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Examining mobile banking user adoption from the perspectives of trust and flow experience

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Abstract Due to the high perceived risk and poor experience associated with using mobile banking, it is critical for service providers to build users' trust and improve their experience. Integrating both perspectives of trust and flow experience, this research examined the factors affecting mobile banking user adoption. The results indicate that structural assurance is the main factor affecting trust, whereas ubiquity and perceived ease of use are the main factors affecting flow experience. Trust has a significant effect on flow experience, and both factors determine usage intention, which in turn affects actual usage. Thus mobile service providers need to concern both trust and flow experience to facilitate user adoption and usage of mobile banking services.

Keywords Trust · Flow experience · Mobile banking · Structural assurance

1 Introduction

With the application of third generation (3G) mobile communication technologies, mobile commerce has acquired rapid development. According to the 28th report issued by China Internet Network Information Center (CNNIC) in July 2011, the number of mobile internet users in China has reached 318 million, accounting for 66% of the internet population (485 million) [1]. This shows the great mobile user base. Faced with this opportunity, mobile service providers have released a variety of services, which can be classified into four categories: communication, information, entertainment and transaction. The CNNIC report indicates that the entertainment applications such as mobile music, games and video have been very popular among users [1]. In comparison, mobile banking as a transaction application has only been adopted by a minority of users (7.1%). Nevertheless, mobile banking as an emerging service has great potential. For example, it is estimated that Chinese mobile payment market will reach 120 billion RMB Yuan (about 18 billion US dollars) in 2012 [2].

Mobile banking means that users adopt mobile terminals such as cell phones to access payment services including account inquiry, transference and bill payment. With the help of mobile terminals and networks, mobile banking has freed users from the temporal and spatial limitations, and enabled them to conduct payment at anytime from anywhere. Four state-owned banks in China including the Industrial and Commercial Bank of China (ICBC), China Construction Bank (CCB), Agricultural Bank of China (ABC), and Bank of China (BOC) have released their own mobile banking services. These banks also own the majority of online banking market share. Private banks such as China Merchant Bank (CMB) have also provided mobile banking services to users. They expect users to widely adopt and use mobile banking. Then they can achieve advantage in the intense competition. The earliest mobile banking is short messaging banking, which is started in 2000 and enables users to check account balance and transfer money via short messages. The second generation of mobile banking is wireless application protocol (WAP) banking. Users can visit a bank's WAP site to access payment services. After that, some banks released mobile banking client-end software catering to different mobile phone operation systems, such as Android,

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Symbian and iPhone. Compared to WAP banking, client-end software has better usability and interface. However, they have similar functions, such as balance check, transference, bill payment and financial management. The CNNIC report indicates that while online banking has been popular among users (31% of acceptance rate), mobile banking is still in its early stage of development (7.1% of acceptance rate) [1].

Considering the low adoption rate of mobile banking, it is necessary to identify the factors affecting mobile banking user adoption. On one hand, due to the virtuality and lack of control, mobile banking involves great uncertainty and risk. Especially, compared to wired networks, mobile networks may be more vulnerable to hacker attack and information interception. This leads to users' concern about mobile banking security. They doubt whether mobile banking can effectively protect their account and payment from potential problems. If they cannot engender enough trust in mobile banking, they will not adopt and use it. On the other hand, compared to desktop computers, mobile terminals such as cell phones have some constraints such as small screens, low resolution and inconvenient input, which make it difficult for mobile users to search for relevant information. In addition, users always expect to acquire ubiquitous and reliable mobile banking services. The frequent service interruption and slow responses may undermine user experience. Thus delivering a compelling experience to users is also critical to their adoption and usage of mobile banking.

Extant research has noted the significant effect of trust on mobile banking user behavior [3–5]. However, the effect of user experience on usage behavior has seldom been tested. Without an engaging experience, users may be reluctant to adopt mobile banking even they believe that mobile banking can ensure their payment security. Thus it is necessary to integrate trust and flow experience to examine mobile banking user adoption. This is the purpose of this research. We used flow to reflect user experience. Flow as an optimal experience has been found to affect user behavior [6]. We included structural assurance, ubiquity, perceived ease of use and personal innovativeness into the model as the determinants. Both trust and flow experience act as mediators between these four determinants and usage intention.

The rest of this paper is organized as follows. We review relevant literature on mobile trust, online and mobile banking adoption, and flow in the next section. Then we propose the research model and hypotheses in section three. Section four reports instrument development and data collection. Section five presents data analysis and results, followed by a discussion of these results in section six. Section seven presents the theoretical and managerial implications. We summarize the limitations and conclude the paper in section eight.

2 Literature review

2.1 Mobile trust

Due to the virtuality, anonymity and temporal and spatial separation, online transactions involve great uncertainty and risk. Thus users need to build trust to alleviate perceived risk and facilitate their transactions. Due to its significant role, trust has received considerable attention in information systems research, especially in the e-commerce context. The factors identified to affect online trust include website-based, user-based, company-based determinants [7]. Similar to online transactions, mobile transactions also involve great risk. Thus it is critical to building mobile user trust [8]. Compared to the abundant research on online trust, mobile trust has just begun to receive attention from researchers. Siau and Shen [9] noted that mobile trust includes initial trust and continuous trust, which are affected by the factors associated with two aspects: mobile merchants and technologies. Lin and Wang [10] revealed that trust has significant effects on mobile user satisfaction and loyalty. Li and Yeh [11] argued that design aesthetics affect mobile trust through ease of use, usefulness and customization. Vance et al. [12] examined the effect of system quality including visual appeal and navigational structure on mobile user trust.

2.2 Online and mobile banking adoption

Online banking represents a type of electronic banking and its adoption has received considerable attention from researchers. And most research has been conducted from the perspective of the technology acceptance model (TAM). Laforet and Li [13] compared the factors affecting Chinese users' adoption of online and mobile banking. Their results indicated that security is the main factor affecting online banking adoption, whereas lack of awareness and understanding of benefits is the main factor affecting mobile banking adoption. Lee et al. [14] found that offline banking trust has significant effects on online banking users' flow, structural assurance, satisfaction and perceived extent of use. Lee et al. [15] examined user switch from offline banking to online banking. Their results indicated that perceived usefulness, perceived ease of use, offline trust, offline loyalty and switch cost affect user attitude towards switching. Al-Somali et al. [16] found that perceived usefulness, perceived ease of use and trust affect online banking acceptance in Saudi Arabia. Liao and Cheung [17] suggested that usefulness, ease of use,

reliability, security, responsiveness and continuous improvement affect user satisfaction with online banking. Yiu et al. [18] noted that perceived usefulness, perceived ease of use, perceived risk and personal innovativeness affect online banking adoption in Hong Kong.

As an emerging service, mobile banking adoption has also gained attention from researchers. Luo et al. [5] integrated trust theory and the unified theory of acceptance and use of technology (UTAUT) to examine mobile banking user behavior. Their results show that trust has effects on perceived risk and performance expectancy, further determining behavioral intention. Kim et al. [3] reported that structural assurance, relative benefits and personal propensity to trust affect initial trust in mobile banking. Lin [19] integrated innovation diffusion theory (IDT) and trust theory to examine mobile banking adoption. Their results indicated that relative advantage and perceived competence have strong effects on user attitude towards mobile banking. Shen et al. [20] examined mobile banking adoption from a benefit-cost perspective. They suggested that the key benefit of mobile banking is convenience, whereas the key cost is security.

Comparing above research on online and mobile banking adoption, we can find that trust has been found to be a significant determinant of user behavior. Nevertheless, there may exist some differences between the factors affecting both online and mobile banking adoption. For example, compared to online banking, the main advantage of mobile banking is ubiquity, which enables users to access payment services at anytime from anywhere. In addition, mobile banking needs strong structural assurance as it involves great uncertainty and risk due to possible information interception and hacker attack associated with mobile networks. The constraints of mobile terminals such as small screens and inconvenient input also increase the difficulty of using mobile banking and undermine usage experience. Thus it is necessary to take these unique characteristics such as ubiquity and structural assurance into consideration when examining mobile banking user adoption. Our research model tries to capture the effects of these factors on mobile banking user behavior.

2.3 Flow

Flow is defined as a holistic sensation that people feel when they act with total involvement [21]. Novak et al. [22] described flow as a state that is characterized by: (1) a seamless sequence of responses facilitated by machine interactivity, (2) intrinsic enjoyment, (3) a loss of self-consciousness, and (4) self-reinforcement. Flow reflects a balance between users' skills and challenges. When skills are larger than challenges, users feel bored. In contrast, when challenges are larger than skills, users feel anxious. When both skills and challenges are lower than the threshold values, users feel apathy. Only when both skills and challenges exceed the threshold values and have a good match can users experience flow.

As an elusive concept, flow consists of multiple components, such as perceived enjoyment, perceived control and attention focus [23]. Perceived enjoyment reflects users' pleasure when using an information technology. Perceived control reflects users' feelings of control over the activity and surrounding environment. These feelings come from users' owned skills and necessary resources. Attention focus reflects users' immersion and concentration. Besides these three factors, extant research has also found other components of flow, such as curiosity, interest [24, 25], time distortion [26], and challenge [27]. In this research, we measured flow with three items reflecting attention focus, perceived control and enjoyment, respectively. This measurement has also been used in prior research [14, 28, 29].

Flow has been examined in the electronic commerce contexts, including online shopping [27, 30, 31], instant messaging (IM) [32], e-learning [24] and online travel community [26]. Recently, it has been used to explain mobile user behavior. Deng et al. [33] argued that cognitive absorption (similar to flow) affects users' satisfaction with mobile internet services and their continuance usage. Jung et al. [34] reported that mobile TV content affects users' cognitive concentration, further determining their usage intention. Ha et al. [35] noted that flow experience affects user adoption of mobile games.

3 Research model and hypotheses

Figure 1 presents the research model. Structural assurance, ubiquity, perceived ease of use and personal innovativeness are proposed to affect trust and flow. In addition, trust affects flow and both factors affect usage intention, which in turn affects actual usage. Demographic variables including gender, age and education level are included into the model as control variables.

Structural assurance as an institution-based trust mechanism can effectively build users' trust in and decrease their perceived risk with online transactions [36]. Structural assurance means that there exist adequate technological and legal structures to ensure payment security. Compared to online banking, mobile banking built on wireless networks may be more vulnerable to hacker attack and information interception. In addition, viruses and Trojan horses may exist in mobile terminals. These problems will affect the account and money security. A report also shows that 48.2% of users did not use mobile payment because of their worry about security [2]. Thus, if there exist enough

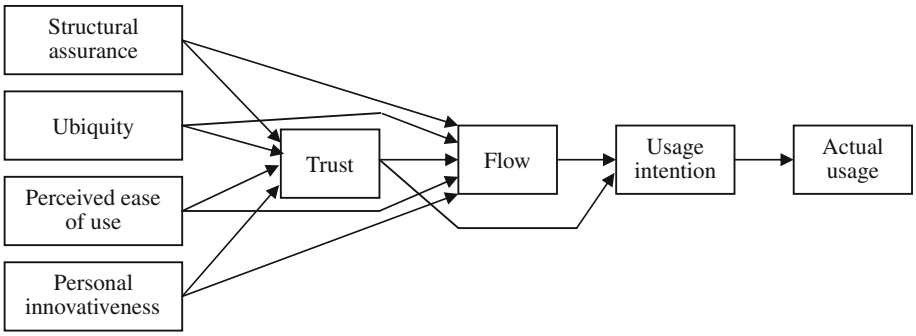

Fig. 1 Research model

structural assurances such as certification and regulations to ensure payment security, users can build their trust in mobile banking because they may transfer their trust in these third-party mechanisms to mobile banking. In addition, structural assurance increases users' feelings of control over mobile payment. They will feel comfortable to use mobile banking and this helps them acquire a pleasant experience. Prior research has suggested the effect of structural assurance on user trust in online health infomediaries [37] and mobile banking [3]. Structural assurance is also found to affect flow in using online banking [14]. Thus, we propose,

H1 Structural assurance positively affects user trust.

H2 Structural assurance positively affects flow experience.

Ubiquity means that with the help of mobile terminals and networks, users can access mobile banking at anytime from anywhere. Ubiquity is a main advantage of mobile banking compared to traditional and online banking. It frees users from the spatial and temporal limitations and enables them to conduct ubiquitous payment. Nevertheless, presenting ubiquitous services to users is not easy for service providers. They need to spend continuous effort and resources on ensuring ubiquitous mobile banking services. Thus ubiquity will act as a trustworthiness signal. If users cannot acquire reliable and ubiquitous services, they may decrease their evaluations on service providers' ability and integrity. Lee [38] also pointed out the positive effect of ubiquitous connection (similar to ubiquity) on mobile trust. Further, ubiquity may help users acquire an engaging experience. They can enjoy the convenient and reliable payment services brought by mobile banking. In contrast, if users often encounter service unavailability or interruption, their experience will be negatively affected. They cannot acquire immersion and pleasure, and may feel lack of control over mobile banking. Thus,

H3 Ubiquity positively affects user trust.

H4 Ubiquity positively affects flow experience.

Perceived ease of use is a main component of TAM [39]. It reflects the difficulty of using mobile banking. Due to the constraints of mobile terminals such as small screens and inconvenient input, it may be difficult for users to operate mobile banking if service providers cannot present a good interface to users. An easy-to-use mobile banking with well-designed interfaces and powerful navigation will reflect service providers' ability and benevolence, thus affecting user trust. In addition, an easy-to-use mobile banking system will also reduce users' effort spent on learning to use mobile banking and increase their feelings of perceived control. This helps focus users' attention on the main activity and improve their experience. The effect of perceived ease of use on trust has been validated in previous research [12, 40]. Perceived ease of use is also found to affect flow experience in using mobile gaming [35], and online communication technologies [29]. Thus, we propose,

H5 Perceived ease of use positively affects user trust.

H6 Perceived ease of use positively affects flow experience.

Personal innovativeness reflects a user's willingness to try out new technologies [41]. Users with high personal innovativeness are willing to experience new technologies such as mobile banking. Due to their open mind to new technologies and risk-taking attitude, they will readily build trust in mobile banking. This open mind may also help them acquire a good experience. In contrast, those users with low personal innovativeness may doubt the credibility of mobile banking and hesitate to use it. This will negatively affect their trust and usage experience.

H7 Personal innovativeness positively affects user trust.

H8 Personal innovativeness positively affects flow experience.

Trust reflects a willingness to be in vulnerability based on the positive expectations towards another party's future behavior [42]. Trust often includes three dimensions: ability, integrity and benevolence [43]. Ability reflects that

service providers have the skills and knowledge necessary to fulfill their tasks. Integrity reflects that service providers keep their promises and do not deceive users. Benevolence reflects that service providers keep users' interests in mind and will not just care their own benefits. Trust may affect flow experience. Trust provides a guarantee that users acquire positive results in future [44]. This will increase their perceived control and reduce their effort spent on monitoring service providers. They feel ensured that they will obtain a good experience. Thus, we propose.

H9 Trust positively affects flow experience.

Trust and flow experience will affect usage intention. Trust helps alleviate the uncertainty and risk associated with using mobile banking, and will promote user behavior. According to the theory of reasoned action (TRA), trust as user belief will affect behavioral intention, which in turn affects actual behavior [45]. In addition, flow experience as an optimal experience also facilitates user behavioral intention [28].

H10 Trust positively affects usage intention.

H11 Flow experience positively affects usage intention.

H12 Usage intention positively affects actual usage.

4 Method

The research model includes eight factors. Except actual usage, other factors are measured with multiple items. All items were adapted from extant literature to improve content validity [46]. These items were first translated into Chinese by a researcher. Then another researcher translated them back into English to ensure consistency. When the instrument was developed, it was tested among ten users that had mobile banking usage experience. Then according to their comments, we revised some items to improve the clarity and understandability. The final items and their sources are listed in "Appendix". All items were measured with a seven-Likert scale ranging from strongly disagree (1) to strongly agree (7).

Items of structural assurance were adapted from McKnight et al. [47] to reflect that there exist technological and legal structures to ensure payment security. Items of ubiquity, trust and usage intention were adapted from Lee [38]. Items of ubiquity reflect that users can access mobile banking at anytime from anywhere. Items of trust reflect service providers' ability, integrity and benevolence. Items of usage intention reflect a user's willingness to use and continue using mobile banking. Items measuring perceived ease of use and personal innovativeness were adapted from Agarwal and Karahanna [41]. Items of perceived ease of use reflect the difficulty of learning to use and skillfully using mobile banking. Items of personal innovativeness reflect a user's active attitude to experience new technologies. Items of flow experience were adapted from Lee et al. [14] to reflect a user's enjoyment, perceived control and attention focus when using mobile banking. Actual usage is measured with an item reflecting mobile banking usage frequency.

Data were collected at two service halls of China Mobile and China Unicom, which represent the two main mobile telecommunication operators in China. The service halls are located in an eastern China city, where mobile commerce is relatively better developed than other regions. There are plenty of mobile users at these places and this will expedite our data collection process. We randomly contacted users and inquired whether they had mobile banking usage experience. Then we asked those with positive answers to fill the questionnaires based on their usage experience. We scrutinized all questionnaires and dropped those with too many missing values. As a result, we obtained 200 valid responses. Table 1 lists the demographic information of the sample. We tested the effects of these demographic variables including gender, age and education on trust, flow, usage intention and actual usage. The results indicated that except the effect of gender on flow ($\gamma = -0.10$, $p < 0.05$), other path coefficients are insignificant. This suggests that men tend to have better experience than women when using mobile banking.

To test the common method variance (CMV), we conducted two tests. First, we conducted a Harman's single-factor test [48]. The results show that the largest variance explained by individual factor is 11.673%. Thus none of the factors can explain the majority of the variance. Second, we modeled all items as the indictors of a factor representing the method effect and re-estimated the model [49]. The results show a poor fitness. For example, the

Table 1 The demographic information of the sample

	Option	Count	Percentage (%)
Gender	Male	122	61
	Female	78	39
Age (years old)	<20	71	35.5
	20 ~ 29	93	46.5
	30 ~ 39	23	11.5
	>39	13	6.5
Education	High school and blow	56	28
	Associate degree	63	31.5
	Bachelor degree	72	36
	Master degree and higher	9	4.5

goodness of fit index (GFI) is 0.647 (<0.90), and the root mean square error of approximation (RMSEA) is 0.154 (>0.08). With both tests, we feel that CMV is not a significant problem in our research.

5 Data analysis and results

Following the two-step approach recommended by Anderson and Gerbing [50], we first examined the measurement model to test reliability and validity. Then we examined the structural model to test research hypotheses and model fitness.

First, we conducted a confirmatory factor analysis (CFA) to examine the measurement model and test the reliability and validity. Validity includes convergent validity and discriminant validity. Convergent validity measures whether items can effectively reflect their corresponding factor, whereas discriminant validity measures whether two factors are statistically different. Table 2 lists the standardized item loadings, the average variance extracted (AVE), the composite reliability (CR) and Cronbach Alpha values. As listed in the table, most item loadings are larger than 0.7 and t values show that all loadings are significant at 0.001. All AVEs exceed 0.5 and all CRs exceed 0.7. Thus the scale has a good convergent validity [51, 52]. In addition, all Alpha values are larger than 0.7, showing a good reliability [53].

To test discriminant validity, we compared the square root of AVE and factor correlation coefficients. As listed in Table 3, for each factor, the square root of AVE is significantly larger than its correlation coefficients with other factors. Thus the scale has a good discriminant validity [51, 54].

Second, we adopted structural equation modeling software LISREL8.72 to estimate the structural model. Table 4 lists the path coefficients and their significance. Table 5 lists the recommended and actual values of some fit indices. As listed in the table, except GFI, other fit indices have better actual values than the recommended values. This shows a good fitness [51]. The explained variance of trust, flow experience, usage intention and actual usage is 58.3, 51.9, 38.7 and 47.8%, respectively.

We conducted two tests to examine the individual effect of trust and flow on user behavior. The results are listed in Table 6. When the dependent variable is trust and flow separately, the explained variance of usage intention is 33% and 28.6%, respectively. Comparing both models with the integrated model involving trust and flow, we can find that the integrated model explains more variance (38.7%) in usage intention. In addition, comparing Table 4 and Table 6, we can find that when trust is included into the model, the effects of structural assurance, ubiquity and

Table 2 Standardized item loadings, AVE, CR and Alpha values

Factor	Item	Standardized loading	AVE	CR	Alpha
Structural assurance (SA)	SA1	0.649	0.52	0.76	0.76
	SA2	0.720			
	SA3	0.788			
Ubiquity (UBI)	UBI1	0.838	0.64	0.84	0.84
	UBI2	0.783			
	UBI3	0.770			
Perceived ease of use (EOU)	EOU1	0.821	0.69	0.87	0.86
	EOU2	0.879			
	EOU3	0.783			
Personal innovativeness (PI)	PI1	0.755	0.59	0.81	0.81
	PI2	0.690			
	PI3	0.857			
Trust (TRU)	TRU1	0.809	0.56	0.80	0.80
	TRU2	0.733			
	TRU3	0.691			
Flow experience (FLOW)	FLOW1	0.758	0.58	0.81	0.81
	FLOW2	0.820			
	FLOW3	0.708			
Usage intention (USE)	USE1	0.828	0.64	0.84	0.84
	USE2	0.818			
	USE3	0.746			

Table 3 The square root of AVE (shown as bold at diagonal) and factor correlation coefficients

	SA	UBI	EOU	PI	TRU	FLOW	USE
SA	**0.721**						
UBI	0.409***	**0.798**					
EOU	0.350***	0.510***	**0.829**				
PI	0.356***	0.392***	0.484***	**0.770**			
TRU	0.569***	0.581***	0.520***	0.433***	**0.746**		
FLOW	0.451***	0.593***	0.587***	0.469***	0.584***	**0.763**	
USE	0.328***	0.347***	0.466***	0.269**	0.574***	0.516***	**0.798**

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 4 Path coefficients and their significance

Hypothesis	Path	Coefficient	*T* values	Supported or not
H1	SA → TRU	0.46***	5.31	Yes
H2	SA → FLOW	0.08	0.74	No
H3	UBI → TRU	0.26**	2.98	Yes
H4	UBI → FLOW	0.26**	2.79	Yes
H5	EOU → TRU	0.20*	2.34	Yes
H6	EOU → FLOW	0.27**	2.96	Yes
H7	PI → TRU	0.06	0.74	No
H8	PI → FLOW	0.13*	1.98	Yes
H9	TRU → FLOW	0.18*	1.99	Yes
H10	TRU → USE	0.39***	3.80	Yes
H11	FLOW → USE	0.28**	2.80	Yes
H12	USE → ACTUSE	0.69***	5.19	Yes

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 5 The recommended and actual values of fit indices

Fit indices	chi^2/df	GFI	AGFI	CFI	NFI	NNFI	RMSEA
Recommended value	<3	>0.90	>0.80	>0.90	>0.90	>0.90	<0.08
Actual value	1.28	0.899	0.867	0.987	0.950	0.984	0.038

chi^2/df is the ratio between Chi-square and degrees of freedom, *GFI* is Goodness of Fit Index, *AGFI* is the Adjusted Goodness of Fit Index, *CFI* is the Comparative Fit Index, *NFI* is the Normed Fit Index, *NNFI* is the Non-Normed Fit Index, *RMSEA* is Root Mean Square Error of Approximation

perceived ease of use on flow experience become weaker, even insignificant (SA → FLOW). This indicates the mediation effect of trust on flow experience [55]. Especially, the insignificant effect of structural assurance on flow experience suggests that trust fully mediates the relationship between structural assurance and flow experience. These results imply that service providers need to concern user trust when they take measures to improve user experience.

6 Discussion

As listed in Table 4, except H2 and H7, other hypotheses were supported. The results indicate that structural assurance, ubiquity and perceived ease of use affect trust, whereas ubiquity, perceived ease of use and personal innovativeness affect flow experience. Trust has a significant effect on flow experience, and both factors determine usage intention, which further affects actual usage.

Among the factors affecting trust, structural assurance has the largest effect ($\gamma = 0.46$). This is consistent with Kim et al. [3], which reports that structural assurance has a strong effect on initial trust in mobile banking. We also extend Kim et al.'s findings on initial trust to continuance trust. Initial trust develops when users interact with mobile banking systems for the first time. With the increased usage experience, initial trust develops into continuance trust. As our subjects have experience (flow experience) using mobile banking, we tested continuance trust in this

Table 6 The individual effect of trust and flow on usage intention

Path	Dependent variable: trust	Dependent variable: flow
SA → TRU	0.45***	NA
UBI → TRU	0.26**	
EOU → TRU	0.22**	
PI → TRU	0.07	
SA → FLOW	NA	0.18*
UBI → FLOW		0.31***
EOU → FLOW		0.32***
PI → FLOW		0.13*
TRU → USE	0.57***	NA
FLOW → USE	NA	0.53***
USE → ACTUSE	0.69***	0.69***

NA not available

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$)

research. The results suggest that users will rely on technological and legal structures to build their trust in mobile banking. According to trust transference mechanism, users will transfer their trust in these third-parties to mobile service providers [36]. Thus mobile banking service providers need to adopt advanced encryption and third-party certification to increase user trust. They can use secure socket layer (SSL) encryption and digital certificates to ensure payment security. They can also display trust-seals such as VeriSign to demonstrate that they have been verified by the authoritative organizations. Besides structural assurance, both ubiquity and perceived ease of use also have significant effects on trust. Thus whether mobile service providers can provide ubiquitous and ease-of-use services will affect users' evaluations on their ability and benevolence. It is worth noting that to some extent, ubiquity also means vulnerability as ubiquity is built on wireless network, which is vulnerable to information interception and hacker attack. Thus there may exist a negative correlation between ubiquity and trust. In this research, we mainly measured ubiquity with items reflecting service providers' ability to provide ubiquitous mobile banking services to users. If users feel that service providers have this ability, they may build trust. We did not find the direct effect of personal innovativeness on trust. This indicates that users' open mind to new technologies may not help generate trust in mobile banking service providers. They rely more on their perceptions such as structural assurance to build trust in mobile banking.

The results show that among the factors affecting flow experience, both perceived ease of use and ubiquity have relatively larger effects ($\gamma = 0.27$ and 0.26, respectively). Due to the small screens and inconvenient input, it is vital to presenting an easy-to-use interface to users. If it is difficult for users to operate mobile banking, they may feel lack of control and low enjoyment. They need to spend more time and effort on learning to use mobile banking. This will affect their experience. Thus mobile service providers need to improve their interface design of mobile banking. In addition, they can use online help and tutorial to guide users' operation. This may also improve their perceived ease of use. The results indicate that ubiquity also affects flow experience. Users always expect to use mobile banking to conduct payment at anytime from anywhere. If they often encounter service interruption or unavailability, they cannot have a good experience. Mobile service providers need to enhance their back-end systems including databases and servers to provide reliable services and prompt responses to users. On the other hand, ubiquity means smaller screen size as ubiquity is built on portability. As we mainly measured ubiquity with items reflecting service providers' ability, we did not consider the possible negative effect of ubiquity on user experience. Future research can pay attention to this effect. We found that personal innovativeness has a significant effect on flow experience. Thus users that are inclined to new technologies are more likely to acquire a good experience.

Trust has a significant effect on flow experience, and both factors predict usage intention. Trust enables users to believe that mobile service providers have the ability and benevolence necessary to present a good usage experience to them. If they do not trust mobile service providers, they will not expect positive experience associated with using mobile banking. The significant effects of trust and flow experience on usage intention are consistent with prior research findings [5, 32]. This also highlights the necessity to build users' trust and improve their experience to facilitate their adoption and usage of mobile banking.

7 Theoretical and managerial implications

From a theoretical perspective, this research examined mobile banking user adoption from the perspectives of trust and flow experience. As noted earlier, extant research such as Kim et al. [3] has paid attention to the effect of trust on mobile banking user behavior due to the high uncertainty and perceived risk. However, the effect of flow experience on user behavior has seldom been examined. We feel that the constraints of mobile terminals such as small screens and inconvenient input highlight the necessity to deliver a compelling experience to users. The results support this argument and indicate that mobile banking user behavior is not only affected by trust, but also affected by flow experience. In addition, trust has a significant effect on flow experience. This advances our understanding of mobile banking user behavior. This research also extends extant

studies on online banking adoption, which mainly use TAM as the theoretical base and reveal the significant effect of perceived usefulness on user behavior. Our results suggest that flow also affects mobile banking user adoption. This indicates that users are not only utilitarian-oriented, but also expect to acquire an impressive experience when using mobile banking. It is worth noting that both trust and flow represent the enablers of user behavior. However, user behavior may also be affected by inhibitors such as switching cost. Future research can combine both perspectives including enablers and inhibitors to examine mobile banking user behavior.

From a managerial perspective, our results imply that service providers need to concern both trust and flow experience to facilitate mobile banking user behavior. On one hand, they should attach great importance to building user trust. Due to the uncertainty and potential risk associated with using mobile banking, building users' trust is critical to their adoption and usage behavior. We found that structural assurance is the main factor affecting trust. Thus mobile service providers need to employ technological and legal structures to engender user trust in mobile banking. On the other hand, they cannot neglect the effect of flow experience on user behavior. The constraints of mobile terminals highlight the necessity to enhance mobile interface design and deliver a good usage experience to users. We found that perceived ease of use and ubiquity are the two main factors affecting flow experience. This indicates that mobile service providers need to present an easy-to-use interface and ubiquitous services to users.

8 Conclusion

As an emerging mobile service, mobile banking has not been widely adopted by users. Thus it is necessary to identify the factors affecting mobile banking user behavior. Integrating trust and flow theory, this research examined mobile banking user adoption. The results indicate that structural assurance is the main factor affecting trust, whereas perceived ease of use and ubiquity are the main factors affecting flow experience. Trust affects flow experience, and both factors predict usage intention. Thus mobile service providers need to concern both trust and flow experience to facilitate user adoption and usage of mobile banking services.

This research has the following limitations. First, we collected data in China, where mobile commerce is developing rapidly but still in its infancy. Thus our results need to be generalized to other countries that had developed mobile commerce. Second, besides the four factors including structural assurance, ubiquity, perceived ease of use and personal innovativeness, there may exist other factors affecting user behavior, such as network effect. When more peers adopt mobile banking, individual user may also adopt it to facilitate the payment in his/her social circle. Future research can explore the possible effect of network externality on mobile banking user behavior. Third, we mainly conducted a cross-sectional study. However, user behavior is dynamic. Thus a longitudinal research may provide more insights on user behavior development.

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Appendix: measurement scales and items

Structural assurance (SA) (adapted from McKnight et al. [47])

SA1: I feel confident that encryption and other technological advances on the mobile Internet make it safe for me to use mobile banking.
SA2: I feel assured that legal and technological structures adequately protect me from payment problems on the mobile Internet.
SA3: Mobile Internet is a robust and safe environment in which to use mobile banking.

Ubiquity (UBI) (adapted from Lee [38])

UBI1: I can use mobile banking from anywhere.
UBI2: I can use mobile banking at anytime.
UBI3: If needed, I can use mobile banking at anytime from anywhere.

Perceived ease of use (EOU) (adapted from Agarwal and Karahanna [41])

EOU1: Learning to use mobile banking is easy for me.
EOU2: Skillfully using mobile banking is easy for me.
EOU3: Overall, mobile banking is easy to use.

Personal innovativeness (PI) (adapted from Agarwal and Karahanna [41])

PI1: If I heard about a new information technology, I will look for ways to experiment with it.
PI2: Among my peers, I am usually the first to try out new information technologies.
PI3: I like to experiment with new information technologies.

Trust (TRU) (adapted from Lee [38])

TRU1: Mobile banking is trustworthy.
TRU2: Mobile banking keeps its promise.

TRU3: Mobile banking keeps customers' interests in mind.

Flow experience (FLOW) (adapted from Lee et al. [14])

FLOW1: When using mobile banking, my attention was focused on the activity.
FLOW2: When using mobile banking, I felt in control.
FLOW3: When using mobile banking, I found a lot of pleasure.

Usage intention (USE) (adapted from Lee [38])

USE1: Given the chance, I intend to use mobile banking.
USE2: I expect my use of mobile banking to continue in future.
USE3: I have intention to use mobile banking to conduct payment.

Actual usage (ACTUSE)

How many times do you use mobile banking during a week?
Not at all; less than once a week; about once a week; 2–3 times a week; 4–5 times a week; about once a day; several times each day.

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