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Mobile payment services adoption across time: An empirical study of the effects of behavioral beliefs, social influences, and personal traits

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ABSTRACT

Mobile payment is an emerging and important application of mobile commerce. The adoption and use of mobile payment services are critical for both service providers and investors to profit from such an innovation. The present study attempts to identify the determinants of pre-adoption of mobile payment services and explore the temporal evolution of these determinants across the pre-adoption and post-adoption stages from a holistic perspective including behavioral beliefs, social influences, and personal traits. A research model that reflects the characteristics and usage contexts of mobile payment services is developed and empirically tested by using structural equation modeling on datasets consisting of 483 potential adopters and 156 current users of a mobile payment service in China. Our findings show that behavioral beliefs in combination with social influences and personal traits are all important determinants for mobile payment services adoption and use, but their impacts on behavioral intention do vary across in different stages. Theoretical and practical implications of the findings are presented.

1. Introduction

Mobile payment is one of the most critical drivers for successful mobile commerce. Mobile payment refers to a payments for goods, services, and bills using a mobile device using wireless and other communication technologies (Dahlberg, Mallat, Ondrus, & Zmijewska, 2008). Given the widespread use of mobile devices and users' needs for convenient and timely payment, mobile payment is expected to become an important channel for conducting financial transactions. Once realized it could become an additional revenue stream to service providers and investors. Already, a large number of commercial organizations have invested substantially in mobile payment services to reap its prominent profits. For instance, Nokia invested $70 million in Obopay to enter mobile payment market in April 2009, China mobile bought 20% of PuDong bank stake (about $5.9 billion) to develop mobile payment services in May 2010, and Google ventures invested $100 million into mobile payment business in May 2010. Nonetheless, the expected business value that could be derived from mobile payment services relies on its acceptance by the consumers as their favorite payment channel.

In the contemporary information systems literature, research on mobile payment services acceptance focuses mainly on notions of instrumentality, e.g. perceived usefulness and perceived ease of use (Chen, 2008; Dahlberg et al., 2008). On the other hand, literature from behavioral sciences and individual psychology suggests that social influences and personal traits (e.g., subjective norms, social image and individual innovativeness) are potentially important explanatory variables in technology adoption as well (Agarwal & Karahanna, 2000; Agarwal & Prasad, 1998; Venkatesh, Morris, Davis, & Davis, 2003; Wu & Lederer, 2009). It is useful to have a holistic view on identifying the critical determinants of mobile payment services adoption incorporating behavioral beliefs, social influences and personal traits.

In addition, most of the extant studies on user beliefs and attitudes toward mobile payment services were conducted after the system was adopted (e.g., Chen, 2008; Schierz, Schilke, & Wirtz, 2009). The results of these studies on beliefs and external stimuli that users hold for continued use of mobile payment services may not be the same as for initial adoption, or the degree of influence may differ (Karahanna, Straub, & Chervany, 1999). Identification of individuals' pre-adoption beliefs and attitudes on mobile payment services and an understanding of the temporal evolution of these factors across the pre-adoption and post-adoption stages is, therefore, crucial for understanding and managing the individuals' initial adoption and subsequent use of mobile payment services.

In view of the current state of the existing research on mobile payment, the objective of this study is to empirically test a theoretically grounded model on mobile payment services adoption that incorporates behavioral beliefs, social influences, and personal traits. In order to capture the temporal evolution of behavioral

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beliefs, social influences, personal traits, and behavior across different stages of the innovation decision process, we examine these determinants on the pre-adoption stage of mobile payment services and empirically compare the impacts of these factors between the pre-adoption and post-adoption phases. Specifically, the study investigates (1) *to what extent individual perceptions of mobile payment is attributed to social influences and personal traits*; (2) *whether behavioral beliefs such as positive utility and negative utility explain mobile payment adoption*; (3) *how does the influence of the components of behavioral intention (i.e., behavioral beliefs, social influences, and personal traits) on intention to use mobile payment services change over from the pre-adoption stage to post-adoption stage*. In this way, this research attempts to contribute to a better theoretical understanding of the antecedents of pre-adoption of mobile payment services and the differential impact of these factors across pre-adoption and post-adoption stages. Also, this study offers organizations practical insights for managing users' acceptance during each phase of the adoption process.

The rest of this paper is organized as follows. An overview of information systems and technology adoption research is presented in Section 2. In Section 3, we propose the conceptual model and the research hypotheses. Next, we describe the research methodology in Section 4, followed by the analysis of empirical findings in Section 5. Then, we present an extended discussion of the results in Section 6. In Section 7, we conclude with a discussion on the theoretical and practical implications. Finally, limitations and future research are presented in Section 8.

2. Theoretical background

The theory of reasoned action (TRA) and theory of planned behavior (TPB) have been widely used as the primary theoretical framework for understanding and explaining individuals adoption behavior in field of information system (Ajzen, 1991; Ajzen, Fishbein, & Heilbroner, 1980). According to TRA and TPB, an individual's intention to adopt the innovation is determined by attitude and subjective norms, which can be traced back to an individual's behavioral and normative beliefs. Behavioral belief reflects an individual's positive or negative evaluation on performing the behavior, while normative belief refers to an individual's perception of social pressures to adopt or not adopt the innovation. The impact of these two type factors on behavioral intention may vary from person to person (Ajzen et al., 1980; Lu, Yao, & Yu, 2005).

Drawing on TRA and TPB, Davis (1989) proposed the technology acceptance model (TAM) that has been tested and extended by a large number of empirical studies (Chau, 1996; Davis, 1989; Legris, Ingham, & Collerette, 2003; Venkatesh & Davis, 2000; Wu, Chen, & Lin, 2007; Wu & Wang, 2005). The original TAM examined the mediating role of perceived usefulness and perceived ease of use and their relationships between external variables and the probability of information systems adoption (Wu & Wang, 2005). For a long time TAM proved to be a useful theoretical model in helping to understand and explain usage behavior in information systems implementation (Legris et al., 2003). Later, Venkatesh and Davis (2000) proposed TAM2 by including subjective norms as a determinant of perceived usefulness in the original TAM model. Based on a thorough meta-analysis of major technology acceptance studies, Legris et al. (2003) declared that the TAM and TAM2 explained only 40% of the variance in use. They concluded that it may be difficult to increase the predictive capacity of TAM, if it is not integrated into a broader model. Corresponding to this criticism, Venkatesh et al. (2003) developed a unified theory of acceptance and use of technology model (UTAUT) based on a thorough review of user adoption literature and eight prominent models including TRA, TPB, TAM, and the innovation diffusion theory.

As TAM and TAM2 were originally built to ease managing MIS activities in the workplace by measuring the quality of delivered systems (Davis, 1989; Venkatesh & Davis, 2000), the main focus of the TAM-related research perspectives remained confined to understanding adoption process within organizational settings (Hong & Tam, 2006). Although social influence is considered in the TAM2 and particularly in UTAUT, it assesses a kind of normative forces in compliance with organizational goals (Lu et al., 2005). Such influence is therefore different from the social pressures that an individual consumer faces in a free adoption choice context.

Other important work in technology acceptance, notably innovation diffusion theory has been validated by a large number of studies in both organizational settings and individual settings (Choudhury & Karahanna, 2008; Kim, Mirusmonov, & Lee, 2010; Mallat, 2007; Wu, Wang, & Lin, 2007). Proposed by Rogers (1983), the innovation diffusion theory (IDT) includes five significant innovation characteristics: relative advantage, compatibility, complexity, trialability, and observability. Yet, a meta-analysis conducted by Tornatzky and Klein (1982) indicates that, of these attributes, only relative advantage, compatibility, and complexity were consistently related to adoption or utilization decisions. In addition, these traditional models generally neglect the impact of personal innovativeness on adoption which is a critical factor for explaining individual consumer adoption behavior, especially in individual settings (Agarwal & Prasad, 1998). Finally, several studies have shown that the impact of some factors (e.g., behavioral beliefs, social influences, and personal traits) on intention to use IS, varies at different stages of IS initial adoption/continued use (Karahanna et al., 1999; Legris et al., 2003).

Recognizing the potential differences in IS adoption decisions between workplace and home, as well as the widening scope of the elements of an IS study, Lu et al. (2005) conducted an empirical study to identify factors driving the pre-adoption of wireless internet services via mobile technology (WIMT) in the contexts beyond work setting. They included factors such as influences from friends and family members, personal innovativeness, and image concerns that are typically ignored in organizational innovation research. The authors found that the initial adoption of WIMT was driven by a mix of factors that include instrumental beliefs, social influences and personal traits. The present study follows and further develops the work of Lu et al. (2005), by proposing and integrating framework that encompasses specific characteristics of the mobile payment services in non-work settings, and exploring the temporal evolution of these factors across the pre-adoption and post-adoption stages.

3. Conceptual model and research hypotheses

The current study seeks to develop a research framework of mobile payment adoption by drawing on the extant literature on innovation adoption and consumer decision behavior. Having examined prior information systems adoption research and related consumer decision behavior literature, the present study focus on three sets of adoption drivers, namely, behavioral beliefs, social influences, and personal traits. Fig. 1 presents the research model showing the proposed hypotheses. In essence, the current study proposes that (1) relative benefit and compatibility as two positive valence factors in behavioral beliefs may positively influence behavioral intention; (2) perceived risk and perceived fee as two negative valence factors may negatively influence behavioral intention; (3) social influences and personal traits may have both direct and indirect (through relative benefit and perceived risk) influences on behavioral intention. Theoretical justifications of the hypotheses are presented below.

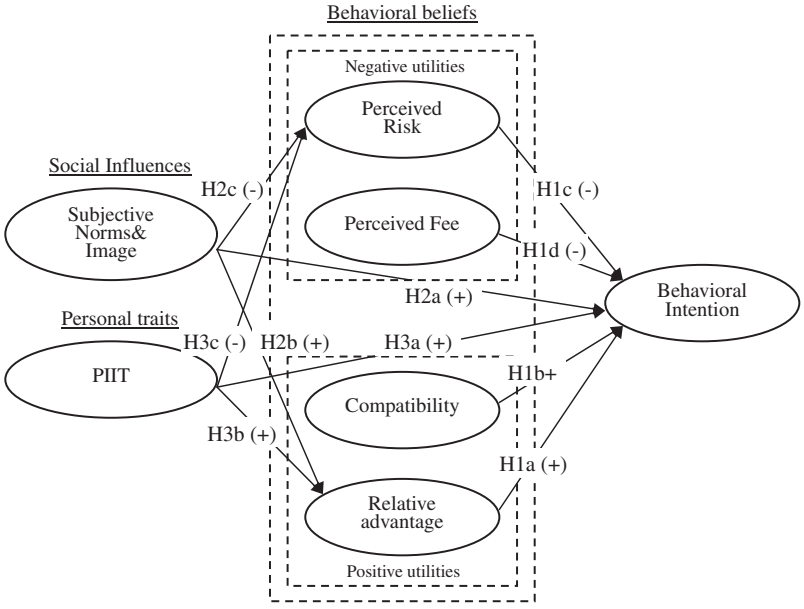

Fig. 1. Research model.

3.1. Behavioral beliefs

A well-grounded consumer decision-making theory, the valence framework, explains consumer behavior intention by considering both positive and negative aspects of behavioral beliefs (Peter & Tarpey, 1975). In the consumer behavior literature, there are generally three alternative decision-making models that explain consumer behavior (Peter & Tarpey, 1975). The "perceived risk" model assumes that consumer acts to minimize any expected negative utility associated with adoption behavior, while the "perceived benefit" model focuses on the maximization of expected positive utility of consumer adoption behavior. Only the valence framework explains consumer behavior intention by considering both positive and negative behavioral beliefs (Peter & Tarpey, 1975). By comparing the three models, Peter and Tarpey (1975) found that the valence framework explains more variance of behavior intention than the other two models. Kim, Ferrin, and Rao (2009) also found that the valence framework is a valid and suitable model in explaining consumer online shopping behavior. Recently, Lu, Cao, Wang, and Yang (2011) successfully applied the valence framework in the context of an online banking adoption and found that the online banking adoption was affected by both positive and negative behavioral beliefs.

3.1.1. The positive utility

In the original valence framework, the positive utility associated with consumer adoption decision is referred to as perceived benefit. To the specific capture more positive utility related to mobile payment adoption we turn to innovation diffusion theory (IDT). Among the set of innovation diffusion characteristics proposed by Rogers (1983), relative advantage and compatibility have been validated as the most consistent explanation for innovation adoption, particularly in the context of mobile-technologies based services adoption (Mallat, 2007; Teo & Pok, 2003; Wu & Wang, 2005). Therefore, we use relative advantage and compatibility as the positive utility dimension in our study by carefully considering the fitness of the characteristics of innovation diffusion theory with the positive utility dimension of the valence framework. The positive utility dimension in the valence framework measures the extent of relative benefit that users may derive by adopting mobile payment services over using online payment services or other traditional payment services. Among the characteristics identified in the innovation diffusion theory, relative advantage and compatibility are two validated constructs that reflect such comparable benefits.

In the context of this research, mobile payment services in many cases have relative advantage over traditional payment services in terms of convenience, efficiency and ubiquity. When people find that mobile payment can deliver values that traditional Internet or offline payment services cannot offer, they may develop a positive intention to adopt the mobile payment services. Previous studies also found that relative advantage has positive influence on behavioral intention in the mobile technologies based service setting (Kim et al., 2010). On the other hand, Tornatzky and Klein's (1982) meta-analysis of research on innovation characteristics found perceived compatibility to be a crucial innovation factor driving consumer adoption. Recently, Wu et al. (2007) also found that compatibility has a positive impact on healthcare professional's intention to adopt the mobile healthcare systems. Regarding mobile payment systems, when an individual can well integrate the new payment services into his or her daily life, the compatibility of mobile payment with the individual's present lifestyle and habits is expected to influence his or her intention to adopt it. Thus, the current study hypothesizes that:

Hypothesis 1a. Perceived relative advantage of mobile payment services positively affects the intention to adopt it.

Hypothesis 1b. Perceived compatibility of mobile payment services positively affects the intention to adopt it.

3.1.2. The negative utility

To adopt mobile payment services, users have to bear the uncertainty and risk (non-monetary expenses) related to adoption decision, and at the same time pay for actual mobile equipment costs, access costs, and transaction fees (monetary expenses) associated with the adoption of the technology (Wu & Wang, 2005). In the traditional valence framework, the negative utility associated with adoption behavior is reflected through perceived risk and it does not considers the monetary expenses that would be incurred

in using mobile payment services. Prior studies have indicated that perceived risk and perceived fee are the two major factors for consumers' resistance to the finance-related mobile services (Luarn & Lin, 2005; Shin, 2009). In the present study, the non-monetary expenses are measured based on perceived risk, while the monetary expenses are assessed based on perceived fee. A recent statistics released by IResearch Group (IResearch., 2009) shows that, 73.5% of consumers surveyed worried about security and transaction risks, and 60.5% of them were to some extent concerned with costs when using mobile payment services. Thus, we can deduce that:

Hypothesis 1c. Perceived risk of mobile payment services negatively affects the intention to adopt it.

Hypothesis 1d. Perceived fee of mobile payment services negatively affects the intention to adopt it.

3.2. Social influences

Social influences, the second component of the model, are defined in this study as individuals' perceived pressures from social networks on adoption or otherwise of the innovation. In the innovation diffusion literature, social influences have long been considered as a critical element in explaining adoption behavior (Cooper & Zmud, 1990; Karahanna et al., 1999). The underlying assumption is that individuals tend to interact in social network for consultation and for reducing their anxiety which arises due to uncertainty from adopting an innovation (Karahanna et al., 1999). In this study, following Lu et al. (2005), we model the construct of social influences by subjective norm and image with consideration of the voluntariness of using the mobile payment services. Image is defined as the extent to which the use of an innovation is perceived as enhancement of one's image or status in one's social system (Moore & Benbasat, 1991).

The relationship between social influences and behavior intention has been empirically investigated by many previous studies (Agarwal & Karahanna, 2000; Lewis, Agarwal, & Sambamurthy, 2003; Taylor & Todd, 1995; Venkatesh et al., 2003). Recently, in the context of mobile-technologies based services adoption, a number of studies incorporated social influences into their research models and found some empirical support (Gu, Lee, & Suh, 2009; Hong & Tam, 2006; Lu, Liu, Yu, & Wang, 2008; Lu et al., 2005). For instance, Hong and Tam (2006) also found that social influences affect adoption intention directly and indirectly via perceived usefulness. In a research on mobile internet services adoption, Lu et al. (2005) found that social influences in form of subjective norm and image positively influence perceived usefulness (or relative advantage). On the other hand, social influences also tend to reduce the perceived risk of adoption because they provide strong evidence indicating the legitimacy and appropriateness of the adoption decision (Karahanna et al., 1999). Hence, we hypothesize that:

Hypothesis 2a. Social influences in the form of subjective norm and image positively affect the intention to adopt mobile payment services.

Hypothesis 2b. Social influences in the form of subjective norm and image positively affect perceived relative advantage of mobile payment services in the initial adoption stage.

Hypothesis 2c. Social influences in the form of subjective norm and image negatively affect perceived risk of using mobile payment services in the initial adoption stage.

3.3. Personal traits

Personal innovativeness in information technology (PIIT) is another component that influences influence IT adoption. PIIT is defined by Agarwal and Prasad (1998) as the willingness of an individual to try out any new information technology. Agarwal and his colleague theorized the new construct of Personal innovativeness in information technology domain and included it into Davis' original TAM model (Agarwal & Prasad, 1998). They found that individuals with higher levels of PIIT form more positive perceptions about the target technology in terms of relative advantage, ease of use, compatibility and have more positive intentions toward the use of the new technology. Lu et al. (2008) tested the PIIT in the adoption model of wireless mobile data services, and they also found the direct impact of PIIT on the intention to adopt wireless services.

PIIT has also been validated to influence perceptions of usefulness in a few studies (Lewis et al., 2003; Lu et al., 2008). For example, Lewis et al. (2003) examined the influences from individual, institution, and society on beliefs about usefulness of the new technology targeted at autonomous knowledge workers. In terms of the individual factors, they found that PIIT exhibited strong effects on the perceived usefulness of the technology. Similarly, Lu et al. (2005) developed a conceptual framework to explain the factors influencing user adoption of wireless internet services. They found that PIIT, along with a number of other factors determine perceived usefulness. Meanwhile, as we discussed earlier, individuals who are high in PIIT are more likely to be risk-seeking (Lewis et al., 2003; Lu et al., 2008), and may demonstrate more confidence in their capacity to adopt or use an innovation. In other words, they should have higher tolerance to risk and be more likely to adopt or use the innovation. Hence, we hypothesize that:

Hypothesis 3a. PIIT positively affect the intention to adopt mobile payment services.

Hypothesis 3b. PIIT positively affect perceived relative advantage of adopting mobile payment services.

Hypothesis 3c. PIIT negatively affect perceived risk of adopting mobile payment services.

3.4. pre-adoption and post-adoption criteria

As individuals' pre-adoption criteria on an innovation are formed primarily based on their indirect experience while post-adoption usage criteria are formed mainly based on their past experience, it is reasonable to assume that the importance of behavioral beliefs, social influences, and personal traits components in determining behavioral intention of mobile payment services are different over the pre-adoption and post-adoption stages.

In terms of behavioral beliefs, previous studies found that beliefs based on direct experience with a certain system predict behavior better than beliefs formed based on indirect experience (Karahanna et al., 1999). In fact, the direct experience of an individual with a target system may enable him or her to receive more information than indirect experience. Consequently, the individual is able to provide clearer and more confident evaluation on the object. Hence, we hypothesize that:

Hypothesis 4a. The effect of behavioral beliefs on behavioral intention will be stronger for users than for potential adopters of mobile payment services.

In terms of social influences, empirical evidence suggests that the direct effect of social influences on intentions may be weakened over time with increased system experience (Karahanna

et al., 1999). The underlying mechanism is that an individual's knowledge and beliefs about a system are "vague and ill-formed" in pre-adoption stages, and he or she must therefore rely more on the opinions of others for making decisions (Venkatesh & Davis, 2000). In post-adoption stages, those social influences will subside as the system's strengths and weaknesses become known via individual's direct experience. Based on the studies mentioned above, we hypothesize that:

Hypothesis 4b. The effect of social influences on behavioral intention will be stronger for potential adopters than for users of mobile payment services.

In terms of personal traits, Moore and Benbasat (1991) depict that the innovators and early adopters are those who are willing to take a risk of trying out a new information technology ahead of other members. Many studies agree that the innovativeness of an individual is a persistent trait or disposition by which one individual can be distinguished from another (Yi, Fiedler, & Park, 2006). During an innovation diffusion process, the time points at which an individual adopts the innovation can well reflect the individual's PIIT level. In the present study, the current mobile payment services users adopted the innovation earlier than the potential adopters. Therefore, it is reasonable to expect that the influences of PIIT on behavioral intention will be stronger for current users than for potential adopters of mobile payment services. Thus, the current study hypothesizes that:

Hypothesis 4c. The effect of PIIT on behavioral intention will be stronger for users than for potential adopters of mobile payment services.

4. Research method

4.1. Instrument

A cross sectional field study was conducted to examine the research model and its corresponding hypotheses. To assure the validity of the instrument, items used to measure the constructs were adapted from the extant literature by modifying the wording of the questionnaire to fit the mobile payment context. The questionnaire used seven-point Likert scales, with response choices ranging from one (strongly disagree) to seven (strongly agree). Four items on relative advantage were adapted from Kim, Shin, and Lee (2009) and measured the convenience, efficiency, effectiveness, and limitless location and time of mobile payment services. Three items on compatibility were adapted from (Moore & Benbasat, 1991). They reflect the degree of consistency between mobile payment services and individuals' existing values, needs, and lifestyle. We adapt the items for perceived risk from Lee (2009) and perceived fee items from Luarn and Lin (2005) to assess the adopters' non-monetary expense and monetary expenses of using mobile payment services, respectively. Five items on social influences were adapted from Lu et al. (2005) to measure the impact of subjective norms and social image on mobile payment adoption. We adapt the personal innovativeness in information technology items from Agarwal and Prasad (1998) to assess the willingness of an individual to try out mobile payment system. Two items on behavioral intention were adapted from Venkatesh and Davis (2000), and measured the intention to adopt mobile payment services.

Because the original items were in English, a back-to-back translation procedure was conducted. First, a researcher whose native language was Chinese translated all original items into Chinese. Then, another researcher independently translated the items back to English. Further, the two English versions were compared by the two researchers to confirm the meaning of the Chinese version. After that, the Chinese version was reviewed by three professors in the mobile commerce field. Based on their feedback, the wording of some of the items was modified to make them clear and understandable. A pilot test of 45 subjects (27 potential mobile payment adopters and 18 mobile payment users) was then conducted to further test the wording of the instruments. Subsequently some changes were made to the questionnaires. The final items used in the questionnaire are listed in the Appendix A.

4.2. Sample

The data collection was conducted using an online survey. The subjects were users of Alipay, which is the largest third-party

Table 1
Sample demographics.

Measure	Item	Potential adopters (N_1 = 483) Count (percentage)	Current users (N_2 = 156) Count (percentage)
Gender	Male	263 (54.5)	92 (59)
	Female	220 (45.5)	64 (41)
Age	18 or below	6 (1.2)	2 (1.3)
	>18 and ⩽ 24	191 (39.5)	79 (50.6)
	>25 and ⩽ 30	202 (41.8)	49 (31.4)
	>31 and ⩽ 35	52 (10.8)	20 (12.8)
	36 or above	32 (6.7)	6 (3.9)
Education	High school or below	98 (20.3)	17 (10.9)
	Two-year college	193 (40.0)	66 (42.3)
	Four-year college	135 (28.0)	57 (36.5.8)
	Graduates school or above	57 (11.8)	16 (10.3)
Occupation	Corporate	201 (41.6)	63 (40.4)
	Government	10 (2.1)	13 (8.3)
	Education	43 (8.8)	15 (9.6)
	Student	110 (22.8)	17 (10.9)
	Others	119 (24.6)	48 (30.8)
Monthly Income (RMB)	⩽1000	161 (33.3)	34 (21.8)
	>1000 and ⩽3000	250 (51.8)	91 (58.3)
	>3000	72 (14.9)	31 (19.9)
Mobile payment experience (years)	Nil	483 (100)	
	>0 and ⩽1		56 (35.9)
	>1 and ⩽2		64 (41)
	>2		36 (23.1)

electronic payment company in China. There were mainly two reasons why we chose Alipay as the test bed for the research. First, Alipay is the most important electronic payment provider in China with over 300 million subscribers at beginning of 2010. This would ensure that we obtain representative data. Second, China's mobile payment market is at a nascent stage. As a pioneer of China's mobile payment industry, AliPay launched its mobile payment services since 2008. Therefore, it would be a good context for identification of mobile payment services pre-adoption criteria and their comparison to post-adoption criteria.

A survey hyperlink was placed on the Alipay forum homepage (http://club.alipay.com/) and subjects were offered the latest models of mobile phones as lucky draw prizes to encourage participation. Before the participants answered the questionnaire, participants were given a description of the Alipay mobile payment services solution and were instructed that the term "mobile payment services" in the survey referred to the solution. Alipay mobile payment services solution is an intermediary that provides mobile payment services by integrating the functions of the mobile network operators' communications network with the financial institutions' payment accounts. Unlike mobile network operators and financial institutions which usually restrict payment services to their own customers and offer limited payment scenarios, Alipay mobile payment services solution can offer broader payment services by supporting a wide range of mobile networks and bank accounts. The survey was available on the website for a period of 4 weeks. A total of 639 valid responses were collected at the end of the period, with 483 potential adopters and 156 current users of mobile payment services.

Table 1 presents the demographic statistics for both potential adopters and current users. The statistics showed that the two samples had similar distribution in terms of gender and age. That is, 54.5% of participants in potential adopters sample and 59% of respondents in current users sample were male. Most respondents were in their 20s and 30s in both the samples. The distribution in terms of education, occupation and monthly income was different in the two samples. In potential adopters' sample, 20.3% of respondents had education less than high school, 22.8% of respondents were students, and 33.3% of respondents had monthly income below 1000 RMB. In the current users' sample, these statistics were 10.9%, 10.9% and 21.8%, respectively.

5. Data analysis and results

Following the two-step approach recommended by Anderson and Gerbing (1988), we first examined the measurement model and tested the construct reliability and validity. Then, we examined the structural model and tested the hypotheses.

5.1. Reliability and validity

We performed both principal components factor analysis and confirmatory factor analysis to assess the reliability and validity of the scales. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy for potential adopters sample and current users sample was 0.838 and 0.788, respectively, indicating the appropriateness of using the principle components factor analysis on the data. As shown in Appendix B, each indicator has a higher loading on its corresponding factor than the cross-loadings on other factors, showing a clear loading matrix.

Construct reliability and validity were further examined by confirmatory factor analysis. As shown in Table 2, the Cronbach's alphas were all above 0.8, indicating good reliabilities of the scales (Nunnally & Bernstein, 1978). The average variance extracted (AVE) for every construct was well above 0.6, indicating good convergent validities (Baggozi & Yi, 1988).

Discriminant validity was examined by comparing the square root of the AVE of each construct and its correlation coefficients with other constructs. As shown in Table 3, for both datasets, the square roots of the AVEs are larger than all corresponding correlation coefficients, suggesting good discriminant validities of the scales.

Table 2
Scale properties.

Variable	Item	Potential adopters			Current users		
		Standard loading	Cronbach's Alpha	AVE	Standard loading	Cronbach's Alpha	AVE
SN	SN1	0.702	0.867	0.653	0.755	0.897	0.709
	SN2	0.710			0.776		
	SN3	0.861			0.898		
	SN4	0.894			0.891		
	SN5	0.852			0.878		
PIT	PIT1	0.894	0.865	0.714	0.933	0.856	0.690
	PIT2	0.887			0.921		
	PIT3	0.807			0.842		
	PIT4	0.785			0.578		
REA	REA1	0.812	0.872	0.724	0.792	0.846	0.690
	REA2	0.884			0.855		
	REA3	0.891			0.896		
	REA4	0.812			0.773		
PRI	PRI1	0.879	0.870	0.795	0.842	0.853	0.769
	PRI2	0.898			0.937		
	PRI3	0.896			0.849		
COM	COM1	0.889	0.848	0.769	0.861	0.815	0.728
	COM2	0.851			0.819		
	COM3	0.889			0.877		
PEE	PEE1	0.871	0.806	0.831	0.963	0.897	0.907
	PEE2	0.950			0.942		
INT	INT1	0.946	0.873	0.887	0.931	0.859	0.876
	INT2	0.938			0.941		

Note. *SN = social influences; PIT = personal innovativeness in information technology; REA = relative advantage; PRI = perceived risk; COM = compatibility; PEE = perceived fee; INT = behavioral intention.

To assess the potential common method bias of our self-reported data, two statistical analyses were conducted by the suggestions from Podsakoff and Organ (1986) and Podsakoff et al. (2003). First, we performed a Harman's one-factor test on the seven conceptually crucial constructs in our proposed model including behavioral intention, relative advantage, compatibility, perceived risk, perceived fee, social influences, and PIIT. The results show that seven factors are present and the covariance explained by one factor in potential adopters' dataset and current users' dataset is 14.52% and 15.49% respectively. This indicates that common method bias is unlikely a problem in this study. Second, we added a general method factor in the model and compared with the original measurement model to further examine the common method bias. The general method factor included all the principal variables' indicators and calculated each indicator's variance substantively explained by the principal variables and by the method. The results of statistical analyses indicate that the principal variables loading are all significant, but the general method factor loadings are all not significant in both datasets. This indicates that the common method bias was unlikely to be a serious problem in the current study.

Table 3
Factor correlation coefficients and square roots of the AVE*.

	SN	PIT	REA	PRI	COM	FEE	INT
For potential adopters of mobile payment services (N_1 = 483)							
SN	0.808						
PIT	0.270	**0.845**					
REA	0.390	0.391	**0.851**				
PRI	−0.124	−0.049	0.060	**0.891**			
COM	0.375	0.452	0.491	−0.117	**0.877**		
FEE	−0.103	−0.042	−0.003	0.250	−0.102	**0.912**	
INT	0.402	0.446	0.466	−0.178	0.536	−0.185	**0.942**
For current users of mobile payment services (N_2 = 156)							
SN	**0.842**						
PIT	0.253	**0.831**					
REA	0.211	0.413	**0.831**				
PRI	0.049	0.118	0.065	**0.877**			
COM	0.257	0.428	0.425	0.065	**0.853**		
FEE	0.106	−0.040	−0.048	0.515	0.046	**0.952**	
INT	0.431	0.471	0.470	−0.141	0.464	−0.058	**0.936**

* Diagonal elements are the square root of AVE. These values should exceed the Inter-construct Correlations for adequate discriminant validity.

5.2. Hypothesis testing

LISREL 8.72 was adopted to test the proposed model and the corresponding hypotheses. According to Gefen et al. (2000), using LISREL to conduct the structural equation model (SEM) needs at least 100–150 respondents. The sample size of potential adopters and current users are 483 and 156, respectively. Therefore, the sample sizes are large enough for LISREL.

The actual and recommended values of the model fit indices are listed in Table 4. Except for GFI and NFI in the current users' dataset were slight below the recommended values, the actual values of all other fit indices were better than the recommended values, which demonstrate a good fit between the model and data (Gefen, Straub, & Boudreau, 2000). Figs. 2 and 3 show the results for potential adopters and current users respectively.

As shown in the Fig. 2, path analysis results of the potential adopters' dataset provide strong support for all the hypotheses, except Hypothesis 3c. In terms of behavioral beliefs, the positive effects of relative advantage (Hypothesis 1a), and compatibility (Hypothesis 1b) on adoption intention were supported; the negative effects of perceived risk (Hypothesis 1c), and perceived fee (Hypothesis 1d) on adoption intention are also found to be significant; In terms of social influences, the positive effect of social

Table 4
Fit induces and recommended values.

Fit index	x^2/df	RMSEA	GFI	CFI	NFI	NNFI
Recommended value	<3	<0.08	>0.90	>0.90	>0.90	>0.90
Potential adopters model value	2.25	0.051	0.921	0.977	0.960	0.973
Current users model value	1.69	0.067	0.836	0.948	0.894	0.936

Notes: RMSEA, root mean square error of approximation; GFI, goodness of fit index; CFI, comparative fit index; NFI, normed fit index; NNFI, non-normed fit index.

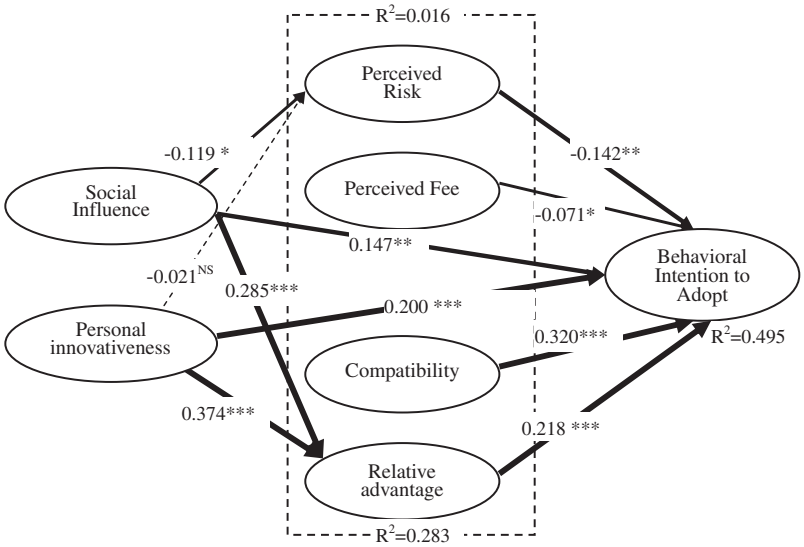

Fig. 2. Test results of the research model (for potential adopters). $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

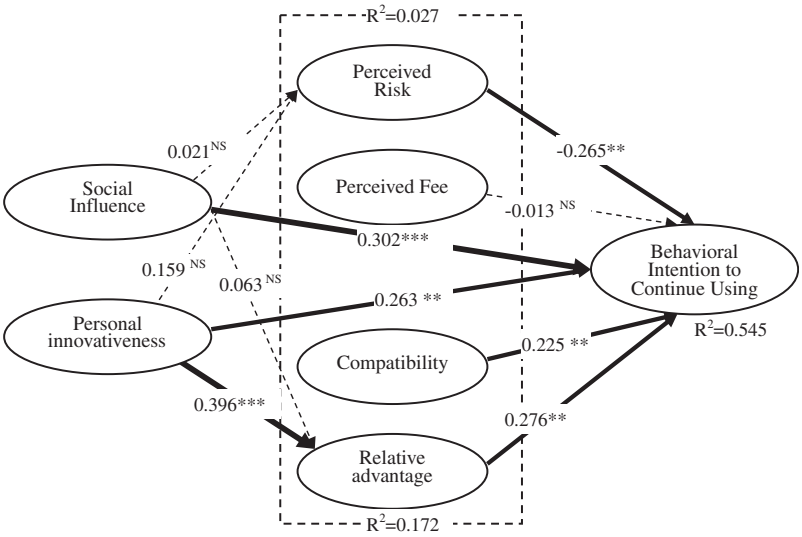

Fig. 3. Test results of the research model (for current users) $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table 5
Model comparison results between initial adopters and current users.

Path	Potential adopters (N_1 = 483)			Current users (N_2 = 156)			T value (coefficient by LISREL)
	Path analysis by LISREL	Path analysis by PLS	Support	Path analysis by LISREL	Path analysis by PLS	Support	
H1a:REA–>INT	0.218***	0.207***	Yes	0.276**[a]	0.244**	Yes	10.116
H1b:COM–>INT	0.320***	0.268***	Yes	0.225**[a]	0.198**	Yes	15.970
H1c:PRI–>INT	−0.142**	−0.104**	Yes	−0.265**[a]	−0.236**	Yes	26.646
H1d:PEE–>INT	−0.071*	−0.108**	Yes	−0.013[n.sa]	0.047[n.s]	No	8.558
H2a:SN–>INT	0.147**	0.144**	Yes	0.302***[a]	0.273***	Yes	31.458
H2b:SN–>REA	0.285***	0.307***	Yes	0.063[n.sa]	0.114[n.s]	No	46.053
H2c:SN–>PRI	−0.119*	−0.119*	Yes	0.021[n.sa]	0.020[n.s]	No	23.879
H3a:PIT–>INT	0.200***	0.195***	Yes	0.263**[a]	0.247**	Yes	10.228
H3b:PIT–>REA	0.374***	0.308***	Yes	0.396***[a]	0.384***	Yes	4.045
H3c:PIT–>PRI	−0.021[n.s]	−0.017[n.s]	No	0.159[n.sa]	0.113[n.s]	No	29.641

$T = (PC_1 - PC_2)/[\text{Spooled} * \text{SQRT}\ (1/N_1 + 1/N_2)]$; Spooled = $\text{SQRT}[[(N_1 - 1)/(N_1 + N_2 - 2)] * SE_1^2 + [(N_2 - 1)/(N_1 + N_2 - 2)] * SE_2^2]$; SE = standard error of path in the structural model; PC = path coefficient in the structural model.

[a] t-Tests showed significant ($p < .001$) differences for these coefficients between Potential adopters and current users groups.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

influences on adoption intention (Hypothesis 2a) and relative benefit (Hypothesis 2b) was supported; the negative effect of social influences on perceived risk (Hypothesis 2c) was also supported; In terms of personal traits, the positive effect of PIIT on adoption intention (Hypothesis 3a) and relative benefit (Hypothesis 3b) were found to be significant, while the negative effect of PIIT on perceived risk (Hypothesis 3c) was not significant.

As for the current users, Fig. 3 shows that most of the causal relationships in the research model were also supported. The negative effect of perceived fee (Hypothesis 1d) on intention to continue use was not supported. The positive effect of social influences (Hypothesis 2b) on relative advantage, and the negative effect of social influences (Hypothesis 2c) on perceived risk were both found to be insignificant. Also, the hypothesized path from PIIT to perceived risk was not significant in the current users' model. All other hypothesized relationships in current users' model were supported. The squared multiple correlations (SMC), which were the explained variances of adoption intention in potential adopters' model and intention to continue use in current users' model, were, 0.495 and 0.545 respectively.

To test whether our results were consistent across different statistical methods, we also performed a path analysis with Partial least squares (PLS) (PLS-Graph version 3.01060). The PLS results are displayed in Table 5. As shown in the Table, the results produced by LISREL and PLS were very similar, which indicated the robustness of our results.

We further conducted a comparison testing to test the difference in the strength of path coefficients between initial adopters and current users. The results presented in Table 5 show that all path coefficients were found to be significantly different between initial adopters and current users. In particular, in terms of behavioral beliefs, the effects of perceived risk and relative advantage on behavioral intention is stronger for current users than for initial adopters, while the effects of compatibility and perceived fee on behavioral intention is weaker for current users than for initial adopters, thus partially supporting H4a; Regarding social

Table 6
The results of mediating effects.

Model	IV	M	DV	IV → DV	IV → M	IV + M → DV	
						IV	M
N_1	SN	REA	INT	0.403***	0.402***	0.262***	0.364***
	PIIT	REA	INT	0.446***	0.395***	0.312***	0.343***
	SN	PRI	INT	0.403***	−0.138***	0.387***	−0.131*
N_2	PIIT	REA	INT	0.474***	0.421***	0.332***	0.343***

* $p < 0.05$.
*** $p < 0.001$.

influences, the effects of social influences on relative advantage and perceived risk are weaker for current users than for initial adopters, while the effect of social influences on behavioral intention is stronger for current users than for initial adopters, thus partially validating H4b; Regarding personal traits, the effects of PIIT on behavioral intention, relative advantage, and perceived risk are all stronger for current users than for initial adopters, thus validating H4c.

Given that relative advantage and perceived risk are sitting between the two components (social influence and personal traits) and behavioral intention variables, their mediating effects were also examined. The mediating effects test were conducted following the procedures suggested by Baron and Kenny's (1986). The results presented in Table 6. As shown, the relationship between social influences and behavioral intention is partially mediated by relative advantage and by perceived risk in the potential adopters' model; the relationship between personal traits (PIIT) and behavioral intention is partially mediated by relative advantage in both models.

6. Discussion

The present study examined two major research questions. The first one examined whether the behavioral beliefs, social influences, and personal traits are all salient factors in determining mobile payment services initial adoption. The second one examined, whether the importance of behavioral beliefs, social influence, and personal traits components in determining behavioral intention of mobile payment services is the same across the initial adoption and continued usage stages of the innovation decision process. The following findings emerge from our analysis.

Finding 1. For potential adopters, behavioral beliefs, social influences (subjective norm and image), and personal trait (PIIT) are found to have significant and direct influence on adoption intention of mobile payment services. In addition, social influences, and personal trait (PIIT) also have strong indirect influence on adoption intention.

As indicated by the significant paths in Fig. 2, among the behavioral beliefs factors, compatibility is the most significant factor, as indicated by its path loadings and significance levels, followed by relative advantage, and two negative utility components-perceived fee and perceived risk. Consistent with Peter and Tarpey's (1975), the results demonstrate that potential adopters tend to form their mobile payment services adoption intention by considering both the positive and negative factors. The findings are also in conformation with a number of previous consumer decision making studies in the e-commerce settings (Kim, Ferrin, et al., 2009; Kim, Shin, et al., 2009; Lu et al., 2011). In particular, the findings highlight the importance of compatibility in determining behavioral intention which is often not considered by adoption studies because compatibility is not considered in the original TAM model. One plausible explanation is that the emphasis points in a number of advertisements have now shifted from advocating utilitarian advantages to fulfilling personal desires, which enhances the impact of compatibility on adoption intention.

As theorized earlier, initial adopters who are without prior experience of mobile payment services tend to rely more on the opinions of others for making their decision. In the potential adopters' model, our results show that social influences in the form of subjective norm and image affect behavioral intention directly and indirectly via relative advantage and perceived risk. This is an intriguing finding because it indicates that social influences not only can directly enhance potential adopters' intention to use mobile payment services, they can also indirectly improve adopters' intentions by increasing relative advantage perceptions, and by reducing risk perceptions. Although a number of previous studies have validated the direct influence of social influences on behavioral intention (Hong & Tam, 2006), and the indirect impact through relative advantage (Lu et al., 2005), however, the indirect effect of social influences on behavioral intention via perceived risk has not yet been validated by any of acceptance studies in mobile commerce setting. Our finding suggests that influences from friends, colleagues, and important social circles are a critical determinant for potential adopters of mobile payment services. This is especially the case among highly collective-culture countries such as China where individuals are more easily influenced by others opinions than those living in the low collective-culture countries (e.g., America, Britain, and Australia).

Similar to the effect of social influences, the study also found that PIIT significantly influence behavioral intention directly and indirectly via the increased relative benefit perceptions. This result means that higher degrees of PIIT are associated with greater intention to adopt an innovation. As discussed earlier, individuals who are high in PIIT are more prone to take risks and easily envision the potential benefits associated with an innovation. They thus are more likely to adopt it. Our study has further validated the direct and indirect association between PIIT and behavioral intention which is found in several previous studies (Lewis et al., 2003; Lu et al., 2008). The indirect influence of PIIT via perceived risk on behavioral intention is not significant. This suggests that consumers' risk perceptions may usually not be affected by the internal personal traits.

Finding 2. For current users, perceived fee is no longer significant in determining behavioral intention; the indirect influences of social influences (subjective norm and image) via relative advantage and perceived risk on behavioral intention are also no longer significant.

As shown in Fig. 3, for current users, relative advantage is the most significant factor, followed by perceived risk, and compatibility. However, perceived fee is no longer significant in the post-adoption stage. One plausible explanation is that as the other positive perceptions are evaluated more clearly after directly using the mobile payment services, perceived fee is not among users' primary consideration. In addition, from a technical standpoint, mobile payment services as an innovation may not cost too much as expected in the pre-adoption stages. The current study also found that social influence in the form of subjective norm and image has a direct influence on intention to continue using mobile payment services. But its indirect influences through relative advantage and perceived risk are no longer significant, indicting the loss of the indirect effect of social influence on behavioral beliefs in the post-adoption stage. One plausible reason is that the indirect effect from social influences on consumers' behavioral beliefs via relative advantage and risk perceptions subsides over time with increased system experience. As for PIIT, since the innovativeness of an individual is a persistent trait, PIIT is found significant to affect behavioral intention directly and indirectly via relative benefit perceptions. This finding is consistent with most of the previous

individual behavior studies in information system literature (e.g., Lu et al., 2008).

Finding 3. In terms of behavioral beliefs, the effects of relative advantage and perceived risk on behavioral intention are found to be stronger for current users; while the effects of compatibility and perceived fee on behavioral intention are found to be stronger for potential adopters.

Our results indicate that the effects of relative advantage and perceived risk on behavioral intention are found to be stronger for current users. Such a difference could be explained in that consumers can develop more realistic perceptions toward mobile payment services by knowing more about its strengths and weaknesses through their direct experience. Such realistic perceptions develop through direct experience in turn result in a stronger belief–behavior relationship. As evidenced in the current study, the stronger influence of relative advantage and perceived risk on intention to continuing using mobile payment services re-emphasizes the need to include relative advantage and perceived risk into research model when explaining consumers' post-adoption behavior. This finding is also consistent with the finding in many previous studies (Karahanna et al., 1999) which demonstrate that beliefs based on direct experiences predict behavior better than beliefs formed through indirect experiences.

The effects of compatibility and perceived fee on behavioral intention are found to be stronger for potential adopters. The findings are opposed to our hypotheses. One potential explanation is that the mass media, based on which potential adopters develop their beliefs about mobile payment services, is designed to have emotional appeal (e.g., compatible with daily life) rather than to highlight their functionalities. This strengthens the impact of compatibility on initial adoption intention. On the other hand, unlike potential risk, the perceived fee usually can be well controlled and managed by current users' budget. In this case, they can easily figure out how much budget has been used, resulting in an insignificant impact on behavioral intention.

Finding 4. In terms of social influences, the direct effects of social influences in the form of subjective norm and image on behavioral intention are hold for both groups, while its indirect effects on behavioral intention are only significant in potential adopters' model.

One important finding of this study is the effect of social influence on behavioral intention. Our finding indicates that the effect of social influence in the form of subjective norm and image on behavioral intention differ significantly as individuals move from the initial adoption stage to the post-adoption stage. For potential adopters, social influences have both strong direct and indirect impact on behavioral intention; while for users, the indirect effect through relative advantage and perceived risk on behavioral intention is no longer significant. This is in contrast to a number of previous findings in work settings. The explanation may be that the usage of mobile payment services is a form of public consumption. Such usage will directly serve as a means of maintaining social memberships and status in the pre-adoption stage and in later post-adoption stages. Considering the relative advantage and risk perceptions in post-adoption stage are mainly formed based on users' first-hand experience, the indirect effects of social influences on behavioral intention via relative advantage and risk perceptions may be eclipsed by users' direct experience. Even though their indirect influence via behavioral beliefs vanish following adoption, role of social influences may be important in luring initial adoption and also in facilitating the subsequent continued usage.

Finding 5. In terms of personal traits, PIIT affect behavioral intention directly and indirectly via relative advantage for both groups. In particular, such effects are stronger for users.

Another important finding of this study is regarding the effect of PIIT on behavioral intention. The study reveals that the direct and indirect effects of PIIT on behavioral intention are both stronger for users. The reason for this finding is straightforward. Since the innovativeness of an individual is a persistent trait, individuals who adopt an innovation earlier are usually people with high degree of innovativeness disposition. In the context of this study, the current users adopt the mobile payment services early than those initial adopters. The current users with higher level of PIIT therefore will more easily envision the potential benefits and would be more likely to use the innovation. In light of the persistent influences from PIIT on behavioral intention, we have learned that PIIT plays a significant role plays in facilitating initial adoption and continued usage of mobile payment services.

7. Theoretical and practical implications

7.1. Theoretical implications

The present study reveals a few interesting implications for research and practice. First, its findings help to further our understanding of the nomological network among behavioral beliefs, social influences, personal traits, and behavioral intention in the mobile technologies based services setting. The study reveals that behavioral beliefs, social influences, and PIIT are all important determinants of individual adoption. More importantly, in response to the call for a further exploration of the interplay between innovation attributes and social influences, etc. (Karahanna et al., 1999), we examine the indirect effect of social influences and personal traits on behavioral intention via relative advantage and perceived risk. As expected, social influences exert strong indirect influence on initial adoption through positively influencing relative advantage and negatively affecting perceived risk; PIIT also indirectly affects initial adoption via the positive impact on relative advantage. Such finding is considered a unique contribution to the theoretical understanding of the perception process concerning innovation attributes.

Second, in response to the call for more adequate classifications of mobile payment users (Kim, Ferrin, et al., 2009; Kim, Shin, et al., 2009), the current study distinguished two types of mobile payment users: potential adopters and current users. This study suggests that pre-adoption and post-adoption behaviors are determined by different factors in mobile payment technology. Specifically, in terms of social influence, most of previous studies have found that the effect of social influences subsides over time with increased system experience (Karahanna et al., 1999; Venkatesh & Davis, 2000). These findings are appropriate given the organizational settings of previous research. As usage context expands beyond work setting, our results indicate that the effect trajectories of social influences are more intricate than we might originally think. While the direct effects of social influences are both significant for potential adopters and current users, the indirect effects of social influences on behavioral intention are no longer significant for users. In addition, we also find that the direct and indirect effects of PIIT on behavioral intention are both stronger for users. Thus, this study contributes to a better theoretical understanding of temporal evolution of behavioral beliefs, social influence, personality traits, and behavioral intention from the pre-adoption stage to the post-adoption stage.

Finally, based on the theory of reasoned action (TRA) and the innovation diffusion theory (IDT), the current study bridges three sets of adoption drivers (behavioral beliefs, social influences, and personal traits) over two distinct adoption phases (pre-adoption and post-adoption stages). We believe that this study provides a holistic insight into the decision making process of innovation adoption. We also expect that this study will be a harbinger for future research in the area of mobile payment adoption as well as adoption of other mobile technology based services.

7.2. Practical implications

The successful and mass adoption of mobile payment services is critical for service providers and investors to achieve the desired market share and the profits forecasted in their strategic plans. The findings of this study also provide important practical implications for management.

First, service providers need to increase individuals' perceptions on compatibility and relative advantage, and decrease their perceived risk and cost about the services. For example, to expand their consumer-base, service providers can highlight value of mobile payment services against traditional payment services and emphasize functional advantage and behavioral compatibility of mobile payment services. To relieve negative perceptions, services providers can design various assurance procedures to reduce uncertainties associated with mobile payment adoption and usage. They can also offer a long-term user preferential plan or provide a packaging cost scheme to reduce consumers' perceived costs.

Second, the strong impacts of social influences on intention demonstrate that adopting mobile payment services can serve as a means to reinforce individuals' social connections and social status of group affiliation. The implication for practitioners is clear: service providers and marketers can expand user bases and their sources of revenue by leveraging the effects of social influences. Recent attempts by some mobile service providers to promote services to specific-targeted young consumer groups seem to be moving in this direction (Hong & Tam, 2006). Indeed, the importance of social influences on behavioral intention is that they can indirectly enhance adopters' intention by increasing relative advantage and by decreasing risk perception, in addition to their direct effect on behavioral intention.

Third, the finding also indicates that difference in adopters' personal innovativeness should be taken into account to facilitate the acceptance of mobile payment services. As the PIIT of an individual is a persistent trait, service providers can distinguish groups of individuals based on their PIIT. Then, service providers can employ different implementation and supporting strategies to facilitate effective diffusion of the mobile payment services.

Fourth, the significant different effects of behavioral beliefs, social influence, and personality traits on intention between initial adopters and current users should be of special interest for services providers to maintain a long-term relationship with consumers. As for the current users, service providers need to exert more effort to address consumers' perceptions on relative advantage and risk. The reason is that the critical influence of social influences on intention through increasing relative advantage perceptions and decreasing risk perceptions no longer hold true for current users. On the other hand, since the current users are usually innovators and early adopters, they can be a source for service providers to attract potential adopters via social networks and proper rewarding schemes. However, as the life span of an innovation is usually short, to maintain a high level of current users' satisfaction, new function or services need to be introduced continually.

8. Limitations and future research

This study has some limitation that should be taken into account when interpreting the findings. First, as the biases inherent in most web survey-based research, the current study did not cover users who do not use internet and thus excluded the elderly and the non computer-literate segments of the population. However, this is not a serious limitation because potential and early adopters of mobile technologies tend to be young and educated, and the profile of our sample falls into this category.

Another potential limitation is that the current study does not incorporate actual usage behavior in the continued use model. While this limitation is noted, it should not undermine our results because there is substantial empirical support for the causal association between intention and behavior (Venkatesh & Davis, 2000; Venkatesh & Morris, 2000). However, considering behavioral intentions may be mediated by many other variables and thus may not fully represent the actual behavior, we suggest researchers to include the actual behavior in the future study.

Third, a major theme of this paper is that the adoption of mobile payment services is driven by factors including behavioral beliefs, social influences, and personal traits. Although essential, these three sets of drivers are insufficient to portray a complete picture of adoption behavior of mobile payment services. Psychology and behavioral sciences suggest that users habit and context are also potentially important factors of IT adoption (Fuller & Dennis, 2009; Gefen, 2003; Goodhue & Thompson, 1995; Limayem, Hirt, & Cheung, 2007; Ouellette & Wood, 1998; Wu, Chen, et al., 2007). Thus, it is important for further research to investigate how habit and use context affects consumer mobile payment services adoption behavior.

Finally, a more qualitative approach, such as a case study, may offer a different and perhaps complementary insight for explaining the adoption of mobile payment services than a quantitative survey as used in the present study. Clearly, the methodology adopted for the present study presents certain constraints as common in the most previous adoption studies. Future efforts should attempted to utilize different methodologies (such as combined qualitative approach with the quantitative methods) to uncover research artifacts and triangulate on the phenomenon. In addition, a potential limitation also arises from the different cultural and market conditions. Because different countries have notable differences in the use of mobile payment services, the research findings may vary from one country to another. Therefore, continued research can further test and validate our findings in different companies and different cultural contexts.

The current study also opens a few opportunities for future research. First, as we all know, with few exceptions, most mobile-technology based services evolved from the internet technology or other traditional technology based services. Accordingly, most mobile-technologies based service users actually upgrade from the users of traditional technologies based services. Consequently, consumers' prior experiences with the traditional services may affect their perceptions and beliefs about the corresponding mobile-technologies based services. Future studies can examine adoption of mobile payment services from a dynamic cross-environment perspective.

Second, while this study focuses on finance related mobile services a number of different types of mobile-technology related services are currently available to individual users in the market. As different innovations are designed to interact with users in different contexts, factors that influence individual's adoption of a target innovation may be different in various contexts (Hong & Tam, 2006). Future studies can contribute richness and depth to the understanding of mobile-technologies related services adoption in various social settings.

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Appendix A. Measurement scales

Social influences (adapted from Lu et al. (2005)).

- SN1: People who influence my behavior think that I should use mobile payment.
- SN2: My friends think that I should use mobile payment.
- SN3: People around me who use mobile payment have more prestige than those who do not.
- SN4: People who use mobile payment have a high profile.
- SN5: Using mobile payment is considered a status symbol among my friends.

Personal innovativeness in information technology (adapted from Agarwal and Prasad (1998)).

- PIT1: If I heard about a new information technology, I would look for ways to experiment with it.
- PIT2: Among my peers, I am usually the first to explore new information technologies.

Table A1
For potential adopters of mobile payment services ($N = 483$).

Factor	SN	PIT	REA	PRI	COM	PEE	INT
SN1	**0.617*****	0.221	−0.006	0.272	−0.006	−0.090	−0.405
SN2	**0.620*****	0.127	0.101	0.281	−0.091	−0.180	−0.385
SN3	**0.837*****	0.156	0.124	0.086	−0.006	−0.039	0.137
SN4	**0.883*****	0.162	0.105	0.070	−0.061	0.013	0.152
SN5	**0.864*****	0.075	0.108	0.062	−0.072	0.041	0.169
PIT1	0.080	0.178	**0.836*****	0.217	0.005	−0.068	0.026
PIT2	0.053	0.152	**0.838*****	0.235	0.004	0.000	0.049
PIT3	0.135	0.174	**0.743*****	0.134	−0.028	−0.003	0.075
PIT4	0.090	0.056	**0.826*****	0.039	−0.044	0.037	0.063
REA1	0.075	**0.749*****	0.226	0.185	0.202	−0.004	0.052
REA2	0.090	**0.866*****	0.125	0.161	0.085	0.000	0.079
REA3	0.168	**0.843*****	0.128	0.188	0.002	0.033	0.060
REA4	0.259	**0.742*****	0.126	0.159	−0.117	−0.064	0.014
PRI1	−0.061	0.038	−0.028	−0.013	**0.873*****	0.069	−0.040
PRI2	−0.021	0.051	−0.018	−0.072	**0.891*****	0.087	−0.046
PRI3	−0.072	0.028	−0.015	−0.060	**0.875*****	0.132	0.008
COM1	0.149	0.179	0.175	**0.821*****	−0.065	0.043	0.103
COM2	0.131	0.186	0.214	**0.788*****	−0.021	−0.042	−0.011
COM3	0.119	0.270	0.199	**0.767*****	−0.068	−0.057	0.130
PEE1	−0.060	0.036	0.026	0.034	0.189	**0.882*****	−0.039
PEE2	−0.016	−0.008	−0.036	−0.089	0.088	**0.905*****	−0.043
INT1	0.272	0.293	0.252	0.391	−0.133	−0.137	**0.590*****
INT2	0.252	0.256	0.225	0.396	−0.086	−0.172	**0.606*****
Eigen-values	3.340	3.080	3.015	2.623	2.480	1.735	1.159
Variance %	14.523	13.393	13.109	11.405	10.785	7.542	5.039
Cumulative	14.523	27.915	41.025	52.429	63.214	70.756	75.794

*** $P < 0.001$.

Table A2
For current users of mobile payment services ($N = 156$).

Factor	SN	PIT	REA	PRI	COM	PEE	INT
SN1	**0.615*****	−0.039	0.025	0.210	0.052	−0.184	0.532
SN2	**0.664*****	0.067	0.018	0.090	0.134	−0.111	0.381
SN3	**0.897*****	0.077	0.193	−0.010	0.088	0.110	0.045
SN4	**0.929*****	0.105	0.105	−0.040	0.065	0.116	−0.028
SN5	**0.905*****	0.058	0.032	−0.035	0.037	0.078	0.072
PIT1	0.033	0.245	**0.821*****	0.148	0.186	0.031	0.201
PIT2	0.028	0.206	**0.836*****	0.150	0.205	−0.031	0.170
PIT3	0.160	0.129	**0.731*****	−0.061	0.242	0.034	0.219
PIT4	0.141	−0.045	**0.784*****	−0.058	−0.069	−0.206	−0.187
REA1	−0.063	**0.704*****	0.193	0.175	0.335	0.048	0.086
REA2	0.007	**0.883*****	0.134	0.036	0.139	0.023	−0.107
REA3	0.116	**0.848*****	0.198	−0.002	0.062	−0.114	0.167
REA4	0.211	**0.725*****	−0.038	−0.050	0.113	−0.064	0.258
PRI1	−0.010	−0.014	0.032	**0.738*****	0.066	0.398	−0.115
PRI2	0.050	0.034	0.075	**0.865*****	0.008	0.200	−0.096
PRI3	0.001	0.072	0.031	**0.864*****	0.018	0.120	0.034
COM1	0.133	0.180	0.164	−0.028	**0.777*****	0.167	0.121
COM2	0.023	0.137	0.155	0.062	**0.853*****	−0.102	0.003
COM3	0.131	0.178	0.096	0.037	**0.797*****	−0.023	0.204
PEE1	0.082	−0.038	−0.095	0.332	0.077	**0.833*****	−0.001
PEE2	0.075	−0.065	−0.071	0.351	−0.065	**0.859*****	0.058
INT1	0.171	0.372	0.237	−0.187	0.235	0.128	**0.634*****
INT2	0.260	0.222	0.291	−0.239	0.257	0.070	**0.692*****
Eigen-values	3.563	2.951	2.891	2.511	2.424	1.846	1.667
Variance %	15.492	12.830	12.571	10.92	10.541	8.028	7.247
Cumulative	15.492	28.322	40.894	51.813	62.354	70.382	77.629

*** $P < 0.001$.

- PIT3: I like to experiment with new information technologies.
- PIT4: In general, I am hesitant to try out new information technologies.

Perceived fee (adapted from Luarn and Lin (2005)).

- PEE1: It would cost a lot to use mobile payment.
- PEE2: There are financial barriers (e.g., having to pay for handset and communication time) to my using mobile payment.

Perceived risk (adapted from Lee (2009)).

- PRI1: I would not feel totally safe providing personal privacy information over the mobile payment system.
- PRI2: I am worried to use mobile payment because other people may be able to access my account.
- PRI3: I would not feel secure sending sensitive information across the mobile payment system.
- Relative advantage (adapted from Kim, Shin, et al. (2009)).
- REA1: Mobile payment has more advantages than internet or off-line payment because services are not limited by location.
- REA2: Mobile payment is more convenient than internet or off-line payment.
- REA3: Mobile payment is more efficient than internet or off-line payment.
- REA4: Mobile payment is more effective than internet or off-line payment in managing a payment account.
- Compatibility (adapted from Moore and Benbasat (1991)).
- COM1: Using mobile payment is compatible with all aspects of my work.
- COM2: I think that using mobile payment fits well with the way I like to work.
- COM3: Using mobile payment fits into my work style.
- Behavioral intention (adapted from Venkatesh and Davis (2000)).
- INT1: Assuming I have access to the mobile payment system, I intend to use it.
- INT2: Given that I have access to the mobile payment system, I predict that I would use it.

Appendix B. Loadings and cross loading

See Tables A1 and A2.

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