. 2.

The study results indicate the social motivation has a significant positive influence on the adoption of ubiquitous mobile social service ([H1]: $\beta = 0.153$, $t = 2.134$); wherein, the motivation of keeping in

Table 4
Means of variables.

Variable	Sm	Em	Fm	Pm	Int	Ase	Ine	Tco	Ico	Ado
Mean	3.05*	3.27*	3.28*	3.42*	3.83*	3.45*	3.10*	2.47*	2.79*	3.63*

Note:
(1) * indicates significant at $p < 0.05$. And, the mean is compared to median 3, $N = 226$.
(2) The abbreviations of variables are the same as those shown in the note (1) of Table 3.

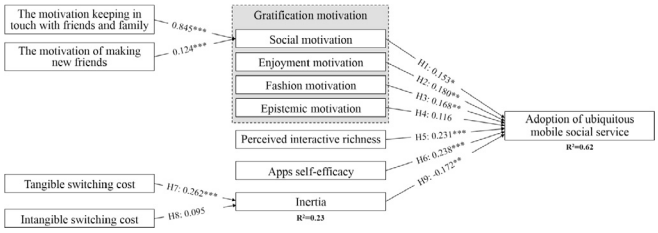

Fig. 2. Results of structural model analysis. **Note:** *p-value < 0.05; **p-value < 0.01; ***p-value < 0.001 (2-tailed).

touch with friends and family (β = 0.845, t = 48.937) has a greater influence than the motivation of making new friends (β = 0.124, t = 12.925). The enjoyment motivation and the fashion motivation also have significant positive influences on the adoption of ubiquitous mobile social service ([H2]: β = 0.180, t = 3.274; [H3]: β = 0.168, t = 2.637). However, the influence of the epistemic motivation on the adoption of ubiquitous mobile social service is insignificant ([H4]: β = 0.116, t = 1.291). Furthermore, the perceived interactive richness and the apps self-efficacy similarly have significant positive influences on the adoption of ubiquitous mobile social service ([H5]: β = 0.231, t = 4.042; [H6]: β = 0.238, t = 4.153). In fact, the apps self-efficacy is the most significant factor among all the seven variables, and followed by the perceived interactive richness.

In addition, the analysis results also indicate the tangible switching cost has a significant positive influence on the inertia ([H7]: β = 0.262, t = 4.841), while the intangible switching cost has no significant influence on the inertia ([H8]: β = 0.095, t = 0.726). Moreover, the inertia has a significant negative influence on the adoption of ubiquitous mobile social service ([H9]: β = −0.172, t = 2.729). Lastly, the structural model of this study with seven independent variables has a good ability to explain the adoption of ubiquitous mobile social service of users. The research model accounts for 62% (R^2 = 0.62) of explained variances.

4.4. Group analysis

Without a priori assumption, this study explored an ad-hoc analysis on respondent's characteristics. The respondents were grouped into male and female groups according to their gender (male vs. female), employment status (employed vs. unemployed), and aged[5] 61–65 (61 and 65 inclusive) vs. aged over 65. Then, the hypothesis testing to analyze and to compare the elderly mobile users based on their gender, employment and age were also conducted.

In order to solve the problem that the number of samples may not be large enough in each group, this study applied the bootstrapping technique to create a large number of subsamples randomly from the original set of data. In this study, the number of bootstrap subsamples was set to 5000. Through the bootstrapping technique, it is able to ensure the stability of the testing results (Hair, Hult, Ringle, & Sarstedt, 2014). The subsamples are further used to estimate the hypothesis model for each group. The hypotheses for each of the six groups are summarized in Table 5.

Some interesting phenomena are found in Table 5. For both male and female elderly mobile users, perceived interactive richness, apps self-efficacy and inertia all have a significant influence on their adoption of ubiquitous mobile service. However, these two groups are just contrary to one another in terms of the motivations that significantly influence their adoption of ubiquitous mobile service. That is, the male elderly mobile users' adoption of ubiquitous mobile service is most significantly influenced only by fashion motivation and epistemic motivation, while the female elderly mobile users are most significantly influenced only by social motivation and enjoyment motivation.

Furthermore, the employed elderly mobile users' adoption motivation of ubiquitous mobile service is significantly positively influenced by fashion motivation and epistemic motivation. On the contrary, the unemployed elderly mobile users' adoption motivation of ubiquitous mobile service is significantly positively influenced by social motivation, enjoyment motivation and fashion motivation. Similar contrast phenomenon occurs in the groups of differently aged elderly mobile users. That is, for the elderly mobile users aged 61–65, their adoption motivation of ubiquitous mobile service is most significantly influenced by fashion motivation and epistemic motivation, while for the elderly mobile users aged over 65, their adoption motivation of ubiquitous mobile service is most significantly influenced by social motivation and enjoyment motivation.

5. Conclusions and future research

Ubiquitous mobile social service has become the most widely used mobile service since various mobile apps were introduced into the market. In the past, most of the constantly increased users of ubiquitous mobile social service are younger users aged between 20 and 50 years old. However, the number of elderly users of ubiquitous mobile social service aged over 50 has also largely increased recently. But the needs and the adoption motivations of the elderly for this service seemed to have been neglected in the development of mobile devices or services, even in the academic research. Therefore, this study conducted a research to explore what motivations and influential factors make the elderly mobile users willing to adopt the ubiquitous mobile social service.

The results from this study indicated that social, enjoyment and fashion motivations have an influence on the elderly mobile users' adoption of mobile social service. In addition, the elderly mobile users' perceived interactive richness of mobile social service and mobile apps self-efficacy also have an influence on their adoption of ubiquitous mobile social service. On the other hand, the tangible switching cost leads the elderly mobile users to maintain their habitual ways of socializing with others at some fixed points via traditional cell phones, landline phones, or social networking websites and messenger, which significantly hinders them from adopting ubiquitous mobile social service. In addition, different sub-groups of samples have different determinants.

5.1. Implications for academia

This study makes the following contributions to academia. First, there was a lot of earlier researches that applied the uses and gratification theory to explore users' motivations to use various social media (Dunne, Lawlor, & Rowley, 2010; Lee & Ma, 2012; Raacke & Bonds-Raacke, 2008; Xu et al., 2012). However, in view that ubiquitous mobile social service is a new communication way having emerged in recent years, this study not only applied the uses and gratification theory, but also combined it with the media richness theory to propose a hypothetical model, especially for the neglected group, i.e. the elderly users. In terms of gratification motivations, this study empirically discovered not only social and enjoyment motivations mentioned in the above literature, but also fashion motivation has an impact on the elderly mobile users. Further, this study also found that perceived interactive richness, which was not mentioned in past research, would induce the elderly mobile users to adopt ubiquitous mobile social service. The proposed model can be used in future researches or by other scholars to study the elderly mobile users' intention to adopt various emerging technological services. Further, Barker (2009) found in his

[5] The sample distribution of the survey showed most of the samples are users aged over 60 (total 193 samples are aged over 60). In Taiwan, according to the Ministry of Labour, the statutory retirement age is 65. In this survey, the number of users 50–60 is only 33, which is too small to be a group. Thus, we only explored the group aged 61–65 and aged over 65 group. Actually, we also found the same results between aged 50–65 and 61–65.

Table 5
Hypothesis testing results for each group.

Groups		Hypotheses	Path Coefficient (t-value)
Gender	Male (N = 73)	• Tangible switching coast → Inertia	0.282 (4.339)***
		• Perceived interactive richness → Adoption of ubiquitous mobile social service	0.259 (5.280)***
		• Apps self-efficacy → Adoption of ubiquitous mobile social service	0.234 (4.859)***
		• Fashion motivation → Adoption of ubiquitous mobile social service	0.218 (3.265)**
		• Epistemic motivation → Adoption of ubiquitous mobile social service	0.176 (2.583)**
		• Inertia → Adoption of ubiquitous mobile social service	−0.155 (2.179)*
		• Social motivation → Adoption of ubiquitous mobile social service	n.s.
		• Enjoyment motivation → Adoption of ubiquitous mobile social service	n.s.
		• Intangible switching coast → Inertia	n.s.
	Female (N = 153)	• Tangible switching coast → Inertia	0.331 (4.342)***
		• Enjoyment motivation → Adoption of ubiquitous mobile social service	0.287 (4.438)***
		• Inertia → Adoption of ubiquitous mobile social service	−0.277 (3.278)**
		• Apps self-efficacy → Adoption of ubiquitous mobile social service	0.264 (3.091)**
		• Perceived interactive richness → Adoption of ubiquitous mobile social service	0.252 (4.218)***
		• Social motivation → Adoption of ubiquitous mobile social service	0.208 (2.495)*
		• Fashion motivation → Adoption of ubiquitous mobile social service	n.s.
		• Epistemic motivation → Adoption of ubiquitous mobile social service	n.s.
		• Intangible switching coast → Inertia	n.s.
State of Employment	Employed (N = 136)	• Apps self-efficacy → Adoption of ubiquitous mobile social service	0.312 (5.081)***
		• Perceived interactive richness → Adoption of ubiquitous mobile social service	0.269 (3.471)***
		• Tangible switching coast → Inertia	0.233 (2.529)*
		• Fashion motivation → Adoption of ubiquitous mobile social service	0.197 (2.788)**
		• Inertia → Adoption of ubiquitous mobile social service	−0.170 (2.108)*
		• Epistemic motivation → Adoption of ubiquitous mobile social service	0.161 (1.985)*
		• Social motivation → Adoption of ubiquitous mobile social service	n.s.
		• Enjoyment motivation → Adoption of ubiquitous mobile social service	n.s.
		• Intangible switching coast → Inertia	n.s.
	Unemployed (N = 90)	• Tangible switching coast → Inertia	0.378 (5.381)***
		• Perceived interactive richness → Adoption of ubiquitous mobile social service	0.376 (5.087)***
		• Inertia → Adoption of ubiquitous mobile social service	−0.328 (3.819)***
		• Enjoyment motivation → Adoption of ubiquitous mobile social service	0.301 (3.545)*
		• Social motivation → Adoption of ubiquitous mobile social service	0.226 (2.496)*
		• Fashion motivation → Adoption of ubiquitous mobile social service	0.158 (1.978)*
		• Epistemic motivation → Adoption of ubiquitous mobile social service	n.s.
		• Apps self-efficacy → Adoption of ubiquitous mobile social service	n.s.
		• Intangible switching coast → Inertia	n.s.
Age	61-65 (N = 117)	• Apps self-efficacy → Adoption of ubiquitous mobile social service	0.317 (4.833)***
		• Perceived interactive richness → Adoption of ubiquitous mobile social service	0.288 (3.251)**
		• Fashion motivation → Adoption of ubiquitous mobile social service	0.222 (2.564)*
		• Inertia → Adoption of ubiquitous mobile social service	−0.210 (2.312)*
		• Tangible switching coast → Inertia	0.210 (2.193)*
		• Epistemic motivation → Adoption of ubiquitous mobile social service	0.201 (2.257)*
		• Social motivation → Adoption of ubiquitous mobile social service	n.s.
		• Enjoyment motivation → Adoption of ubiquitous mobile social service	n.s.
		• Intangible switching coast → Inertia	n.s.
	Over 65 (N = 76)	• Perceived interactive richness → Adoption of ubiquitous mobile social service	0.356 (4.567)***
		• Tangible switching coast → Inertia	0.353 (4.945)***
		• Inertia → Adoption of ubiquitous mobile social service	−0.335 (3.836)***
		• Enjoyment motivation → Adoption of ubiquitous mobile social service	0.294 (3.075)**
		• Social motivation → Adoption of ubiquitous mobile social service	0.278 (2.899)**
		• Apps self-efficacy → Adoption of ubiquitous mobile social service	0.166 (1.992)*
		• Fashion motivation → Adoption of ubiquitous mobile social service	n.s.
		• Epistemic motivation → Adoption of ubiquitous mobile social service	n.s.
		• Intangible switching coast → Inertia	n.s.

Note:
(1) The hypothesis sorting for each group is based on magnitude of path coefficient.
(2) The "n.s." indicates the hypothesis is non-significant at level of 0.05.

research that elderly mobile users of different genders and natures of works would also have different motivations to adopt mobile social media. The results of group analyses conducted in this study also indicated that there are indeed different models for male, female, employed, unemployed, aged 61–65, and aged over 65 elderly mobile users.

Second, just like the personal computers in early 2000, mobile devices have become so popular within a short span of only a few years that almost every person owned one mobile device. Mobile apps are newly emerging technological applications in response to the rapid development of mobile devices and wireless networks. Generally, anyone who owned a smart mobile device should have the experience of trying different mobile apps. In view of this fact, this study used the social cognitive theory as a basis and further referred to the concept of computer self-efficacy proposed by Compeau and Higgins (1995) to propose a new construct, namely, "apps self-efficacy". Many previous studies have found computer self-efficacy has an influence on users' intention to adopt IT products/services. The results from this study also proved that the elderly mobile users' apps self-efficacy indeed has a significantly positive influence on their intention to adopt IT products/services.

5.2. Implications for practices

The research findings of this study also have several practical implications for ubiquitous mobile social service providers, telecom

carriers and government agencies by drawing their attentions to some specific factors that either facilitate or hinder the ubiquitous mobile social service adoption among the elderly mobile users.

First, Coelho and Duarte (2016) pointed out that, recently, more and more elderly persons used mobile social service as a main channel to social and interact with their family members and friends. This study further found that elderly mobile users' intention to adopt ubiquitous mobile social service is influenced by several motivations, namely, social motivation, enjoyment motivation and fashion motivation. Furthermore, when elderly mobile users interact and communicate with others via mobile social service, the interactive richness of this service perceived by elderly mobile users would have an influence on their intention of adopting the service. Doubtlessly, the main function of ubiquitous mobile social service is to enable elderly users to socialize with others at any time and place. However, it is also important for the elderly users to experience the ubiquity, interactivity, instantaneity and amusement that are not possible with the old habitual social ways. On the other hand, the survey samples of this study were mainly elderly mobile users who have not been accustomed to using mobile social service, even not installed those social service apps in their smartphones. These elderly users have the intention to try ubiquitous mobile social service because they want to catch up with the times of using technology and be fashionable enough among their friends and family members. In view of this fact, mobile social service providers, in developing different mobile social apps, can provide more ways for vivid and diversified message expression for the elderly mobile users to use when they communicate and exchange messages with others. For example, mobile social service providers can roll out static or dynamic stickers associated with current events at irregular intervals for the elderly mobile users to download, such as a series of Olympic Games-related stickers or a series of World Cup-related stickers. The elderly mobile users can transmit these most fashionable stickers to their friends or family members while proving they can catch up with the fashion trends. In addition, mobile social service providers may also try to add some different functions to their mobile social apps, such as online voting, column/forum of news, so that the elderly mobile users can have an idea about the currently most fashionable things at any time and place, and interact and discuss with others about these particular themes.

Further, the currently available mobile social apps can be generally divided into social apps for communication with family members or other existing friends, such as LINE, WhatsApp, WeChat, and Facebook Messenger, and mobile social apps for making new friends with strangers, such as Beetalk, SKOUT, and Tinder. Service providers might generally think that only younger users have the desires to make new friends. However, this study confirmed that elderly users also have this type of motivation, especially the retired elderly users. Petrovčič et al. (2015) also indicated the use of mobile social service to maintain and develop social interactions with family members, old friends and new friends has become an important part of many retired elderly users' life. Therefore, it is suggested that ubiquitous mobile social service providers can try to combine these two types of apps into mobile social service apps, allowing the elderly mobile users not only to make new friends with persons having similar hobbies and interests at any time and place, but also introduce the new friends to their old friends and family members at the soonest possible time. Further, mobile social service may be associated with mobile commerce, so that the elderly mobile users can browse while discussing with others about different products or even initiate a group buying. By combining the above suggested functions, the ubiquitous mobile social service can not only enable the elderly mobile users to maintain close affection with family members and friends, make new friends with others, kill time and relax mind, but also make them feel they are avant-garde and can catch up with the fashion trends among people. The wide adoption of the ubiquitous mobile social service by the elderly mobile users can also make such mobile social apps more famous to attract younger users.

Second, elderly users' apps self-efficacy has a strong influence on users' intention to adopt ubiquitous mobile social service. It is conjectured that the elderly mobile users who are skilled with the operation of mobile apps could also quickly get familiar with and start using not only ubiquitous mobile social apps but also other different types of app services even if they have come to face such services all of a sudden. Nägle and Schmidt (2012) also indicated that, for elderly users who have less knowledge and experience in using new technological products/services, a simple operating mode/interface can release them from frustration, which would usually appear when they start trying an unfamiliar product/service, and accordingly, let them have the confidence to continue the usage of the product/service and even to learn other different new technological products/services. In view of this fact, mobile social service providers should make more efforts in layout design when they develop apps, and also provide clear operation guides to help elderly users to use the apps more smoothly. In addition, the mobile social service providers should establish more complete customer service mechanism to address all questions or problems the elderly users might encounter when using the apps.

Third, the results from this study indicated that the expenses required for buying mobile devices and renting 3/4G mobile internet access are perceived as high, and cause the elderly mobile users to keep using their habitual ways to socialize with others, that is, to communicate with others at some fixed points via computer-based social networking sites or Messenger, or even traditional cell phones and landline phones. Thus, indirectly through inertia, the tangible switching cost has a negative influence on elderly users' intention to adopt ubiquitous mobile social service. Currently, the selling prices of most commercially available mobile devices, such as tablet computers and smartphones, and the 3/4G mobile internet rentals offered by mobile dealers in Taiwan are not cheap. Due to these costs for using mobile devices, many elderly mobile users only want to access internet via some free-of-charge Wi-Fi networks and have low intention to adopt ubiquitous mobile service apps. In view of these facts, it is suggested that telecom carriers and mobile device providers can cooperate together to roll out programs that give users a much better price if they buy a mobile device and apply for 3/4G mobile internet access at the same time. An effective promotion program might be similar to the recent program in Taiwan, which many telecom carriers provide users with the chance to experience the 4G mobile internet access free of charge within a specific short term -. For elderly mobile users, through short-term free trial, they can have a general idea about the average daily internet traffic from their mobile devices and rent a most suitable mobile internet access program based on their average internet traffic. In addition, for the purpose of increasing the number of elderly mobile users and stimulating consumption, this study also suggests that government agencies can timely give the elderly mobile users a subsidy for buying mobile devices and applying for 3/4G mobile internet access. According to the concept of network externality, the increase of users of 3/4G mobile internet access is an effective way to cause more people to learn more about and adopt mobile apps and to reflect the value and usefulness of mobile services, particularly the mobile social service. In other words, the elderly mobile users would have stronger intention to adopt the ubiquitous mobile social service when they find people around them all use mobile social service to communicate and exchange information with others.

Fourth, the group analysis based on gender indicated that, compared to female elder users, most male elder users are more interested in and could quickly accept new technological services/products. This is probably because the Taiwanese elder persons are traditional: the male are responsible for working in order to earn money, the female are responsible for keeping family inside affairs (Lu, 2010; Wu, 2006). Thus, the male might be forced to try more technological services, and also had experiences to follow the technological fashion and seek for technological novelty. Such findings are consistent with the literature, as Van Slyke, Comunale, and Belanger (2002) noted that, in general,

men are more likely to try a new IT than are women; Bae and Lee (2011) also mentioned that in comparison with females, males tend to have higher personal innovativeness of information technology. In contrast with elderly male users, most elderly female users prefer to keep close contacts with their family members or friends and to kill time and relax mind through chatting and interacting with others. Besides, according to the results of group analyses based on state of employment and age, it is indicated that 88.89% of the samples of elderly mobile users aged 61–65 used in this study are in employment, and these employed elderly mobile users often have to face and interact with other persons, such as fellow workers and customers, and accordingly, have more chances to learn or use new technology and related information. Therefore, elderly mobile users in employment are more easily attracted by and willing to try and adopt the ubiquitous mobile social service when they face this quite new technological service. On the other hand, 76.67% of the samples of elderly mobile users aged over 65 used in this study are the retired or housekeepers. Compared to the employed elderly mobile users, the unemployed elderly mobile users are free in most time but they have no opportunity to contact with other people in any workplace, and therefore, they expect more diversified interactive functions from the ubiquitous mobile social service, such as stickers and audio/video sharing, which conveniently enable the unemployed elderly mobile users to contact and chat with their family members and friends or even make new friends at any time and place, so as to kill time and relax mind. Based on the above characteristics of different groups, service providers can initiate different sales promotion programs for different advantages of ubiquitous mobile social service. In addition, this study also found the unemployed elderly mobile users are less interested in knowing or learning fashion-related things because of their relatively higher ages in the unemployed group.

5.3. Limitations and future research

Despite the meaningful findings, this study bears several limitations that future researches might need to address further. First, since the samples are from Taiwan and not randomly samples from population, the findings should be applied conservatively. Future research might try other countries before generalizing the conclusions. Second, while this study is aimed at the motivations for the elderly mobile users to adopt ubiquitous mobile social service, the proposed model did not explore some other obstructive factors, such as privacy risk and data security risk, which would impede the elderly mobile users from adopting ubiquitous mobile social service. Ubiquitous mobile social service provides users with diversified functions. However, in order to bring more personalized values to a user, it might be necessary to collect more personal data from the user, such as the user's personal location, contact directory and even personal hobbies/interests. Generally, elderly mobile users have less knowledge about new technological products/services and accordingly feel more concerns about the exposure of their personal private information when they use the ubiquitous mobile social service. Therefore, the elderly mobile users tend to refuse the usage of mobile social service in order to avoid the possible privacy risk. In view of this fact, future researches may be conducted to discuss issues about the influence of privacy risk or data security risk on elderly mobile users' adoption of ubiquitous mobile social service.

Third, while this study had conducted group analyses and found that the groups of male, female, employed, unemployed, aged 61–65 and aged over 65 elderly mobile users are influenced by somewhat different factors in terms of their adoption of the ubiquitous mobile social service, the number of samples in each of the six groups is not large. According to Hair et al. (2016), when applying PLS to examine the research hypotheses, the number of samples should be larger than 150. Even though the bootstrapping technique had been applied to compensate the problem of low number of samples in this study, it might be still possible to have some deviation. In view of this fact, future researches can increase the number of samples in different groups and conduct analyses based on the larger samples, so as to verify the correctness of the group analysis results from this study.

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Appendix A. Measurement items

Gratification motivations

Social motivation	
Sm1	I hope that, whenever I need, I can make friends at any time and place with unknown people who are near my location and have the same interests as me.
Sm2	I hope that, whenever I need, I can find at any time and place unknown people who are near my location and have the same purpose as me, such as group buying, card playing, etc., so we can accomplish a task together.
Sm3	I hope I can receive at any time and place my friends' and family members' recent news and audio/video messages about their moods and daily life stories.
Sm4	I hope I can share my recent news and audio/video messages about my moods and daily life stories with my friends and family members at any time and place.
Sm5	I hope I can check up, send text description, or post collected pictures and audio/video messages at any time and place to share the current scenes with my friends and family members in real time.
Sm6	I hope I can share with my friends and family members at any time and place all kinds of interesting and useful information, such as news and gossips that I obtained from various channels.
Sm8	I hope I can interact and communicate with others at any time and place via text, picture or audio/video messages.
Enjoyment motivation	
Em1	I hope I can interact and communicate with others at any time and place to kill time.
Em2	I hope I can interact and communicate with others at any time and place to relax my mind.
Fashion motivation	
Fm1	I hope I can be fashionable enough among my friends.
Fm2	I hope I can make my friends feel that I am in style.
Fm3	I hope other people will not think I am behind the times in using technology.
Epistemic motivation	
Pm1	I am very curious about new technology.
Pm3	I am very curious about the services and contents that mobile apps can provide to me at any time and place.

Pm4	Mobile social apps, such as LINE, Facebook, etc., can help me to know at any time and place the novel things and situations encountered by my acquaintances or other unknown people.
Pm5	I am very curious about the use of mobile devices to interact and communicate with others at any time and place via text and audio/video messages.

Perceived interactive richness

Although you did not frequently use ubiquitous mobile social service, you might have opportunities to try some mobile social apps, such as LINE, Facebook, etc.. Please recall your experiences to answer the following five questions.

Int1	It seems that those mobile social apps could enable me to interact and communicate with others at any time and place via different types of messages, such as text, sticker and audio/video messages.
Int2	It seems that those mobile social apps could enable me to interact and communicate with others at any time and place with the help of an abundance of static and dynamic stickers.
Int3	It seems that those mobile social apps could enable me to make my conversation with others more interesting by sending my pictures and video clips at any time and place.
Int4	It seems that via the instant feedback function, such as “marked as read”, provided by those mobile social apps, I could communicate with others at any time and place, just as I am talking with them face to face.
Int5	It seems that via the internet video communication function provided by those mobile social apps, I could interact and communicate with others at any time and place, just as I am communicating with them face to face.

Apps self-efficacy

Ase1	Even if no one can teach me how to use various mobile apps, I still have the ability to use them.
Ase2	Even if I have never used various mobile apps before, I still have the ability to use them.
Ase3	Once I saw how people use a mobile app, I would have the ability to use the same app.
Ase4	I would have the ability to use a mobile app when someone can just give me the first guide initially.
Ase5	I would have the ability to use a mobile app after browsing the mobile app tutorials shared by others on the internet.
Ase6	When I have troubles in mobile apps using, I have the ability to seek helps and solve the problems.

Tangible switching costs

Tco1	To me, it is relatively expensive to buy mobile devices for the purpose of using mobile social apps, such as LINE, Facebook, etc.
Tco2	To me, it is relatively expensive to use 3/4G network at a cost for the purpose of using mobile social apps, such LINE, Facebook, etc.

Intangible switching costs

Ico3	To me, it would be very difficult to learn how to use mobile social apps, such as LINE, Facebook, etc., to interact and communicate with others.
Ico4	To me, it would be very difficult to learn how to use mobile social apps, such as LINE, Facebook, etc., to share information with others.

Inertia

Ine1	I am accustomed to using the computer-based social tools, such as Facebook, Skype, etc., on non-mobile devices, such as desktop computers and notebook computers, or just use the traditional cell phones and landline phones to contact and communicate with others.
Ine2	I am accustomed to using the computer-version social tools, such as Facebook, Skype, etc., on non-mobile devices, such as desktop computers and notebook computers, to interact/play online games with other.
Ine3	I am accustomed to using the computer-based social tools, such as Facebook, Skype, etc., on non-mobile devices, such as desktop computers and notebook computers, or just use the traditional cell phones and landline phones to obtain information I need.
Ine4	I am accustomed to using the computer-based social tools, such as Facebook, Skype, etc., on non-mobile devices, such as desktop computers and notebook computers, or just use the traditional cell phones and landline phones to make the acquaintance with or to show my concerns for people I am interested in.
Ine5	I am accustomed to using the computer-based social tools, such as Facebook, Skype, etc., on non-mobile devices, such as desktop computers and notebook computers, or just use the traditional cell phones and landline phones to express my personal moods and views.

Adoption of ubiquitous mobile social service

Ado1	In the future, I will frequently to use mobile apps, such as LINE, Facebook, etc., to interact and communicate with others **at any time and place**.
Ado2	In the future, I will frequently to use mobile apps, such as LINE, Facebook, etc., to follow up people I am interested in **at any time and place**.
Ado3	In the future, I will frequently to use mobile apps, such as LINE, Facebook, etc., to share my recent news with friends and family members **at any time and place**.

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