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How does family support work when older adults obtain information from mobile internet?

Information
from mobile
internet

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Abstract

Purpose – More and more older adults begin to use the mobile internet to obtain information. However, the quality of information obtained through mobile internet by older adults is hard to be guaranteed. The purpose of this paper is to study the role of family support when older adults obtain information from mobile internet.

Design/methodology/approach – This study conducted a survey of 263 older adults who owned mobile internet devices such as smartphones or tablet PCs. The theory hypotheses are tested using partial least squares techniques.

Findings – For older adults, family support is the influencing factor of mobile internet literacy improvement. Family emotional support has stronger impacts on the improvement both of mobile internet skill literacy and of mobile internet information literacy than family cognitive support has. Furthermore, the improvement of both mobile internet skill literacy and of mobile internet information literacy has positive impacts on the quality improvement of obtained information by older adults.

Practical implications – This paper gives advice on how family members can support older adults during their obtaining information from mobile internet to improve their mobile internet literacy and quality of obtained information.

Originality/value – This study examines the factors that influence mobile internet literacy and quality of obtained information among older adults from the perspective of family support in the Chinese mobile internet context. The research results enrich the internet literacy theory and the information quality theory.

Keywords Information literacy, Information seeking behaviour, Empirical study, Digital divide, Mobile system

Paper type Research paper

1. Introduction

The mobile internet is the data transfer network that can be accessed through mobile communication devices such as smartphones or tablet devices by which internet experiences truly become portable across a multiplicity of spaces and places of every life (Herman *et al.*, 2014). The 42th China Statistical Report on internet Development released by the China Internet Network Information Center (CNNIC) showed that the mobile internet users in China increased from 464m in June 2013 to 788m in June 2018. The number of Chinese internet users aged 50 and above reaches 84.174m in June 2018, and the number had increased by 4.8 percent over December 2017 (CNNIC, 2018). Considering 98.3 percent of internet users surfed the internet by smartphones (CNNIC, 2018), we can see that more and more older adults are beginning to use mobile internet in China.

Information obtaining is one of the main motivations to use the mobile internet for the older adults (Hur, 2016). In the twenty-first century, everyone has the need for information access, and older adults also need a lot of information to help them make choices in their life and continuously keep informed of news and events around them (Edewor *et al.*, 2016). For older

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adults, using the mobile internet to access and share information not only meets their information needs and gains the value of information, but also provides them with psychological benefits and proactive pleasure of getting information through emerging media (Gatto and Tak, 2008). However, in the era of information explosion, the amount of network information resources is substantial and unorganized. There are some challenges for older adults when using mobile internet to obtain information. On the one hand, most of older adults are at a low level of understanding of mobile internet technologies and usage methods (van Deursen and van Dijk, 2015), and the lack of necessary operational capacity of mobile devices will reduce their efficiency in mobile internet use. On the other hand, older adults generally experience physical, psychological and cognitive degeneration (Chou *et al.*, 2013), and often cannot judge, analyze, refine and apply the obtained information accurately (Tams *et al.*, 2014). For those challenges, older adults are susceptible to inaccurate or misleading information. For example, some older adults are less able to identify rumors and scams on WeChat (one SNS in China similar to WhatsApp). They may easily become the rumor spreaders indirectly or suffer economic losses. "It is of immeasurable merit to spread this message! A charity conference will be hosted at Beijing Bird's Nest Stadium. Participants' travel and accommodation expenses can be reimbursed. The participants in attendance will receive 50,000 RMB yuan charity." Above was a piece of fake news that was widely circulated on WeChat on April 2017. Many older adults believed it, spread it, paid membership fees to the cheaters, went to Beijing to attend the fictitious meeting despite the warning by police and found to be cheated at last.

Older adults (aged over 50) have been reported as the main disadvantaged group within the digital divide (Chu, 2010), and the quality of information on the mobile internet is difficult to guarantee, so it is imperative to improve the mobile internet literacy of older adults and to improve the quality of information they obtained on mobile internet. Previous studies have argued that availability of information technology, social support and individual characteristics are the main factors that influence internet literacy (van Deursen *et al.*, 2011; Mansour, 2016; Simard and Karsenti, 2016). Among the social support available to older adults in China, education and training are extremely scarce (Jiang, 2016). Because of a shorter history of using the internet and less familiarity with the technology, Chinese users are more likely to seek help and advice from their community than western society (Chen and Zahedi, 2016). Especially, the majority of Chinese older parents are supported by their adult children (Chen and Silverstein, 2000), so they have more chances of receiving family support. Some scholars have pointed out that family support can help older adults to accept and use information technology (Selwyn, 2004; Chu, 2010), but there are still few studies focusing on how family support can improve the ability of information technology use, especially the ability of mobile internet use, which, in turn, can improve the quality of obtained information among older adults.

In this paper, we need to explore the following question:

RQ1. What impacts does family support have on older adults' ability to use the mobile internet and subsequent quality of information obtained from mobile internet?

2. Literature review

According to the social support theory, individuals can enhance their well-being, cope with stressful events, and achieve their goals through managing the psychological and material resources available in their social networks, such as family support (Cohen and Syme, 1985; Lin *et al.*, 2012). In the current research context, the "goal" refers to obtaining high-quality information, and the provision of social support can improve the capacity for older adults to utilize the internet (Freese *et al.*, 2006). The capacity improvement will enhance the internet using effect and encourage more online information seeking to improve decisions (Sheng and Simpson, 2013). Therefore, our theoretical framework is grounded on the proposition

that family support, as one form of social support, can enhance older adults' ability to use mobile internet, and improve the quality of information they obtained through mobile internet. In this section, we will review the literature from the perspectives of information obtaining from mobile internet, internet literacy and family support.

2.1 Information obtaining from mobile internet

Vandenbosch and Huff (1997) pointed that the ways to acquire information can be divided into four categories: undirected viewing such as happening across information purely by chance, conditioned viewing such as scanning broadly to see what strikes our interest when reading magazines and newspapers, informal search such as regular looking through a predefined set of reports and formal search such as explicitly searching for a specific fact. The concept of information obtaining in this study is consistent with the meaning above, which not only includes informal search and formal search, but also includes undirected viewing and conditioned viewing.

Mobile internet is a new way for older adults to obtain information. There are many differences between obtaining information from mobile internet and obtaining information from PC-based internet in terms of terminals, search methods and information types. First, the terminals to access mobile internet and PC-based internet are different. The terminal to access PC-based internet is personal computer, while the main terminal to access mobile internet is smartphone (Puspitasari and Ishii, 2016). Users mainly interact with PCs through indirect-manipulation devices such as a physical keyboard and a mouse, while users mainly interact with smartphones or tablet PCs through direct-manipulation devices such as touch screen, handwriting, voice control and voice input (Rau and Hsu, 2005). That is to say, the skill literacy required to use the PC-based internet is different from the skill literacy required to use mobile internet. For older adults whose eyesight is poor and whose fingers are not flexible enough, browsing and searching performance will be better with direct-manipulation devices than with indirect-manipulation devices (Rau and Hsu, 2005).

Second, different information obtaining channels are used on mobile internet and PC-based internet. According to the report of CNNIC, the usage rate of WeChat search was 63.9 percent and the usage rate of Sina microblog search was 43.6 percent among mobile internet users (CNNIC, 2017). Therefore, obtaining information through social media tools has become very popular, which is very different from obtaining information from PC-based internet using a comprehensive search tool such as Yahoo! News and Google. In the era of mobile internet, the increasing use of social media has led to a substantial increase of content generated by users. The information generated by individual users varies a great deal in quality, which poses a greater challenge to user's information literacy.

Third, mobile internet enables people obtain information whenever and wherever needed (Deng *et al.*, 2015), and changes the types of information people seek. Apart from keeping up to date with news and current affairs, mobile internet is used to access new types of information, from finding information about current social events to finding information about how to get to one place (Kushlev and Proulx, 2016). Context-aware mobile applications are able to filter information based on the user's preferences, purpose of use, current time and current location (Tan and Goh, 2015). Obtaining information from mobile internet has been integrated into all aspects of people's lives. In such circumstances, the accuracy and reliability of obtained information is becoming more and more important. Therefore, how to guarantee the information quality is an important issue in the field of obtaining information from mobile internet.

Information quality reflects information relevance, sufficiency, accuracy and timeliness (Zhou, 2013). Information quality is important to general people because it is positively related to consumer's trust and has been found to be an important predictor of consumer satisfaction (Dan *et al.*, 2008; Ghasemaghahi and Hassanein, 2015). Information quality is also very important for older adults whose information needs are highly correlated with their own lives,

including health conditions, pension/finance, government policies, current affairs and transport (Edewor *et al.*, 2016). Obtaining high-quality information and using it to participate in one's own life is an important component of improving older adults' well-being (Xie and Bugg, 2009), while believing in low-quality information may lead to inappropriate behavior or delays in seeking necessary information (Wathen and Burkell, 2014).

Information on the internet varies a great deal in quality, ranging from highly accurate and reliable, to inaccurate and unreliable, even to intentionally misleading, and it is often difficult to tell how frequently the information in websites is updated and whether the facts have been checked or not (Dan *et al.*, 2008). In order to improve the quality of information obtained from mobile internet, people, especially older adults, should master good mobile internet skills, which are different from traditional PC-based internet skills. Besides, as the information obtained through mobile internet varies a great deal in quality, people, especially older adults, should also improve their capacity to handle mobile internet information.

2.2 Internet literacy and mobile internet literacy

"Internet literacy," also known as "network literacy," was defined as "the ability to identify, access and use electronic information from the network" (McClure, 1994). Based on the latest internet practices, Kim and Yang (2016) gave a more complete definition: they pointed out that internet literacy is the ability to access, understand, analyze and evaluate internet information.

van Deursen *et al.* (2011) pointed out that medium-related internet skills and content-related internet skills are the two dimensions of internet skill. Medium-related internet skills include operational internet skills (e.g. opening websites by entering the URL, bookmarking websites or entering keywords in the proper field) and formal internet skills (e.g. maintaining a sense of location while navigating on the internet). Content-related internet skills include information internet skills (e.g. choosing a website, defining search options, selecting information or valuating information sources) and strategic internet skills (e.g. taking advantage of internet to fulfill aims). Based on van Deursen *et al.* (2011), Kim and Yang (2016) proposed two dimensions of internet literacy, namely, internet skill literacy and internet information literacy. Internet skill literacy is the set of basic skills required to use internet technology, including the ability to navigate hypermedia environments. Internet information literacy refers to one's ability to sift through information to achieve certain needs, which often involves searching, collecting, understanding and evaluating content (Kim and Yang, 2016).

With the popularization of mobile devices such as smartphones and tablet PCs, more and more people use the mobile internet to obtain information. The mobile internet is different from the PC-based internet in terms of terminals, search methods and information types. And the requirements for user capabilities are also different. For example, people need the ability to find, download, install and uninstall various mobile internet applications, the ability to use new human-computer interaction technologies such as touch screen, handwriting, voice control and voice input, and the ability to distinguish good information from bad information in social networks when using mobile internet. In the context of the mobile internet, the definition, dimension and measurement of internet literacy have undergone some changes. According to the latest mobile internet practices and the concept and dimensions of internet literacy by Kim and Yang (2016), this paper puts forward the concept of mobile internet literacy, and defines it as the ability to access, understand, analyze and evaluate mobile internet information. Mobile internet literacy also includes two dimensions, namely, mobile internet skill literacy and mobile internet information literacy. The former is the ability to access mobile internet information, and it is the set of basic skills required to use mobile internet technology.

The latter is the ability to understand, analyze and evaluate mobile internet information, and it refers to one's ability to sift through information to achieve certain needs.

Previous studies have argued that availability of information technology, individual characteristics and social support are three main kinds of factors that influence internet literacy. Specifically, some scholars studied the influencing factors of internet literacy in terms of information technology availability such as access to necessary technologies (e.g. Simard and Karsenti, 2016), physical facilities, internet connectivity and e-databases subscription (e.g. Mansour, 2016). Some scholars investigated this issue from the perspective of individual characteristics, such as internet experience and individual education (e.g. van Deursen *et al.*, 2011). Some scholars investigated this issue in terms of social support such as training (e.g. Mansour, 2016). But there are few studies on the influencing factors of mobile internet literacy.

2.3 Family support

As mentioned above, social support is one of the main factors that influence internet literacy. Social support refers to the support given to individuals by other interacting individuals (Thoits, 1982). Family support, the support given to individuals by their family members, is an important social support source for older adults. From the perspective of "needs" theories of stress, Jacobson (1986) categorized social support, especially support from family members, into emotional, cognitive and material support. Emotional support refers to the behavior that fosters feelings of comfort and leads an individual to believe that he or she is admired, respected and loved, and that others are available to provide caring and security. Cognitive support refers to the behavior that provides information, knowledge and advice to help the individual understand and adapt his or her world. Material support refers to the behavior that provides goods and services to help solve practical problems. Wills (1991) discussed the question of what aspects of social relationships contribute to well-being and categorized social support into four types: emotional support, informational support, instrumental support and companionship support. He pointed out that emotional support can "provide a source of acceptance, intimacy, and confiding about emotions"; informational support may "provide useful information, advice, or cognitive guidance"; instrumental support may "help with instrumental problems by providing financial assistance, good, or services"; and companionship support may "provide social companionship."

In the definitions above, it seems that there are little differences between the two groups of concepts, i.e. instrumental support and material support, and informational support and cognitive support. "Cognition" is one term often mentioned with "emotion" together in the classical psychological theory (Gerrig, 2013); in fact, cognitive support is more intuitive and easier to understand by more people than informational support. Considering understandability, we use the classification of Jacobson (1986) to study family support issue.

In the context of supporting older adults to obtain information from mobile internet, family material support includes mobile device such as smartphone or tablet PC provided by family members; family cognitive support includes the information, knowledge and advice provided by family members that help individual to use the mobile internet to obtain information more effectively; and family emotional support includes the behavior of family members that fosters feelings of comfort. Puspitasari and Ishii (2016) identified four levels of hierarchical digital divides: device ownership, mobile internet adoption, use of mobile internet and information acquisition. They pointed out that achieving the lower levels such as device ownership will act as a prerequisite for reaching the higher levels such as information acquisition. Since this study focused on information obtaining by older adults, we only target the older adults who have already owned mobile internet devices, which indicates material support is not the focus of this study. Therefore, only emotional support and cognitive support are taken into consideration in our study.

The existing studies show that when older adults encounter problems in using information technology, they will first seek help from their family members. Specifically, Selwyn (2004) pointed out that the tools for older people who are learning information communication technology (ICT) are usually provided by their younger family members, and older adults are more likely to use ICTs when family support exists. Chu (2010) argued that family support can improve the effects of e-learning by raising internet self-efficacy of older adults.

3. Hypotheses development

3.1 *The impact of family support on mobile internet literacy improvement*

The older adults normally have a low level of knowledge about how to use mobile internet technology. Their operational internet skills to handle menus, hyperlinks and internet lags are worse than that of young people (van Deursen and van Dijk, 2015). Moreover, the older adults' physiological limitations, such as tremors and decrements of memory, also impacted upon their usage of new technologies (Hill *et al.*, 2008). The rapid development of information technology has made internet devices such as smartphones and tablet PCs more intelligent and complicated. It is even more difficult for older adults who are not skilled in operation of terminals (Klimova *et al.*, 2016). After retirement, family members will substitute older adults' missing social interaction with colleagues in some extent (Dingemans *et al.*, 2017). Therefore, to overcome above obstacles, older adults are mostly willing to seek help from their families (Edewor *et al.*, 2016). Instruction about how to use mobile internet is one kind of important cognitive support to older adults. Family cognitive support for mobile internet use is mainly about transferring the knowledge of mobile internet skills to older adults by family members with richer mobile internet experience, including verbal and hands-on instructions. The knowledge transfer will increase older adults' knowledge about and application ability of mobile internet, help them overcome the technical obstacles and help them acquire more skills of using the mobile internet. For example, Ms Cao, one of our respondents, said, "From the very beginning, I did not know how to reply message on WeChat using smartphone, it was my daughter who taught me how to press this button to record and send voice message, and how to press that button to input text on WeChat." Based on the analysis above, we hypothesize that:

H1. Family cognitive support has a positive impact on mobile internet skill literacy improvement among older adults.

One of the drawbacks of obtaining information from mobile internet is the difficulty to ensure the reliability of the information source and the accuracy of the information (Dan *et al.*, 2008). Recent research has shown that fluid intelligence strongly declines as people age. Specifically, older adults suffer from large impairments in such fluid abilities as attention, working memory capacity, spatial abilities, reasoning and perceptual speed (Tams *et al.*, 2014). When obtaining information from mobile internet, they often cannot judge, analyze, refine and apply the obtained information correctly. Cognitive support provided by family members about how to judge, analyze, refine and apply internet information can help older adults to overcome obstacles and improve their cognitive level (Zhu *et al.*, 2012), which, in turn, is beneficial to their mobile internet information literacy improvement. For example, Ms Zhou said, "My son often tells me how to get correct information, and he teaches me how to separate the useful information links from a lot of advertise links, then I grasp the way to pick out useful information." In this case, family cognitive support enhanced the information analysis skill of the older adults. Based on the analysis above, we hypothesize that:

H2. Family cognitive support has a positive impact on mobile internet information literacy improvement among the older adults.

The lack of the necessary operational skills when using new technologies is an obstacle for older adults, which will make them feel difficult to cope with the changes generating from new technologies (Klimova *et al.*, 2016). Compared with younger people, older adults have lower self-efficacy and lower control over information technology (Heart and Kalderon, 2013). Negative emotions such as anxiety, fear and annoyance are more likely to occur during their using the mobile internet. The emotional support provided by family members, such as encouragement and comfort, can help alleviate the negative emotions of older adults (Montpetit *et al.*, 2016). This will enhance the confidence, intention and interest of older adults in learning to use the mobile internet and encourage them to try their best to improve their skills and methods of using the mobile internet for information, and, at last, improve their mobile internet skill literacy. The study by Deptula *et al.* (1993) showed that there is a positive relationship between emotional state and memory in the elderly. According to Isen (2000), when people are in positive emotions, they can more easily obtain knowledge and information from the memory bank and establish the connection between the knowledge and information in the memory bank to improve their cognitive ability and learning efficiency. Therefore, family emotional support is beneficial to the learning outcomes of internet skills among older adults and has a positive impact on the improvement of their mobile internet skill literacy. For example, in one of our respondents, Ms Yang, told us that her husband was very patient in helping her to use the smartphone to search information on internet, and always gave her encouragement and comfort, which enhanced her intention to improve her skills to use mobile internet. She said, "My ability to find information using a smartphone is getting better every year under the help of my husband. My husband was able to surf the Internet with his smartphone skillfully. He always taught me very patiently and told me it was absolutely not a difficult thing for me to learn to use smartphones, so that I am very willing to learn." Based on the analysis above, we hypothesize that:

H3. Family emotional support has a positive impact on mobile internet skill literacy improvement among older adults.

If the family can provide enough emotional support, not only will the older adults not be bored and frustrated in obtaining information from mobile internet, they will also enjoy the positive and proactive pleasure of getting information through new media (Gatto and Tak, 2008), and then more willing to actively search for information. People who are proactive in searching for information will get richer information from more diverse information sources. Access to richer and more diverse information will enable searchers to place greater emphasis on information quality, and to judge the information critically (Altizer *et al.*, 2014). In addition, positive emotion generated by family emotional support will improve older adults' learning efficiency (Deptula *et al.*, 1993; Isen, 2000), thereby enhancing their ability to identify, evaluate and use effectively the information obtained.

On the contrary, the lack of necessary emotional support will discourage older adults to obtain information from mobile internet, which is disadvantageous to improving their mobile internet information literacy. For example, during our interviews, Ms Li told us that her son was impatient in directing her to discern online information. She said, "My son always criticizes me for my forwarding fake news. But I do not know which ones are true. Occasionally he taught me but impatiently. I was too old and I always forget what I have learned. Now I do not want to forward any information." In this case, the impatience and negative comments from his son sapped the confidence of Ms Li, and made her lose the motivation to improve her ability to identify information. As a result, her mobile internet information literacy came to a standstill. Based on the analysis above, we hypothesize that:

H4. Family emotional support has a positive impact on mobile internet information literacy improvement among older adults.

3.2 *Impact of mobile internet literacy improvement on quality improvement of obtained information*

Some new skills are required to navigate the internet, so the operational aspect of internet technology is very important (Kim and Yang, 2016). The older adults with a high level of mobile internet skill literacy are more skillful to use mobile internet, resulting in high quality of their obtained information. For the older adults with low level of mobile internet skill literacy, the lack of online skills can lead to a view of the internet as an overwhelming, untrustworthy, risky place, with too much information and where navigation is too difficult (Hargittai and Dobransky, 2017), then they will give up efforts, as often results in obtaining poor information or incorrect information. Therefore, higher mobile internet skill literacy will lead to higher quality of obtained information. And, it also means that the mobile internet skill literacy improvement of older adults is positively related to quality improvement of obtained information. Based on the analysis above, we hypothesize that:

H5. Mobile internet skill literacy improvement has a positive impact on quality improvement of obtained information among older adults.

Older adults sometimes access the internet for the purposes of obtaining information, building social relations, learning, shopping, and promoting business activities (Hur, 2016). Obviously, using the mobile internet to obtain useful information requires more knowledge than other activities such as communication and entertainment. Individuals who have better knowledge of the internet will be more likely to use the internet for appropriate information such as healthy information (Sheng and Simpson, 2013), so the older adults who have a higher level of mobile internet information literacy will try to get more information from mobile internet and sift through information to achieve certain needs. For the older adults with lower level of mobile internet information literacy, the lack of information literacy in mobile internet will affect their judgment and identification of online information. As a result, large amounts of information on the internet will make them confused (Michailidou *et al.*, 2015), making it difficult to guarantee the quality of obtained information. Therefore, higher mobile internet information literacy will lead to higher quality of obtained information. And, it also means that the mobile internet information literacy improvement of older adults is positively related to quality improvement of obtained information. Based on the analysis above, we hypothesize that:

H6. Mobile internet information literacy improvement has a positive impact on quality improvement of obtained information among older adults.

In the information systems literature, gender, education and years of using internet have found to be potential factors that predict the effect of using information technology (Hur, 2016; Bessho *et al.*, 2007). The present study thus includes gender, education and years of using mobile internet as control variables in our research model.

4. Methodology

Survey methodology was employed to test the hypotheses. Interviews with some respondents after finishing the questionnaires were conducted as a supplement to enrich our understanding of the underlying reasons.

4.1 *Instrument*

Based on the well-established studies, this study develops the survey instruments measuring the five major constructs: family cognitive support, family emotional support, mobile internet skill literacy improvement, mobile internet information literacy improvement, quality improvement of obtained information. Items of family cognitive support and family emotional support are adapted from Chu (2010). Items of quality improvement of obtained information

are designed based on the measurement scale of information quality proposed by Dan *et al.* (2008). The items of mobile internet skill literacy improvement and mobile internet information literacy improvement are designed based on the measurement scale of internet literacy proposed by Kim and Yang (2016). In the new scale items, the expression of PC is replaced by that of smartphone or tablet PC, and more mobile internet attributes are absorbed in. For example, when measuring user's information input ability, we specifically pointed out that the ways of inputting information include touch input, voice input, handwriting input, etc., which is different from the PC-based internet.

Table I presents the operational definitions of these constructs. And the final scales are listed in Table AI. The questionnaire is measured with a five-point Likert scale. As the cognitive level of older adults is generally low, the options are modified with specific meaning to make it easier to understand by respondents, instead of merely asking the respondents to indicate the extent to which they agreed with the items on a Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). For example, as to item FCS1, we provide five options, namely, "No guidance," "Little guidance," "Moderate guidance," "A lot of guidance" and "Adequate guidance."

Initially, we formed a questionnaire for the pilot survey, and distributed a total of 56 questionnaires. Based on the data analysis results and the communication with the respondents, the questionnaire was modified to align with the actual context of smartphone usage, and the ambiguous, inappropriate expression was replaced with words more easily understood by older adults. Then the formal questionnaire was created.

4.2 Data collection and sampling

Opinions from older mobile internet users were collected to test the proposed model. Aligned with Guo (2017), the minimum age for participants of the survey was set at 50 years old. First, unlike young people who grow up with information era, individuals aged 50 or older are often termed digital immigrants. Second, in China, seniors, especially females, can retire as early as age 50 in many industries and institutions. Based on the two reasons above, we chose 50 years as the minimum age for potential participants in this study. Therefore, we targeted responders as older adults aged 50 and above who owned mobile internet devices such as smartphones or tablet PCs. Since our research problem is the impact of family support on the quality of information obtained by the older adults using the mobile internet, rather than the problem of information technology adoption, the older adults who did not own smartphones or tablet PCs are not our research subjects.

Construct	Operational definition	Source
Family cognitive support	The information, knowledge and advice provided by family members that help individual to use the mobile internet to obtain information more effectively	Adapted from Chu (2010)
Family emotional support	Behavior of family members that fosters feelings of comfort	Adapted from Chu (2010)
Mobile internet skill literacy improvement	The improvement of basic skills required to use mobile internet technology	Developed in this study based on Kim and Yang (2016)
Mobile internet information literacy improvement	The improvement of one's ability to sift through mobile internet information to achieve certain needs	Developed in this study based on Kim and Yang (2016)
Quality improvement of obtained information	The improvement of obtained information quality such as information relevance, sufficiency, accuracy and timeliness	Adapted from Dan <i>et al.</i> (2008)

Table I.
Operational definitions
of constructs

A total of 299 questionnaires were received, including 233 online questionnaires and 66 offline questionnaires. In total, 263 questionnaires are valid after dropping those by unqualified respondents whose age is under 50, and those filled within 120 s, yielding a valid rate of 88 percent. Regarding gender, 159 respondents (60.5 percent) are females. As to the education background, 104 respondents (39.5 percent) graduated from senior high school, and 68 respondents (25.9 percent) got college degree. Details of the respondents' demographics are shown in Table II.

5. Data analysis and results

5.1 Common method bias and sample bias assessment

The data were collected via the survey method. To examine the possible severity of common method bias, we adopted the method of Harman's one-factor test (Podsakoff and Organ, 1986). The factor solution results in three factors with eigenvalues greater than 1.0, accounting for 64.39 percent of variance. The first factor explains 44.8 percent of variance. This factor does not account for the majority of the variance, indicating that common method variance is not a serious problem in this study.

Since sample data from online survey and offline survey may have difference, we tested the sample bias between the online survey and the offline survey. The results of *t*-tests show that except for the gender variable, the significance level of all other research variables are between 0.053 and 0.931, revealing no systematic differences. As one of control variables, gender does not significantly affect quality improvement of obtained information by older adults. Therefore, there is no large sample bias in the data.

5.2 Measurement model

Since the sample for this study was not large, the partial least squares (PLS) was chosen and used for hypothesis testing of the structural equation model (Hair *et al.*, 2011). To assess the overall model, this study mainly used SmartPLS version 3.0 to examine the measurement model to measure reliability, convergent validity and discriminant validity. As shown in Table III, Cronbach's α values range from 0.71 to 0.90 for the five constructs. The values all exceed 0.7, indicating high internal consistency of the measure reliability

Measure	Item	Frequency	Percentage
Age	50–54	107	40.7
	55–59	77	29.3
	60–64	54	20.5
	65–69	17	6.5
	≥70	8	3.0
Gender	Male	104	39.5
	Female	159	60.5
Education	Elementary school or lower	6	2.3
	Junior high school	54	20.5
	Senior high School	104	39.5
	College degree	68	25.9
	Bachelor degree or higher	31	11.8
Occupation	Worker	97	36.9
	Management	50	19.0
	Specialist	28	10.6
	Clerk	26	9.9
	Teacher	20	7.6
	Farmer	14	5.3
	Other	28	10.7

Table II.
Sample demographics

(Nunnally, 1978). As the construct of family emotional support only has two items, we calculated the Spearman–Brown coefficient, which is the most appropriate statistic for two-item measures (Eisinga *et al.*, 2013; Yin *et al.*, 2018). The result shows that the Spearman–Brown coefficient for the construct of family emotional support is 0.716 ($p < 0.01$), which is commonly considered acceptable. We tested the convergent validity according to Fornell and Larcker (1981). The results show that the factor loading for all items exceed 0.7 and are significant ($p < 0.001$), the composite reliability is between 0.87 and 0.93, all exceeding the minimum acceptable value of 0.7, and the average variance extracted (AVE) values are between 0.67 and 0.78, all exceeding 0.5. Therefore, the conditions for convergent validity are met.

We used three methods to test the discriminant validity. First, to ensure the discriminant validity, the square roots of AVEs should be greater than the correlation between each pair of constructs (Fornell and Larcker, 1981). As Table IV shows, the square root of AVE (diagonal elements) for each construct is larger than its correlation with the other constructs (off diagonal elements), which meets the Fornell-Larcker criterion. Second, to demonstrate discriminant validity, the HTMT ratio of correlations should be lower than 0.9 (Henseler *et al.*, 2015). Using HTMT criterion indicates that discriminant validity is not an issue in our research (the HTMT ratios are between 0.288 and 0.850, which are all below the cut-off value of 0.9). Third, to ensure the discriminant validity, the loadings should be greater than cross-loadings (Chin, 1998; Tam and Oliveira, 2017). We listed cross-loading matrix in

Construct	Item	Factor loading ^a	Composite reliability	AVE	Cronbach's α
Family cognitive support (FCS)	FCS1	0.877	0.898	0.746	0.831
	FCS2	0.888			
	FCS3	0.826			
Family emotional support (FES)	FES1	0.844	0.873	0.775	0.716
	FES2	0.916			
Mobile internet skill literacy improvement (MISLI)	MISLI1	0.824	0.892	0.675	0.839
	MISLI2	0.845			
	MISLI3	0.884			
	MISLI4	0.725			
Mobile internet information literacy improvement (MIILI)	MIILI1	0.849	0.909	0.769	0.850
	MIILI2	0.901			
	MIILI3	0.879			
Quality improvement of obtained information (QIOI)	QIOI1	0.784	0.926	0.714	0.899
	QIOI2	0.872			
	QIOI3	0.895			
	QIOI4	0.846			
	QIOI5	0.822			

Notes: $n = 263$. ^aAll item loadings were significant at $p < 0.01$

Table III.
Scale properties of
measurement model

	Means	SDs	FCS	FES	MISLI	MIILI	QIOI
Family cognitive support (FCS)	3.094	0.848	<i>0.864</i>				
Family emotional support (FES)	3.534	1.010	0.427	<i>0.881</i>			
Mobile internet skill literacy improvement (MISLI)	2.817	0.996	0.312	0.431	<i>0.822</i>		
Mobile internet information literacy improvement (MIILI)	2.978	0.928	0.243	0.441	0.654	<i>0.877</i>	
Quality improvement of obtained information (QIOI)	3.011	0.839	0.257	0.372	0.699	0.744	<i>0.845</i>

Note: Values given in italic in the diagonal are square roots of the average variance extracted (AVE)

Table IV.
Means, standard
deviations, correlations
and the square roots
of the average
variance extracted

Table AII, and as Table AII shows, no indicator has loadings (in bold) with lower values than their cross-loadings. Therefore, discriminant validity has been established. In addition to validity assessment, we also checked for multicollinearity. The variance inflation factor values for all constructs are between 1.025 and 1.818, which are smaller than 5, the suggested indicative of multicollinearity (Hair *et al.*, 2011).

5.3 Structural model

The research model was assessed using PLS. The bootstrap resampling method was applied to determine the significance of the structural model paths. The path coefficient and significance of each hypothesis were examined. The explained variance (R^2) of each dependent construct was calculated. The results are shown in Figure 1.

The model explains 20.6 percent variance for mobile internet skill literacy improvement, 19.8 percent variance for mobile internet information literacy improvement and 63.5 percent variance for quality improvement of obtained information. *H1* and *H2* examine the effects of family cognitive support on mobile internet skill literacy improvement and mobile internet information literacy improvement. Family cognitive support is significantly related to mobile internet skill literacy improvement ($\beta = 0.156, p < 0.05$), but not significantly related to mobile internet information literacy improvement ($\beta = 0.067, p > 0.05$). *H3* and *H4* examine the effects of family emotional support on mobile internet skill literacy improvement and mobile internet information literacy improvement. Family emotional support is significantly related to mobile internet skill literacy improvement ($\beta = 0.364, p < 0.001$), and also significantly related to mobile internet information literacy improvement ($\beta = 0.412, p < 0.001$). *H5* and *H6* examine the effects of mobile internet skill literacy improvement and mobile internet information literacy improvement on quality improvement of obtained information. Mobile internet skill literacy improvement is significantly related to quality improvement of obtained information ($\beta = 0.372, p < 0.001$), and mobile internet information literacy improvement is also significantly related to quality improvement of obtained information ($\beta = 0.507, p < 0.001$). Therefore, all hypotheses except *H2* are supported. As control variables, gender, education and years of using mobile internet do not significantly affect quality improvement of obtained information by older adults.

5.4 Further analysis

5.4.1 Comparison analysis of family support's impacts. During the interview process with some respondents, we all have strong feeling that family emotional support is more important than cognitive support. The results above also show that the difference between

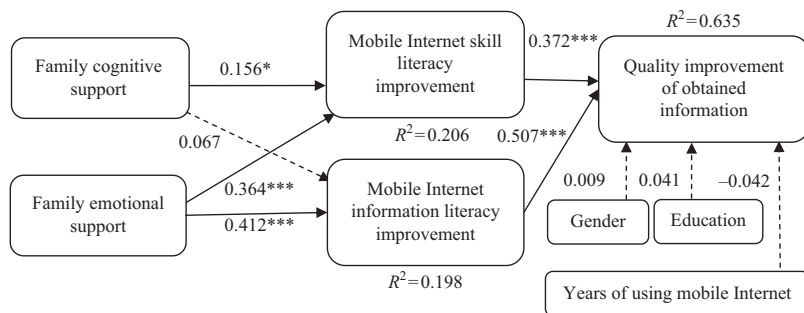


Figure 1.
Results of
structure model

Notes: * p -value < 0.05; *** p -value < 0.001

path coefficients of *H1* and *H3* and the difference between path coefficients of *H2* and *H4* are both very great. In order to confirm that family emotional support has stronger impacts on mobile internet skill literacy and mobile internet information literacy among older adults, we did a further analysis to compare the path coefficients of the two types of family support. To achieve this, we followed the method proposed by Chin (2003) (see Appendix 3 for the relevant formula). The results of the comparison are presented in Table V.

According to this equalization, $t_1 = 34.797$ and $t_2 = 63.678$ all exceeded 1.96, which indicates that family emotional support has stronger impacts on both mobile internet skill literacy and mobile internet information literacy than family cognitive support.

5.4.2 Mediation analysis of mobile internet literacy. Although the study did not propose mediating effect hypothesis, the two variables of mobile internet skill literacy improvement and mobile internet information literacy improvement may have mediating effects. To explore the mediation role of these two variables, we adopted the bootstrapping technique (Zhao *et al.*, 2010; Wu *et al.*, 2018). In our study, the 95 percent confidence interval of the indirect effects was obtained with 5,000 bootstrap resamples. We summarized the mediation analysis results in Table VI. Based on the significance of indirect effect, mobile internet skill literacy improvement significantly mediates the relationship between family cognitive support and quality improvement of obtained information and the relationship between family emotional support and quality improvement of obtained information, while mobile internet information literacy improvement only significantly mediates the relationship between family emotional support and quality improvement of obtained information. Meanwhile, based on the significance of direct effect, the effect of family cognitive support on quality improvement of obtained information is fully mediated by mobile internet skill literacy improvement, while the effect of family emotional support on quality improvement of obtained information is fully mediated by mobile internet skill literacy improvement and mobile internet information literacy improvement.

	Path compared	PC (β)	SE	<i>t</i> -value of difference
Comparison 1	Family emotional support→mobile internet skill literacy	0.364	0.066	34.797
	Family cognitive support→mobile internet skill literacy	0.156	0.071	
Comparison 2	Family emotional support→mobile internet information literacy	0.412	0.058	63.678
	Family cognitive support→mobile internet information literacy	0.067	0.066	

Table V.
Results of path
comparison tests

Independent variable	Mediating variable	Dependent variable	Indirect effect			Direct effect			Mediation proportion
			2.5% CI	97.5% CI	Effect value	2.5% CI	97.5% CI	Effect value	
FCS ^a	MISLI ^b	QIOI ^c	0.009	0.123	0.058	-0.085	0.117	0.021	Full mediation
FCS	MILI ^d	QIOI	-0.030	0.104	0.034	-0.085	0.117	0.021	No mediation
FES ^e	MISLI	QIOI	0.079	0.197	0.136	-0.126	0.087	-0.023	Full mediation
FES	MILI	QIOI	0.134	0.295	0.211	-0.126	0.087	-0.023	Full mediation

Notes: ^aFCS, family cognitive support; ^bMISLI, mobile internet skill literacy improvement; ^cQIOI, quality improvement of obtained information; ^dMILI, mobile internet information literacy improvement; ^eFES, family emotional support

Table VI.
Mediation
analysis using
bootstrapping method

6. Discussion

6.1 Discussion of findings

The research results show that the theoretical model we have proposed has been verified. So it is of great significance to provide family support to the older adults when they are using the mobile internet to obtain information.

The positive impact of family cognitive support on mobile internet skill literacy improvement is significant, but the impact of family cognitive support on mobile internet information literacy improvement is not significant. One plausible reason why the latter impact is not significant is that their young family members do not know exactly what information the older adults need because the two generations' knowledge backgrounds, life experiences and information needs are different greatly. While mobile internet information literacy is the ability to sift through mobile internet information to achieve certain needs, when the two generations have different concerns, use different apps and search different information most of time, the instructions from young members would have limited effect. As one of our respondents Mr Li said, "My daughter taught me how to identify the information I need from different online sources. For example, she told me that the information on Baidu baike (one Network encyclopedia in China similar to Wikipedia) is more reliable than the information on some unknown websites. Her guidance helps me a bit, but there are still lots of information that I am concerned about, such as how much will the pension rise next year, cannot be found on Baidu baike." In this case, we found that young people could not offer the most useful tactics to older adults because they cannot think from the perspective of older adults. This is consistent with the finding of Lin *et al.* (2012) that a lack of empathetic understanding is one of the obstacles to ICT learning from family. The second plausible reason is that there is a great knowledge gap between young family members and older adults in the field of mobile internet, which makes older adults difficult to understand and practice the tactics they received from young family members. According to Ko *et al.* (2005), the lack of common knowledge makes knowledge transfer more inefficient. Especially the capabilities related to mobile internet information literacy are more complicated than those related to mobile internet skill literacy, so even when young family members try to help older adults to improve their mobile internet information literacy, the effect is not great for many older adults.

The positive impact of family emotional support, another dimension of family support, on mobile internet skill literacy improvement and mobile internet information literacy improvement among older adults is significant. The analysis results also show that family emotional support has stronger impacts on both mobile internet skill literacy improvement and mobile internet information literacy improvement than family cognitive support. Although this finding is somewhat counterintuitive since cognitive support is more related with information quality seemingly, this is consistent with the finding of Chu (2010) that offering emotional support is more important than offering skill support to older adults when they are learning. We believe that one possible reason is that older people pay more attention to psychological feelings in the process of learning new things. Compared with younger people, older adults often have lower level of confidence because of their chronological ageing and physical degeneration. The lack of confidence will produce apprehension and anxiety in using new technological products and prevent older adults from continual learning of new technological products (Chou *et al.*, 2013). Therefore, emotional support that can alleviate negative emotions is very important to older adults. Besides, older adults tend to have self-directed learning needs and they need more practice when learning (Chiu *et al.*, 2016). That is to say, self-directed learning is very important for older adults to improve their capacity. However, the lack of emotional support will lead to negative emotions such as depression and anxiety among older adults (Leung *et al.*, 2007), thereby discouraging their self-directed learning. While giving them

support in order to cope with the difficulties they face, the most important problem that should be taken into consideration is how to make them will to learn, rather than how to help them to learn. Therefore, family emotional support should be paid more attention to than family cognitive support.

In addition, the results also show that mobile internet skill literacy improvement and mobile internet information literacy improvement both have a significant impact on quality improvement of obtained information among older adults. It means that upgrading mobile internet skill literacy and mobile internet information literacy among older adults is an effective way to improve the quality of information obtained through mobile internet.

6.2 *Theoretic implications*

This research enriches the internet literacy theory and the information quality theory in information management field. First, previous studies on the ability to use internet focused on the individual's ability to use PC-based internet. However, there are great differences between PC-based internet and mobile internet in many aspects, such as terminals, search methods and information types. This study introduces the concept of mobile internet literacy, and examines the mediation role of mobile internet literacy improvement on the relationship between family support and quality improvement of obtained information. Second, previous scholars mainly discussed the influencing factors of internet literacy from the perspectives of information technology availability, training and individual factors such as education level and internet experience, while this study focuses on family support factors which are important part of social support. Especially, we found that family emotional support has stronger impact on mobile internet literacy improvement than family cognitive support. Third, we expanded the application of the internet literacy theory and the information quality theory to a specific group, i.e. older adults. To our knowledge, this is the first paper to explore the influencing factors of mobile internet literacy and the impact of mobile internet literacy on the quality of information for the older adults, one kind of specific research subjects, which is sensitive to family support. Finally, this paper verifies that mobile internet skill literacy improvement and mobile internet information literacy improvement have significant positive impacts on quality improvement of obtained information among older adults in the study, which is not touched by previous literature.

6.3 *Practical implications*

The research results provide practical implications for how to improve the quality of obtained information for the older adults when using the mobile internet. First, the research results show that mobile internet skill literacy improvement and mobile internet information literacy improvement both have a significant positive impact on quality improvement of obtained information among older adults. Therefore, in order to enhance the quality of information obtained by the older adults through mobile internet, measures need to be taken to upgrade their mobile internet skill literacy and mobile internet information literacy. Second, the research results show that family cognitive support has a significant impact on mobile internet skill literacy improvement, and family emotional support has a significant impact on both mobile internet skill literacy and mobile internet information literacy. In order to improve mobile internet literacy among older adults, their family members need to provide both cognitive support and emotional support. And family emotional support is more important than cognitive support. However, in reality, emotional support is easily overlooked. Many young people are impatient when they help their parents to learn to use the mobile internet. Therefore, it is necessary to remind the family members, especially the young members, of strengthening emotional support such as patience, praise, encouragement and comfort. Offering parents one digital picture book

about how to use WeChat offered by one college student named Zhang Ming is a good example of family support. In this picture book, Zhang Ming explained to his parents patiently how to use WeChat so that his parents mastered the skill to deal with voices and pictures in WeChat quickly.

7. Limitations and future research

Nevertheless, this study presents specific limitations as well. First, to faithfully capture the association among family support, mobile internet literacy improvement and quality improvement of obtained information, an ideal research design would be a longitudinal analysis conducted over different periods. Future research can employ a longitudinal design to retest our proposed model. Second, in this study, the explained variance of mobile internet skill literacy improvement or mobile internet information literacy improvement is less than 50 percent. Thus, other factors such as other social support from friends, experts and teachers may be also associated with mobile internet literacy improvement. Furthermore, the older adults' learning ability, the change of mobile internet environment, peer influence and other factors also play important roles, so these factors should also be taken into consideration in the future research. Third, our research on family support does not distinguish between online support and offline support. In our interviews, some respondents received family support through online channels, such as WeChat, while others received family support through face-to-face contact. Yang *et al.* (2016) pointed out that online social supports and offline social supports have different impacts on technology use. Therefore, future research needs to differentiate between the impact of online family supports and that of offline family supports on mobile internet literacy for the older adults.

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Construct	Item	Source
Family cognitive support (FCS)	FCS1: How often did your family members give you guidance when you used your smartphone or tablet PC to get information online in the past year? FCS2: How often did your family members help you out when you went into trouble using your smartphone or tablet PC to get information online in the past year? FCS3: How often did your family members give you guidance about how to identify the information online in the past year?	Adapted from Chu (2010)
Family emotional support (FES)	FES1: How patient were your family members when they helped you solve your problems during your obtaining information online by your smartphone or tablet PC in the past year? FES2: How often did your family members comfort and encourage you when you had difficulty obtaining information on your smartphone or tablet PC online in the past year?	Adapted from Chu (2010)
Mobile internet skill literacy improvement (MISLI)	MISLI1: Please tell us how much your ability to use your smartphone or tablet PC to open and view web pages has increased over the past year MISLI2: Please tell us how much your ability to input information (such as voice input, handwriting, keyboard input) on your smartphone or tablet PC has increased over the past year MISLI3: Please tell us how much your ability to use your smartphone or tablet PC to download files /photos and save them has increased over the past year MISLI4: Please tell us how much your ability to install and uninstall applications on your smartphone or tablet PC has increased over the past year	Adapted from Kim and Yang (2016)
Mobile internet information literacy improvement (MSII)	MSII1: Please tell us how much your ability to identify the information you need from different online sources has increased over the past year MSII2: Please tell us how much your ability to discern the authenticity of online information has increased over the past year MSII3: Please tell us how much your ability to identify the reliability of online sources of information (e.g. news agencies, WeChat public accounts) has increased over the past year	Adapted from Kim and Yang (2016)
Quality improvement of obtained information (QIOI)	QIOI1: How much has the usefulness of the information you obtained through smartphone or tablet PC has increased over the past year? QIOI2: How much has the sufficiency of the information you obtained through smartphone or tablet PC has increased over the past year? QIOI3: How much has the reliability of the information you obtained through smartphone or tablet PC has increased over the past year? QIOI4: How much has the timeliness of the information you obtained through smartphone or tablet PC has increased over the past year? QIOI5: How much has the satisfaction of the information you obtained through smartphone or tablet PC has increased over the past year?	Adapted from Dan <i>et al.</i> (2008)

Table A1.
Measurement of
the variables

Appendix 2

Information
from mobile
internet

	QIOI	FES	FCS	MISLI	MILI
FES1	0.274393	<i>0.844067</i>	0.275184	0.320482	0.327820
FES2	0.370033	<i>0.915522</i>	0.455443	0.442435	0.421422
QIOI1	<i>0.783784</i>	0.273911	0.180550	0.603181	0.567841
QIOI2	<i>0.872069</i>	0.351899	0.128863	0.648132	0.582595
QIOI3	<i>0.895342</i>	0.358382	0.266761	0.683242	0.661712
QIOI4	<i>0.846279</i>	0.286217	0.222861	0.624735	0.562770
QIOI5	<i>0.821624</i>	0.293415	0.285270	0.577488	0.571249
MILI1	0.652974	0.439358	0.210329	<i>0.849413</i>	0.623284
MILI2	0.651806	0.384310	0.201779	<i>0.901814</i>	0.535325
MILI3	0.651809	0.331973	0.228014	<i>0.878986</i>	0.559714
MISLI1	0.545966	0.394985	0.254124	0.548459	<i>0.823905</i>
MISLI2	0.631188	0.392629	0.370985	0.525014	<i>0.844608</i>
MISLI3	0.614969	0.357611	0.267340	0.568128	<i>0.883966</i>
MISLI4	0.490957	0.252652	0.088008	0.516873	<i>0.725864</i>
FCS1	0.221995	0.310804	<i>0.876806</i>	0.181238	0.280502
FCS2	0.222391	0.443391	<i>0.887532</i>	0.235354	0.310079
FCS3	0.222668	0.340352	<i>0.825863</i>	0.211478	0.205773

Note: Values given in italic are PLS loadings

Table AII.
PLS loadings
and cross-loadings

Appendix 3. Formula for path comparison tests

To test the statistical difference between the two beta coefficients, Chin's (2003) equation, which is an adaptation of the traditional *t*-test, is used in this paper:

$$t = \frac{PC_1 - PC_2}{\sqrt{(SE_1^2 + SE_2^2)/N}}$$

where *t* refers to the *t*-value, *N* refers to the sample size, SE1 and SE2 refer to the standard error of each path and, finally, PC1 and PC2 refer to the two path coefficients under comparison.

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