An empirical investigation of mobile government adoption in rural China: A case study in Zhejiang province

Yong Liu [a,*], Hongxiu Li [b], Vassilis Kostakos [a], Jorge Goncalves [a], Simo Hosio [a], Feng Hu [c]

[a] Community Imaging Group, Department of Computer Science and Engineering, University of Oulu, Oulu, Finland
[b] Information Systems Science, Department of Management, Turku School of Economics, University of Turku, Turku, Finland
[c] Xingzhi College, Zhejiang Normal University, Jinhua, China

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ABSTRACT

This study is among the first attempts to empirically investigate the adoption of mobile government by rural populations in developing economies. Based on 409 validated questionnaires collected from families living in rural China, the study examines the interdependences among rural inhabitants' demographic attributes, their access to and perceptions of mobile government, and quantifies how their intention to use mobile government is influenced by technology attributes, social factors and trust beliefs. The results indicate that young males, who live far from a village center or market, and have some knowledge of recent government policies, tend to have a more positive perception of mobile government, and therefore become potential adopters of the service. Perceived ease of use, near-term usefulness, long-term usefulness, integrity, benevolence, image and social influence have significant and positive influences on the intention to use mobile government. Specifically, perceived ease of use, long-term usefulness and social influence have a direct influence on intention to use, while perceived near-term usefulness, integrity, benevolence and image have an indirect influence.

1. Introduction

This paper seeks to investigate the perceptions of rural populations that affect the adoption of mobile government services in the sparsely populated rural areas of developing economies. Previous work has highlighted how the use of the Internet and computers has been instrumental, particularly for those living in developed economies like the USA and Western Europe, in effectively accessing government information and services (see Chadwick & May, 2003; Hosio, Goncalves, Kostakos, & Riekki, 2014; Lee, Tan, & Trimi, 2005). Internet-based e-government appears to be well-suited for urban populations considering the dense and cheap coverage of the Internet in such areas. However, an open challenge remains as to how government can effectively deliver information and services to inhabitants in remote areas, particularly those living in the sparse rural regions of developing economies, such as rural China, India and Africa. This paper provides empirical evidence on how the perceptions of citizens in such areas are likely to affect their adoption of such services.

To date, the main challenges of deploying Internet-based e-government in a rural environment, such as high implementation costs, IT infrastructure costs, computer costs and Internet fees as well

as the inhabitants' low computer literacy, have given rise to the likelihood of an increase in the technological divide between urban and rural areas. However, the rapid penetration of cell phones in recent years has also given rise to an economic alternative. Thus, there is a timely need to investigate how formerly hard-to-reach rural citizens can benefit from recent advances in mobile technology and mobile government. Support for this comes from Kushchu and Kuscu (2003, p. 3) who state, "in such countries with insufficient conventional telecom infrastructures and greater acceptance of mobile phones, ability of reaching rural areas may be considered as an important feature of m-government".

According to a report by the World Bank and infoDev, in 2012 mobile phone access had reached three quarters of planet's population (The World Bank, 2012). The number of mobile subscriptions in use worldwide has grown from fewer than 1 billion in the year 2000 to over 6 billion in 2012, of which nearly 5 billion are in developing countries (The World Bank, 2012). The International Telecommunication Union (ITU) claims that, by the end of 2013, overall mobile penetration rates will have reached 96% globally, 128% in the developed world, and 89% in developing countries (International Telecommunication Union, 2013). In comparison, 2.7 billion people, or 39% of the world's population, will use the Internet by the end of 2013 (International Telecommunication Union, 2013). Therefore, considering its broad convergence, the utilization of the mobile phone as an alternative communication channel is particularly meaningful for future government service development and research. In this vein, Kushchu and Kuscu

* Corresponding author.
  E-mail addresses: yoliu@ee.oulu.fi (Y. Liu), hongxiu.li@utu.fi (H. Li), vassilis@ee.oulu.fi (V. Kostakos), jgoncalv@ee.oulu.fi (J. Goncalves), simo.hosio@ee.oulu.fi (S. Hosio), hufeng@zjnu.cn (F. Hu).

(2003) argue that mobile government is inevitable, and will be a key approach for developing countries in reaching their citizens and promoting the exchange of communications, especially in remote areas.

Mobile government (m-government) refers to the use of various mobile platforms (e.g., cell phones, notepads) for deploying government information and services to citizens in a way that is independent of time and location (c.f. Scholl, 2005). From a technological perspective, mobile government services can be delivered to users in remote areas through the use of the mobile Internet, pre-installed phone software and SMS. As a new paradigm of e-government development, recent mobile government has attracted considerable research attention (i.e., Gang, 2005; Hung, Chang, & Kuo, 2013; Mengistu, Zo, & Rho, 2009; Ntaliani, Costopoulou, & Karetsos, 2008; Song & Cornford, 2006). However, existing studies on mobile government are mostly theoretically based or targeted at users in developed economies. There is a lack of empirical investigation into the diffusion of mobile government among rural users. In addition, even though there are a number of studies on the diffusion of mobile services in rural regions from the perspective of telecommunication operators or commercial corporations, there has been a lack of investigation into the willingness of rural citizens to adopt government services.

In this light, the study seeks to examine the interdependences among a rural population's demographic features, their access to and perceptions of mobile government, and quantify how different factors affect service adoption. Based on the technology acceptance model, a theoretical research model was developed for this study by incorporating three kinds of diffusion factors: technologies attributes (perceived ease of use and perceived usefulness), trust toward government (integrity and benevolence) and social environmental factors (social influence and image). Based on 409 validated questionnaires, the research model is evaluated through the use of structural equation modeling technologies.

The remainder of the paper is structured as follows: a literature review will be presented in the next section, followed by a discussion about the research model and its hypotheses. The fourth section presents the research methodology while the fifth section discusses the results. Section 6 concludes the paper. The limitations of the research and future research directions are discussed in Section 7.

2. Literature review

2.1. Mobile government for rural development in developing economies

A number of studies and projects have focused on the value of mobile technologies for benefiting the rural citizens of developing economies (Jalote, 2013; Jotischky & Nye, 2011; Ojo, Janowski, & Awotwi, 2012). It is worth noting that the SMS function offered by even the most basic handset can be used to provide information to farmers that they would not have had access to in former times (Vark, 2012). As a result, a recent report from the World Bank described the expansion of mobile networks in rural areas as "a unique and unparalleled opportunity to give rural smallholders access to information that could transform their livelihoods" (Halewood & Surya, 2012). In Africa, a number of mobile services have been developed to improve agricultural yield and profits by providing advice to farmers on crops, weather and market prices (see Vark, 2012). Hellström (2008) argues that mobile technologies would help improve governance because they can reduce inefficient use of state resources, corruption and unstable systems. Encouraged by increased demand, India's National Agricultural and Rural Development Bank (Nabard) announced a pilot project for the dissemination of agriculture advisory services via SMS to 50,000 farmers in 10 districts of Maharashtra in September 2012 (Times of India, 2012). The Madhya Pradesh government of India launched a pilot mobile government project to facilitate the electronic provisioning of services and access to government information using a cell phone, especially for regions that lack Internet connectivity (m-Govworld, 2013). There is clear evidence that mobile devices offer an unprecedented chance for

governments to facilitate economic growth in rural regions via the proper implementation of mobile government services. However, the factors influencing the adoption of such services, particularly in rural areas, have not been investigated.

2.2. Mobile government for China's rural population

The issues of *agricultural economy, village community, and farmers*, also known as the *Three Agrarian Issues* (TAIs, or **San-nong** in Chinese), have been widely used to represent the focus of government work in rural China (for a review see Xia & Lu, 2008; Xia, 2010). Politically, the Communist Party of China has put forward the goal of establishing an equitable and harmonious society, which has TAIs as a focal point (Xia & Lu, 2008). "To achieve this goal, the improvement of rural communications, among other things, was intended as a sign of [the Communist] Party's drive to address these issues" (Xia & Lu, 2008, p. 688). It is worth noting that economic development in rural regions has long been an important focus of society development in China due to (i) the imbalance in the economic and income growth between urban and rural regions (Xia & Lu, 2008; Yao & Zhou, 2011); (ii) over 656 million people living in rural China wishing to benefit from the economic growth (National Bureau of Statistics of China, 2012); and (iii) a high and growing domestic demand for agricultural products. Regarding government investment, 2013 will be the third year that the Chinese government invests over one trillion RMB (approximately 125 billion euros) to address TAIs (Xinhua News Agency, 2013). Considerable investment has been made in delivering government information to the rural population of China, while China's administration, at different levels, has sought to establish various web portals for this purpose.

However, despite the constant improvement in e-government services, the service quality as well as the adoption of e-government websites varies greatly across different administrative levels — with a particularly low performance at the local government level in rural China (Anhuinews, 2011; Xinhua News Agency, 2008, 2012a; Zheng, 2012). In addition, many Chinese rural inhabitants are unable or unwilling to afford a computer and an Internet connection fee and/or have low computer literacy. From the perspective of the government, it is very important to effectively disseminate and publicize government information to the rural population in order to improve the economic conditions of those living there. In this regard, mobile government offers a chance for the government to change the wait-to-use style of government information provision and become a rather personalized 'home-delivery' government. Therefore, it is imperative that governments investigate mobile government as a possible alternative for complementing existing e-government services.

Considering the ineffectiveness of conventional e-government in rural China, there have been some discussions and initial efforts to construct mobile government for rural inhabitants (Schlæger, 2011; Yu & Qin, 2011). As a consequence, this pilot research project seeks to offer first-hand information to facilitate a more complete understanding of a rural population's accessibility, requirements and perceptions of mobile government, thus providing a useful reference for the future implementation of the service.

2.3. Advantages of using mobile government for rural inhabitants

Mobile-phone-based government service has a number of unprecedented features. We argue that, especially for rural inhabitants, mobile government offers at least seven different advantages with regard to affordability, reachability, ubiquity, on-time information delivery, a low technology literacy requirement, personalized information delivery and emergency management.

1) *Affordability*. Compared to the cost of computers and Internet infrastructure in vast rural regions, sending government information via cell phones is a much more affordable and economic solution

(Halewood & Surya, 2012; Vark, 2012). This is an important benefit for users in rural areas, in particular those in a poor economic situation but eager to access government information.

2) *Reachability*. By the end of October 2012 over 1.1 billion (about 82% of the Chinese population) already owned and used cell phones (Xinhua News Agency, 2012b). Like many other developing economies, this figure is much higher than the amount of computer users. This suggests that mobile government has a broader reachability. If mobile phone subscribers could be converted into subscribers of mobile government services, the take-up of the services would be considered successful.

3) *Ubiquity*. Through cell phones, a government is able to deliver information to users regardless of distance, time, place, and adverse natural conditions (Goncalves et al., 2014; Ntaliani et al., 2008).

4) *On-time information delivery*. Cell phones can offer real-time and fast access to certified information (i.e., seasonal agricultural technology and weather forecasts) to effectively assist farmers in their decision-making, such as when conducting an on-time diagnosis of a disease (Ntaliani et al., 2008).

5) *Low technology literacy requirement.* Many users in rural areas have low technology literacy and cannot properly operate a computer. However, they can easily operate a mobile phone (Halewood & Surya, 2012; Vark, 2012).

6) *Personalized information delivery.* Considering the highly personalized nature of cell phones, a phone number may represent access to a specific person over a long period of time. This feature makes it easy to deliver personalized information and services to users in rural areas.

7) *Emergency management.* The personalized and portable features of cell phones make it possible for governments to deliver crucial information to targeted users at the right time (Ntaliani et al., 2008). Governments can utilize the technology to precisely broadcast disaster information about, for example, hurricanes, fires and disease, and to eliminate rumors.

3. Research model and the development of hypotheses

While Shareef, Kumar, Kumar, and Dwivedi (2011) argue that the acceptance, diffusion, and success of e-government initiatives are contingent upon the willingness of citizens to adopt these services, we believe this also applies in the context of mobile government. Considering the fact that mobile government is emerging as a new IT solution for accessing government information, the technology acceptance model (TAM) (Davis, 1989) is utilized as the basis for developing our research model. However, different researchers have emphasized that e-government adoption is more than a technological issue as it is influenced by many factors, like social, human and cultural issues (for a review see Shareef et al., 2011). Therefore, in addition to the technology attributes emphasized by TAM, we incorporate both social environmental factors and trust beliefs to explore the driving factors behind mobile government adoption.

3.1. Technological attributes: the Technology Acceptance Model

Many researchers have applied TAM to predict and explain the adoption of a diversity of various IT innovations, including e-government (Carter & Bélanger, 2005; Warkentin, Gefen, Pavlou, & Rose, 2002). The model has been declared to be robust (Davis, 1989). The model hypothesizes that perceived ease of use and usefulness are the two key drivers of technology adoption. Perceived usefulness is defined as the degree to which an individual perceives that using a particular system would enhance his or her job performance. Perceived ease of use refers to the degree to which a user believes that using a particular service would be free of effort. Intention to use technology is postulated to be a product of both perceived usefulness and ease of use. In addition, the model claims that perceived ease of use has a significant and positive influence on perceived usefulness. As mobile government is an emerging

IT innovation for users, it is reasonable to apply TAM to investigate how new technology features affect their intention to adopt the service.

Many scholars note that, in addition to an instant improvement in work performance (or near-term usefulness), the use of an IT innovation may also bring about outcomes that have a pay-off in the future or long-term usefulness (Chang & Cheung, 2001; Liu, Li, & Carlsson, 2010; Thompson, Higgins, & Howell, 1991). Therefore, they argue that perceived usefulness consists of two distinct aspects: near-term usefulness and long-term usefulness (Chang & Cheung, 2001; Liu et al., 2010; Thompson et al., 1991). For instance, Liu et al. (2010) argue that long-term usefulness is an important driver for people who aim to utilize educational IT innovations. Chang and Cheung (2001) found that perceived near-term consequences have a significant and positive influence on the perceived long-term consequences of Internet adoption at work. Hence, we argue that rural inhabitants' use of mobile government is not just about more effective access to government information. As a result of the future consequences of using the system, they access government information in the hope of improving their quality of life. Therefore, based on prior studies, we hypothesize that:

H1. Perceived near-term usefulness positively relates to perceived long-term usefulness.

H2. Perceived near-term usefulness positively relates to intention to use.

H3. Perceived long-term usefulness positively relates to intention to use.

Based on TAM, we argue that if rural citizens feel the use of mobile government to be free of effort, they will be more likely to find the service to be useful, and therefore become more willing to adopt the service. Hence, we hypothesize:

H4. Perceived ease of use positively relates to perceived near-term usefulness.

H5. Perceived ease of use positively relates to intention to use.

3.2. Social environment: social influence and image

Prior studies indicate that social environmental factors may have significant influence over e-government acceptance (AlAwadhi & Morris, 2008; Hung, Chang, & Yu, 2006; Shareef et al., 2011). For instance, a study by AlAwadhi and Morris (2008) indicates that social environmental factors, such as peer influence, become more significant and important for e-government adoption when individuals have limited experience of online services. In a similar manner, social environmental factors may contribute to motivating mobile government acceptance among users in remote areas. In this vein, two social environmental factors are incorporated into the research model, which are social influence and image.

Image refers to citizens' perceptions that the adoption of mobile government would enhance the adopters' status in the social system. A number of researchers have included the construct of image to investigate the adoption of e-government (i.e., Phang & Li, 2005; Shareef et al., 2011). Since the adoption of mobile government offers adopters the advantage of accessing the latest government information, they consequently become an important source of information among peers, which may help improve their image. In addition, the enhanced social status that users receive as a result of adopting an IT innovation may contribute to a kind of social pressure on others, also forcing them to adopt the innovation (Lee & Kozar, 2008). Lee and Kozar (2008) investigated the adoption of anti-spyware software and found that image has a significant and positive impact on subjective norms. Therefore, we propose:

H6. Image positively relates to intention to use.

H7. Image positively relates to social influence.

Social influence refers the degree to which an individual perceives that important others believe s/he should use a system (Venkatesh, Morris, Davis, & Davis, 2003). The construct is included in the unified theory of acceptance and use of technology as an important determinant of adoption intention (Venkatesh et al., 2003). Prior studies found social influence to be a significant determinant of mobile Internet (Wang & Wang, 2010; Zhou, 2011), mobile shopping (Yang, 2010), mobile banking (Zhou, Lu, & Wang, 2010) and e-government adoption (Tung & Rieck, 2005). Hung et al. (2013) applied subjective norms to predict mobile government adoption among Internet users in Taiwan and found a significant relationship between subjective norms and intention. Furthermore, it is expected that adopters of mobile government will be more likely to become successful due to their familiarity with government policies. Thus, the success of others in using mobile government is seen as being likely to impress potential adopters regarding the long-term benefits of using the service. Therefore, we hypothesize:

H8. Social influence positively relates to perceived long-term usefulness.

H9. Social influence positively relates to intention to use.

3.3. Trust: integrity and benevolence

Trust has been frequently discussed in prior studies on e-government (Parent, Vandebeek, & Gemino, 2005; Shareef et al., 2011; Warkentin et al., 2002). Trust refers to the belief that the other party will behave as expected and in a socially responsible manner, and, in doing so, will fulfill the trusting party's expectation (Warkentin et al., 2002). Warkentin et al. (2002) proposed that there are three sources of trust affecting e-government adoption: institutional-based trust, characteristics-based trust, and process-based trust. Shareef et al. (2011) found that perceived trust has a positive relationship to the adoption of e-government in Canada. Hung et al. (2013) reported the significant indirect influence of trust on the intention to use mobile government among Taiwan e-government website users. Therefore, it is necessary to incorporate trust in order to study mobile government acceptance among rural inhabitants.

Based on the work of McKnight and Chervany (2002), Wang and Benbasat (2005) utilize competence, benevolence and integrity as three sub-dimensions of trust when studying the adoption of online recommendation agents. Competence reflects an individual's belief that the trustee has the ability, skills and expertise to perform effectively in specific domains; benevolence refers to an individual's belief that the trustee cares about her/him and acts in her/his interests; integrity refers to an individual's belief that the trustee adheres to a set of principles (i.e., honesty and promise keeping) that s/he finds acceptable (McKnight & Chervany, 2002; Wang & Benbasat, 2005). In our study, we seek to introduce and investigate how two key dimensions of trust—integrity and benevolence—affect the acceptance of mobile government. As the competence of mobile government in China relies on how it will be implemented in the future, it is not investigated in our study. Prior studies suggest that trust mediates the influence of perceived ease of use on perceived usefulness (Wang & Benbasat, 2005; Wu & Chen, 2005). In other words, if a service is provided in an easy-to-use manner, users may have a stronger feeling that the service provider is trustworthy. In addition, the enhanced feeling of trust, in turn, brings about a positive evaluation of the usefulness of the service. In a similar way, we propose that trust would mediate the influence of perceived ease of use on the perceived usefulness of mobile government. We argue that trust should be an important determinant of both near-term and long-term usefulness. If users do not trust mobile government, it would be difficult for them to believe the service would provide them with useful information and subsequently benefit their future life. Therefore, we propose:

H10a. Perceived ease of use positively relates to integrity.

H10b. Perceived ease of use positively relates to benevolence.

H11a. Integrity positively relates to perceived near-term usefulness.

H11b. Benevolence positively relates to perceived near-term usefulness.

H12a. Integrity positively relates to perceived long-term usefulness.

H12b. Benevolence positively relates to perceived long-term usefulness.

A number of studies found that subjective norms are an important source of trust beliefs (Li, Hess, & Valacich, 2006, 2008). This suggests that people tend to obtain important information from their referents when ascertaining whether a service provider is trustworthy or not. In rural China, people may obtain more information from important others rather than from the Internet because face-to-face communication with neighbors and relatives remains crucially important in their daily lives. In this regard, social influence may have a stronger influence on trust beliefs in relation to mobile government. Therefore, as shown in Fig. 1, we hypothesize:

H13a. Social influence positively relates to integrity.

H13b. Social influence positively relates to benevolence.

4. Research methodology

4.1. Survey and respondents

A questionnaire survey was conducted to collect data for evaluating the research model. The questionnaire consists of two parts. The first part collects information about the demographic characteristics of the respondents as well as their preferences regarding the service, while the second part collects information about their perceptions of the service. A five-point Likert-scale ranging from disagree (1) to agree (5) was used to measure each perception item. The measurements for the constructs of our research model are derived from prior studies and are included in the Appendix A. The measurements for integrity and benevolence are adjusted from the work of Wang and Benbasat (2005). The items for measuring perceived ease of use and near-term usefulness are based on the study by Davis (1989). The measurements for perceived long-term usefulness are derived from the study by Liu et al. (2010) and Chang and Cheung (2001). The items for social influence and intention are derived from the measurements used by Venkatesh et al. (2003). The measurements for image are based on the work of Lee and Kozar (2008) as well as Moore and Benbasat (1991).

To obtain validated responses for the survey, 21 student volunteers, whose families live in the rural regions of the Zhejiang province in China, were recruited to help us collect responses from the different
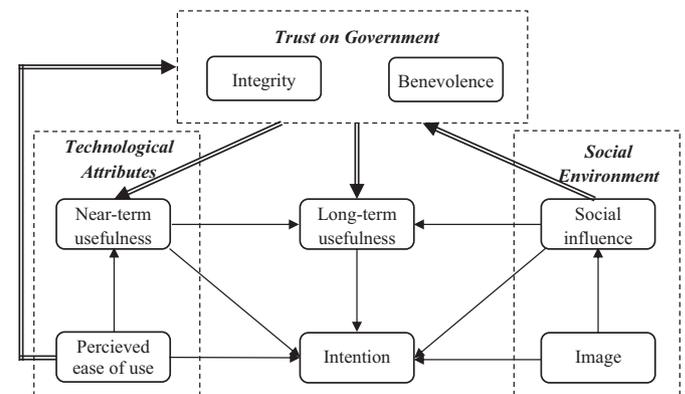

Fig. 1. Research Model (two-line arrows indicate that both integrity and benevolence are connected).

villages in which their families live. Before the survey, researchers offered training to the volunteers and elucidated the research purpose. The volunteers were requested to visit about 15–25 different rural families, and collect *a response from one person per family* visited. Finally, we collected 433 responses, 409 of which are retained for analysis. The responses containing missing values in the second part of the questionnaire were removed to obtain more model fit indices that precisely test the research model.

The final sample consists of 236 males and 173 females. As most young people have migrated to find a job in urban regions, permanent residents in rural China are typically older than in urban areas. Therefore, the respondents to the survey are on average 42.74 years old (Stdev = 11.8) and live on average 4.1 km from the nearest village market (Stdev = 3.56). Most families had 3 to 4 family members (65.8%), as shown in the Table 1. The survey also reveals relatively large variations in family income. Migrant working and other sorts of income were found to be more important sources of income than traditional farming.

Concerning inhabitants' access to government information, the survey indicates that only 10.3% of respondents have ever used a computer to access San-nong information (TAIs), as shown in Table 2. In addition, the rural inhabitants' understanding of recent San-nong government policies is limited, as 94.1% of respondents have no (31.3%) or only a partial (62.8%) understanding of the policies. The data show that 93.7% of respondents already used a mobile phone, and that 32.8% of respondents own a 3G phone. SMS is the preferred solution for rural inhabitants when accessing San-nong government information (58.2%), followed by the mobile Internet (36.2%). Twenty percent of respondents indicated that they are willing to use preinstalled software. However, 20.3% of respondents do not want to use any of the above methods to access mobile government. We inquired about the respondents' current mobile government service usage by listing the seven main mobile government services providers. A total of 126 respondents (30.8%) reported using mobile government services. The three most popular mobile government services among the participants are the Zhejiang peasant mail box[1] (N = 46), Nongxintong[2] (N = 37) and Nongshitong[3] (N = 37). The correlations among the demographic attributes, accessibility to government, and latent variables are calculated through the use of SPSS 21, as shown in Appendix B.

4.2. Reliability and validity

Confirmatory factor analysis was applied to test the adequacy of the measurement model through the use of AMOS 21. The initial model fit indices demonstrated poor fit. Two items of perceived usefulness were found to share a high residual variance with other items across the constructs. After deleting them and rerunning the analysis, the model then demonstrated a satisfactory fit as shown in Table 5. As shown in Table 3, the values of Cronbach's Alpha (α), composite reliability (CR) and average variance extracted (AVE) of the constructs are all over the thresholds of 0.7, 0.7 and 0.5, respectively. The squared roots of AVE are higher than their correlations with other constructs, as shown in Table 4. In addition, principal component analysis was conducted to further test measurement validity, as shown in Appendix C. The results

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[1] Established by Zhejing province government, Zhejiang peasant mail box (ZPMB, 浙江农民信箱) is a free and real-name system, in which users can communicate with others about technology, markets and agricultural trading information. For the details please see http://baike.baidu.com/view/3508016.htm (in Chinese).

[2] Implemented by China Mobile Limited, Nongxintong (农信通) is a mobile application that provides users with information about government policies and regulations, news alerts, agricultural technology, market demand and supply, price quotes, agricultural meteorological information, etc. It supports rural government management. For the details of the software please see http://12582.10086.cn/download/new/zwy_mb.html (in Chinese).

[3] Established by Department of Agriculture of Shanxi province, Nongshitong (农事通) targets users across the country. Similar to Nongxintong it offers diverse information services for rural inhabitants. For the details of the software please see http://www.3nong.com/NST.aspx (in Chinese).

Table 1
Demographic characteristics of respondents.

Demographic profile	Options	Frequency	Percentage (%)
Q1 Gender	Male	236	57.7
	Female	173	42.3
Q2 Education	No formal education	27	6.6
	Primary school	87	21.3
	Junior middle school	137	33.5
	High school or technical secondary school	105	25.7
	Junior college	24	5.9
	University	26	6.4
	Missing value	3	0.7
Q3 Annual family income (RMB)	Less than 10 thousand	29	7.1
	10–30 thousand	98	24
	30–60 thousand	105	25.7
	60–100 thousand	91	22.2
	100–150 thousand	53	13
	150–200 thousand	16	3.9
	Over 200 thousand	14	3.4
	Missing value	3	0.7
Q4 Number of family members	1–2	16	3.9
	3–4	269	65.8
	5–6	106	25.9
	Over 6	9	2.2
	Missing value	9	2.2
Q5 Main source of income (*multiple choice*)	Crop farming	105	25.7
	Fruit tree planting	37	9
	Livestock and fish breeding	27	6.6
	Migrant work	139	34
	Other	154	37.7

show that all items fit their respective factors quite well without any substantial cross loading over 0.4. The results suggest the unidimensionality, convergent and discriminant validity of the measures. Harmon's one-factor test was applied to test common method bias (MacKenzie, Podsakoff, & Jarvis, 2005). No factor was found to account for the majority of the covariance in the variables, which suggests that the common method bias is an unlikely concern in the data. In addition, a single factor model test was conducted. The single-factor model showed a poor fit (CMIN/DF = 13.675; P < 0.001; GFI = 0.455; NFI = 0.454; IFI = 0.467; TLI = 0.412; CFI = 0.465; RMSEA = 0.214) against the existence of common method bias.

5. Results

As shown in Table 5, the results of the structural model analysis indicate a good model fit, as all the values of model fit indices satisfy their thresholds. Most of the hypotheses proposed are supported, except for H2, H6 and H12b, as shown in Table 6. Perceived ease of use (β = 0.211, p-value < 0.001), perceived long-term usefulness (β = 0.201, p-value < 0.01) and social influence (β = 0.209, p-value < 0.01) are direct determinants of the intention to use mobile government. However, against our expectations, perceived near-term usefulness and image have no significant direct influence on intention to use. Perceived ease of use is a motivator of perceived near-term usefulness (β = 0.365, p-value < 0.001), which in turn affects perceived long-term usefulness (β = 0.471, p-value < 0.001). Image is a significant predictor of social influence (β = 0.744, p-value < 0.001), while social influence is a determinant of perceived long-term usefulness (β = 0.291, p-value < 0.001). Social influence significantly affects trust in government service and its path coefficients are 0.443 (p-value < 0.001) and 0.192 (p-value < 0.001) for integrity and benevolence, respectively. Also, the technology attribute of perceived ease of use significantly influences trust. Specifically, perceived ease of use significantly relates to integrity (β = 0.401, p-value < 0.001) and benevolence (β = 0.253, p-value < 0.001). Integrity (β = 0.223, p-value < 0.001) and benevolence (β = 0.250, p-value < 0.001) are

Table 2
Rural inhabitants' accessibility to government information.

Accessibility	Options	Frequency	Percent (%)
Q6 Understanding of recent government policy for rural regions	Full understanding	24	5.9
	Partial understanding	257	62.8
	No understanding	128	31.3
Q7 Experience of browsing San-nong information via computer	No experience	253	61.9
	I have experienced using that before, but not recently.	82	20
	I have experiences using that before and recently.	42	10.3
	I cannot remember [a]	27	6.6
	Missing value	5	1.2
Q8 Do you own a 3G phone?	Yes	134	32.8
	No	250	61.1
	Not sure [a]	20	4.9
	Missing value	5	1.2
Q9 Experience of using a mobile phone	I do not have a mobile phone	26	6.4
	Less than 1 year	23	5.6
	1–2 years	27	6.6
	2–3 years	58	14.2
	Over 3 years	273	66.7
	Missing value	2	0.5
Q10 Mobile government users or not	Non-users	281	68.7
	Users	126	30.8
	Missing value	2	0.5
Q11 What is the best way for you to access San-nong information from government, if your mobile phone supports all the mentioned functions (multiple choices)	Through the mobile Internet	148	36.2
	Through SMS	238	58.2
	Through the software preinstalled in your mobile phone	82	20
	I prefer none of the above.	83	20.3
	Missing value	5	1.2

[a] : Code as missing value in correlation analysis.

significant determinants of perceived near-term usefulness. Integrity is a significant precursor of perceived long-term usefulness ($\beta = 0.142$, p-value < 0.01), but benevolence is not. The model is found to interpret about 55.4% of the variance of social influence, 34% of the variance of benevolence, 25.3% of the variance of integrity, 42.5% of the variance of perceived near-term usefulness, 49.5% of the variance of perceived long-term usefulness and 36.3% of the variance of intention to use.

As perceptual factors in the research model have significant influence on the adoption intention regarding mobile government, we analyze how perceptions are associated with inhabitants' demographic attributes and access to mobile government, and thus identify possible indicators of service adoption. As shown in Appendix B, gender and age have negative and significant correlations with perceived ease of use, while distance has positive and significant correlation with both family size and perceived near-term usefulness. This indicates that males and young people tend to have a positive feeling that mobile government will be easy to use. In addition, inhabitants living in remote areas tend to have a bigger family and stronger feelings about the usefulness of mobile government. Furthermore, people having a higher level of education are found to know more about San-nong government policies and have more experience of browsing government information through the use of computers. They also have longer experience of using a mobile phone and are more likely to believe the use of mobile government will be free of effort and enhance their social status and prestige. An interesting finding is that

people with good income tend to trust the government less with regard to the mobile government service, even if they are more likely to browse mobile government information via the Internet. They also associate the use of mobile government with a negative effect on their image. In other words, they may feel the use of mobile government is for those who are still struggling for better economic conditions. Moreover, people who know more about recent San-nong policies appreciate the necessity of having mobile government services and have a positive perception on all the attributes of mobile government reported in the research model. Similarly, users who have previously browsed government information from computers have stronger and more positive perceptions about mobile government, and therefore appreciate accessing government information via the use of mobile phone as an alternative. The ownership and use experience of a mobile phone is found to be significantly associated with positive feelings about both ease of use and the usefulness of mobile government.

6. Discussion and conclusion

Effectively delivering information to inhabitants in sparsely populated rural regions has long been a challenge for governments in developing economies. The failure to do so can impede economic development and increase the technological gap between rural and urban areas. Considering the large rural population size in developing economies, promoting

Table 3
Reliability and convergent validity statistics.

Construct (no. of items)	α	Composite reliability	Minimal. factor loading	AVE
Near-term usefulness (2)	0.834	0.833	0.832	0.715
Perceived ease of use (4)	0.904	0.905	0.808	0.705
Integrity (3)	0.913	0.913	0.841	0.779
Benevolence (3)	0.912	0.914	0.814	0.780
Long-term usefulness (3)	0.907	0.907	0.867	0.765
Social influence (3)	0.930	0.929	0.902	0.814
Image (3)	0.952	0.952	0.933	0.871
Intention (2)	0.910	0.911	0.881	0.838

Table 4
Discriminant validity.

Construct	Pu	Eou	Inte	Be	Va	Si	Im	Int
Near-term usefulness (Pu)	**0.84**							
Perceived ease of use (Eou)	0.48	**0.84**						
Integrity (Inte)	0.43	0.42	**0.88**					
Benevolence (Be)	0.43	0.37	0.43	**0.88**				
Long-term usefulness (Va)	0.54	0.46	0.43	0.40	**0.87**			
Social influence (Si)	0.32	0.33	0.30	0.49	0.45	**0.90**		
Image (Im)	0.26	0.44	0.31	0.44	0.45	0.69	**0.93**	
Intention (Int)	0.33	0.42	0.29	0.39	0.44	0.45	0.45	**0.91**

Note: The bold diagonals are the square roots of the AVEs of the individual constructs; off diagonal values are the correlations between constructs.

Table 5
Model fit indices.

Model fit indices	X^2/df	GFI	AGFI	NFI	IFI	TLI	CFI	RMSEA
Recommended value	<3	>0.90	>0.80	>0.90	>0.90	>0.90	>0.90	<0.08
Measurement model	2.322	0.911	0.878	0.943	0.967	0.958	0.967	0.057
Structural model	2.473	0.901	0.871	0.937	0.961	0.954	0.961	0.060

Note: X^2/df is the ratio between the Chi-square and the degrees of freedom, GFI is the Goodness of Fit Index, AGFI is the Adjusted Goodness of Fit Index, NFI is the Normed Fit Index; IFI is Incremental Fit Index; TLI is the Tucker–Lewis coefficient, CFI is the Comparative Fit Index, RMSEA is the Root Mean Square Error of Approximation.

economic development in such regions is of particular significance in terms of the world's economic and societal development. While the use of Internet-based e-government has been reported to be somewhat ineffective, such as in rural areas of China, the fast proliferation of cell phones offers a flexible alternative to addressing this challenge (c.f. Kushchu & Kuscu, 2003). As shown by our survey results, Chinese rural inhabitants show a clear inclination to adopt mobile government.

Our study quantified how seven factors influence the intention of rural inhabitants to adopt mobile government. All of the factors were found to have a significant influence on intention to use. Specifically, perceived ease of use, perceived long-term usefulness and social influence have significant, direct influences on intention to use, while perceived near-term usefulness, image, integrity and benevolence have indirect influences. The results show that trust in mobile government is a result of both the social environment and technological ease of use. Image significantly gives rise to social influence, which in turn enhances trust toward the government service. In other words, when rural inhabitants see successful examples of mobile government use, they feel social pressure to adopt the service. The existence of successful examples and enhanced social influence give rise to a strong feeling that mobile government is reliable. Social influence is also reported to have a significant influence on perceived long-term usefulness, indicating other people's positive comments on mobile government promote the perception of the long-term usefulness of using mobile government. On the other hand, trust is found to mediate the influence of perceived ease of use on both perceived near-term and long-term usefulness. To put it another way, when individuals in rural areas find the service easy to use, they believe that mobile government is a reliable service and that the government has taken the wishes of the rural population into consideration and has helped to improve their quality of life by developing the service. The enhanced trust then brings about the stronger belief that the service is useful. Perceived ease of use also has an indirect impact of perceived long-term usefulness as mediated by integrity. In other words, the feeling that mobile government is a reliable and trustworthy service leads to a stronger perception of the long-term usefulness of using a mobile government service.

Table 6
Results of hypotheses test.

Hypotheses	Path coefficients	Finding
H1: Near-term usefulness → long-term usefulness	0.471***	Supported
H2: Near-term usefulness → intention to use	n.s.	Not Supported
H3: Long-term ease of use → intention to use	0.201**	Supported
H4: Perceived ease of use → near-term usefulness	0.365***	Supported
H5: Perceived ease of use → intention to use	0.211***	Supported
H6: Image → intention to use	n.s.	Not Supported
H7: Image → social influence	0.744***	Supported
H8: Social influence → long-term usefulness	0.291***	Supported
H9: Social influence → intention to use	0.209**	Supported
H10a: Perceived ease of use → Integrity	0.401***	Supported
H10b: Perceived ease of use → Benevolence	0.253***	Supported
H11a: Integrity → near-term usefulness	0.223***	Supported
H11b: Benevolence → near-term usefulness	0.250***	Supported
H12a: Integrity → long-term usefulness	0.142**	Supported
H12b: Benevolence → long-term usefulness	n.s.	Not Supported
H13a: Social influence → integrity	0.443***	Supported
H13b: Social influence → benevolence	0.192***	Supported

Note: *: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$; n.s.: not significant.

6.1. Theoretical implications

A paradigm shift from e-government to mobile government has been described as inevitable by many scholars (Kushchu & Kuscu, 2003). However, the research on mobile government is still in its early stages. Prior research on e-government adoption mainly focuses on e-government adoption among citizens and business organizations (for a review see Shareef et al., 2011), and research attempting to explore mobile government adoption among rural inhabitants is in a short supply. Our study contributes to existing literature on e-government in the following ways.

First, to the best of our knowledge this study is among the first to empirically investigate interdependences among rural inhabitants' demographic attributes, access to and perceptions of mobile government, and to identify the driving factors behind the adoption mobile government by rural inhabitants. While prior studies have generally discussed the theoretical underpinnings and the possibility of mobile government for rural inhabitants, this study offers empirical evidence that visualizes the flexibility of mobile government in the context of rural inhabitants in China as well as its driving factors.

Second, our study introduces a number of variables, including perceived long-term usefulness, integrity and benevolence, to the literature on e-government and quantifies their influence on the adoption intention. We analyze the interaction between perceived near-term and long-term usefulness, and investigate how the interaction affects the adoption intention. Consistent with the work of Lin, Fofanah, and Liang (2011), we found that perceived near-term usefulness does not have a significant direct influence on the adoption intention. In addition, we found an indirect effect of perceived near-term usefulness on intention, which is mediated by perceived long-term usefulness. This suggests that future studies on mobile government should be cautious regarding the validity of using TAM and perceived usefulness to interpret service adoption in the context of e-government and mobile government.

Third, the study reports a number of interesting relationships among the variables. Integrity is found to have a significant direct influence on perceived long-term usefulness, but benevolence does not. While prior e-government, in general, employs trust as a unified construct, our results indicate the necessity of deconstructing trust as integrity and benevolence for a more complete and precise understanding of how trust affects e-government acceptance. In addition, integrity and benevolence are found to affect other variables in different ways. The results also indicate that integrity and benevolence have an indirect influence on mobile government adoption.

Fourth, the results show significant interdependences among rural inhabitants' demographic attributes, access to and perceptions of mobile government. An inclusion of the different attributes of the users would offer a more complete picture of users in rural areas and helps interpret how different users perceive mobile government in different ways. The results also facilitate a more precise identification of possible adopters of the service.

6.2. Policy implications

A number of suggestions for governments and practitioners can be drawn from the results. The results indicate that those who have positive perceptions of mobile government are male, young, low-income,

educated, interested in government information, and have prior experience of e-government, prior experience of using a 3G phone, and long experience of using a mobile phone. Therefore, pushing mobile government services to those people would more likely make the services accepted.

Trust is found to have mediating and indirect effects on the intention to use mobile government. Therefore, effective strategies are needed to further enhance the government's reputation among rural inhabitants so that they will be more likely to put more trust in the service offered by the government, and this could be achieved by adopting appropriate policies or providing more choices for users. In addition, trust is found to be a product of social influence. In other words, how respected peers talk about the government will significantly alter individuals' trust in the government (c.f. Awad & Ragowsky, 2008; Warkentin et al., 2002). Therefore, governments should work to promote positive word-of-mouth among rural inhabitants, for example, by facilitating the sharing of information between such inhabitants.

Perceived ease of use, as an important attribute of technology, is found to affect trust as well. This indicates that whether government can provide a well-designed mobile government service is regarded as a measure to evaluate government's work. If a government can offer easy-to-use mobile government services, the trust of citizens in the service will be enhanced. Perceived ease of use also has a strong and direct influence on intention to use. Therefore, it should be emphasized that service designers should pay considerable attention to making a service easy to use. In this vein, we would suggest that, at the initial stage of a mobile government initiative, sending information to users in remote areas via SMS should be favored rather than the mobile Internet, especially when considering the complexity of using the two technologies (c.f. Halewood & Surya, 2012). However, as users become more familiar with the concept of mobile government, a web portal accessible via mobile Internet may be necessary considering the fact that 36.2% of respondents indicate their willingness to access mobile government through this technology (see Table 2).

Finally, image is found to significantly relate to social influence, and indirectly influence trust and intention to use. For practitioners, this suggests that proper examples of the successful use of mobile government would be an effective solution for increasing positive word-of-mouth about a service and the subsequent promotion of the adoption of the service (c.f. Kim, Han, & Park, 2001). Furthermore, near-term usefulness does not have a direct influence on intention to use. Instead, it affects intention through the mediating effect of long-term usefulness. Hence, we argue that the use of mobile government is only a means for the effective accessing of government information. However, the expected long-term outcome of achieving a better life is the ultimate purpose behind using mobile government.

7. Limitations and future research

The study has a number of limitations. First, the responses of the study were taken from 433 rural inhabitants living in Zhejiang province in China, which is a relatively small sample size. Due to the differences between different villages and provinces, caution should be exercised when generalizing the results, even in the context of other provinces in China. Second, the study investigates a number of possible drivers of the service acceptance based on the use of TAM. However, the use of different theoretical models, such as the IS success model, would help to provide a different understanding of the topic. The results report a possible experience-transfer effect regarding e-government services and mobile government (c.f. Lu, Yang, Chau, & Cao, 2011) as prior e-government users are found to have more a more positive attitude toward mobile government. Therefore, we intend to investigate how prior experience of e-government moderates the influence of the perceptions of mobile government on the adoption intention as well as the possible moderating effect of demographic attributes.

Appendix A

A.1. Perceived near-term usefulness

PU1: Mobile government improves my efficiency in accessing San-nong-related government information (dropped).
PU2: Mobile government makes it easier to access San-nong-related government information.
PU3: Mobile government saves my time and effort to access San-nong-related government information.
PU4: Mobile government improves my performance to access San-nong-related government information (dropped).

A.2. Perceived ease of use

EOU1: I think it is easy to access San-nong-related government information through a mobile phone.
EOU2: For me, it is easy to access San-nong-related government information through a mobile phone.
EOU3: Learning to use a mobile government for San-nong-related government information is easy.
EOU4: Overall, mobile government is easy to use.

A.3. Trust (integrity)

INTE1: Mobile government is credible.
INTE2: Mobile government is reliable.
INTE3: Mobile government is trustworthy.

A.4. Trust (benevolence)

BE1: Mobile government puts peasants' interests first.
BE2: Mobile government keeps peasants' interests in mind.
BE3: Mobile government understands peasants' needs and preferences.

A.5. Perceived long-term usefulness

VA1: Using mobile government helps improve my family income.
VA2: Mobile government improves my production efficiency.
VA3: Using mobile government helps improve the quality of my life.

A.6. Social influence

SI1: People who are important to me think I should use mobile government.
SI2: The people I know think I should use mobile government.
SI3: My friends think I should use mobile government.

A.7. Image

IM1: People who adopt mobile government have a better reputation.
IM2: People who adopt mobile government have high prestige.
IM3: People who adopt mobile government have a better social status.

A.8. Intention

INT1: I plan to use mobile government in the future.
INT2: I predict that I will use mobile government in the future.

Appendix B

	Gender	Age	Distance	Edu	Q5	Income	Q7	Q8	Q9	Q10	Q11	PNU	EOU	Integrity	Ben	PLU	SI	Image	Intention
Gender	1	−.043	−.081	−.032	−.036	−.075	.214**	−.122*	.066	−.135**	−.153**	−.084	−.111*	−.086	−.016	−.051	−.022	−.032	−.032
Age	−.043	1	.002	−.532**	−.008	−.190**	.139**	−.133**	.278**	−.294**	−.160**	−.087	−.189**	.008	.046	−.057	−.040	−.007	−.095
Distance	−.081	.002	1	.017	.205**	−.002	−.098	.088	.088	−.019	.018	.116*	.062	−.009	.002	.047	.021	.059	−.027
Edu	−.032	−.532**	.017	1	−.082	.337**	−.224**	.281**	−.337**	.193**	.228**	.065	.162**	−.041	.012	−.005	.110*	.115*	.014
Q5	−.036	−.008	.205**	−.082	1	.088	−.042	.010	−.040	.067	.001	.035	−.060	.047	.048	−.014	.009	−.023	.010
Income	−.075	−.190**	−.002	.337**	.088	1	−.110*	.129**	−.262**	.307**	.089	−.009	.013	−.122*	−.124*	−.051	−.099*	−.133**	−.055
Q7	.214**	.139**	−.098	−.224**	−.042	−.110*	1	−.408**	.242**	−.125*	−.313**	−.229**	−.316**	−.112*	−.176**	−.280**	−.233**	−.219**	−.268**
Q8	−.122*	−.133**	.088	.281**	.010	.129**	−.408**	1	−.236**	.131*	.430**	.279**	.310**	.187**	.214**	.276**	.379**	.353**	.299**
Q9	.066	.278**	.088	−.337**	−.040	−.262**	.242**	−.236**	1	−.176**	−.143**	−.133*	−.196**	−.069	−.085	−.169**	−.050	−.052	−.076
Q10	−.135**	−.294**	−.019	.193**	.067	.307**	−.125*	.131*	−.176**	1	.145**	.101*	.182**	.050	−.028	.126*	.026	.019	.073
Q11	−.153**	−.160**	.018	.228**	.001	.089	−.313**	.430**	−.143**	.145**	1	.242**	.286**	.216**	.223**	.304**	.329**	.325**	.351**
PNU	−.084	−.087	.116*	.065	.035	−.009	−.229**	.279**	−.133*	.101*	.242**	1	.484**	.437**	.436**	.548**	.328**	.268**	.334**
EOU	−.111*	−.189**	.062	.162**	−.060	.013	−.316**	.310**	−.196**	.182**	.286**	.484**	1	.423**	.379**	.462**	.333**	.442**	.420**
Integrity	−.086	.008	−.009	−.041	.047	−.122*	−.112*	.187**	−.069	.050	.216**	.437**	.423**	1	.439**	.407**	.307**	.318**	.293**
Ben	−.016	.046	.002	.012	.048	−.124*	−.176**	.214**	−.085	−.028	.223**	.436**	.379**	.439**	1	.407**	.407**	.442**	.391**
PLU	−.051	−.057	.047	−.005	−.014	−.051	−.280**	.276**	−.169**	.126*	.304**	.548**	.462**	.407**	.407**	1	.450**	.457**	.443**
SI	−.022	−.040	.021	.110*	.009	−.099*	−.233**	.379**	−.050	.026	.329**	.328**	.333**	.307**	.407**	.450**	1	.696**	.450**
Image	−.032	−.007	.059	.115*	−.023	−.133**	−.219**	.353**	−.052	.019	.325**	.268**	.442**	.318**	.442**	.457**	.696**	1	.452**
intention	−.032	−.095	−.027	.014	.010	−.055	−.268**	.299**	−.076	.073	.351**	.334**	.420**	.293**	.391**	.443**	.450**	.452**	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Note: Distance: the distance to the nearest village market; Edu: education; PNU: perceived near-term usefulness; PLU: perceived long-term usefulness; EOU: perceived ease of use; Ben: Benevolence; SI: social influence; Q5: Number of family members; Q7: Understanding of recent government policy for rural regions; Q8: Experience of browse San-nong information via computer; Q9: Do you own a 3G phone?; Q10: Experience of using a mobile phone; Q11: Mobile government users or non-users.

Appendix C. Rotated component matrix.[a]

	Component							
	1	2	3	4	5	6	7	8
Near-term usefulness1	.211	−.013	.178	.176	.108	.238	.107	**.823**
Near-term usefulness2	.254	.094	.183	.175	.091	.252	.065	**.797**
Long-term usefulness1	.207	.106	.117	.124	.162	**.825**	.194	.171
Long-term usefulness2	.156	.165	.197	.094	.156	**.841**	.075	.153
Long-term usefulness3	.190	.183	.172	.170	.124	**.792**	.136	.199
Ease of use1	**.826**	.105	.093	.162	.041	.157	.054	.169
Ease of use2	**.844**	.140	.173	.065	.078	.213	.055	.064
Ease of use3	**.785**	.153	.151	.107	.073	.053	.177	.195
Ease of use4	**.822**	.145	.163	.109	.135	.137	.175	.075
Integrity1	.148	.068	**.873**	.147	.058	.119	.104	.176
Integrity2	.173	.120	**.867**	.176	.071	.118	.072	.136
Integrity3	.195	.068	**.842**	.165	.116	.203	.027	.042
Benevolence1	.140	.100	.174	**.867**	.180	.105	.129	.114
Benevolence2	.121	.147	.187	**.855**	.176	.097	.101	.160
Benevolence3	.148	.179	.154	**.803**	.177	.162	.096	.092
Social influence1	.084	.257	.089	.231	**.833**	.194	.130	.068
Social influence2	.107	.309	.095	.181	**.831**	.124	.139	.105
Social influence3	.116	.363	.096	.184	**.795**	.145	.149	.069
Image1	.179	**.834**	.106	.155	.330	.146	.134	.064
Image2	.202	**.820**	.140	.174	.306	.192	.129	.039
Image3	.204	**.844**	.060	.149	.308	.147	.152	.005
Intention1	.186	.204	.109	.157	.162	.188	**.857**	.073
Intention2	.195	.131	.078	.137	.180	.155	**.880**	.093

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Yong Liu is a Postdoctoral Fellow at MediaTeam, Department of Computer Science and Engineering, University of Oulu in Finland. Currently, he has over 20 publications. His recent work has appeared in *Computers & Education, Decision Support Systems, Industrial Management & Data Systems, Computers in Human Behavior, Online information review* and international conferences, such as ECIS, AMCIS and PACIS.

Hongxiu Li is a researcher in University of Turku in Finland. She has received her doctoral degree in Turku School of Economics, University of Turku in Finland in 2011. She has conducted research on user's adoption and post adoption behavior in e-commerce, e-services, and mobile service in different research context, such as e-learning, online gaming, mobile banking, online travel service and e-retailing. She has also researched on e-service quality, e-service process as well as e-service strategies. Currently, Hongxiu Li has together over 30 publications. She has publications in journals, such as Computers in Human Behavior, Computers & Education, Industrial Management & Data Systems, and Campus-Wide Information Systems.

Vassilis Kostakos is a Professor of Computer Engineering in the University of Oulu's Department of Computer Science and Engineering. His research interests include ubiquitous computing, human–computer interaction, and social systems. Kostakos received a PhD in computer science from the University of Bath. He's a member of ACM. Contact him at, vassilis@ee.oulu.fi.

Jorge Goncalves is a doctoral candidate in the University of Oulu's Department of Computer Science and Engineering. His research interests include social and ubiquitous computing, as well as the use of technology to motivate participation. Goncalves received an MSc in computer science from the University of Madeira. Contact him at, jgoncalv@ee.oulu.fi.

Simo Hosio is a doctoral candidate in the Department of Computer Science and Engineering at the University of Oulu and a member of the MediaTeam Oulu research group. His research interests include social computing, particularly leveraging public displays and mobile devices for engaging citizens in public settings. Hosio received an MSc in information engineering from the University of Oulu.

Feng Hu is a lecturer in Zhejiang Normal University. He has received his master degree in informatics from the Central China Normal University in 2006. His main research focus is electronic services.