Understanding user adoption of location-based services from a dual perspective of enablers and inhibitors

Tao Zhou

Abstract Location-based services (LBS) can present the personalized information and services to users based on their positions and contexts. This may improve users' experience and bring a positive utility to them. However, their privacy concern may be aroused and perceived risk be increased because LBS need to utilize their location information. From a dual perspective of enablers and inhibitors, this research examined the factors affecting user adoption of LBS. Enablers include perceived usefulness and trust, whereas the inhibitor is privacy risk. The results indicate that contextual offering is the main factor affecting trust, whereas ubiquitous connection is the main factor affecting perceived usefulness. Privacy concern affects privacy risk. Trust has significant effects on perceived usefulness and privacy risk. And these three factors predict user adoption and usage behavior.

Keywords LBS · Trust · Privacy concern · Perceived usefulness

1 Introduction

Mobile internet has been developing rapidly in the world. According to a report issued by China Internet Network Information Center (CNNIC) in July 2012, the number of mobile internet users in China has reached 388 million, accounting for 72 % of its internet population (538 million) (CNNIC 2012). This indicates the great mobile user base. Mobile service providers have released a variety of services, such as mobile search, mobile games and mobile instant messaging (IM). They expect users to widely adopt and use

T. Zhou (✉)
School of Management, Hangzhou Dianzi University,
Hangzhou 310018, People's Republic of China
e-mail: zhoutao@hdu.edu.cn

these services. Then they can acquire competitive advantage and make profit. Among the various mobile services, location-based services (LBS) are deemed the killer application because LBS can present the optimal information and services to users based on their locations and preferences (Junglas and Watson 2008). This contextual information may improve user experience and satisfaction. Typical LBS include location-based advertisements, mobile navigation, emergency evacuation and location check-in services.

Due to the constraints of mobile terminals such as small screens and inconvenient input, it is difficult for users to access mobile internet to search for relevant information. The ubiquitous and personalized information offered by LBS may reduce users' effort spent on information search and bring a positive utility to them. However, because LBS need to collect and utilize users' location information, this may arouse users' privacy concern and increase their perceived risk, further affecting their adoption and usage intention. Thus, when users decide to adopt LBS, they will not only consider the benefits such as perceived usefulness, but also consider the privacy risk associated with using LBS. They may balance the benefits and privacy risk to determine their further behavior.

Extant research has focused on the effect of perceived risk on user adoption of LBS (Xu and Gupta 2009; Xu et al. 2009). As noted earlier, LBS user behavior is affected by both the benefits and privacy risk. Thus, it is necessary to examine LBS user adoption from a dual perspective of enablers and inhibitors. Kim and Son (2009) also adopted a dual perspective including dedication and constraint to examine online service adoption. In the present research, perceived usefulness and trust are included as the enablers, and privacy risk is included as the inhibitor. Prior research has revealed the significant effects of perceived usefulness and trust on mobile user behavior (Luo et al. 2010; Shin et al. 2010). Thus, they are incorporated into the model. Ubiquitous connection, contextual offering and privacy concern are proposed to affect

perceived usefulness, trust and privacy risk, further determining user adoption and usage behavior. The results of this research will provide a more full understanding of LBS user behavior.

The rest of this paper is organized as follows. Section 2 reviews relevant literature. Section 3 develops the research model and hypotheses. Then the instrument development and data collection are reported in Section 4. Section 5 presents data analysis and results, followed by a discussion of these results in Section 6. Section 7 presents the theoretical and managerial implications. Section 8 summarizes the limitations and concludes the paper.

2 Literature review

2.1 LBS user adoption and privacy risk

As an emerging mobile service, LBS have not been widely adopted and used by mobile users. Thus, researchers have paid attention to identify the factors affecting LBS adoption. They have used the technology acceptance model (TAM), task technology fit (TTF) and perceived value as the theoretical bases. Junglas and Watson (2008) noted that LBS include two categories: location-aware services and location-tracking services. They found that compared to location-aware services, location-tracking services are perceived to be more useful and easier to use. Junglas et al. (2008a) adopted TTF to explain user adoption of LBS. They noted that the fit between location sensitiveness as task characteristics and locatability in combination with mobility as technology characteristics affects individual performance. Pura (2005) noted that perceived value has a significant effect on LBS user loyalty. Perceived value includes social value, emotional value, conditional value, monetary value and convenience value.

Due to the privacy risk associated with using LBS, prior research has focused on its effect on user behavior. Junglas et al. (2008b) proposed that personality traits affect privacy concern and privacy risk, both of which further determine LBS user behavior. Personality traits include extraversion, agreeableness, emotional stability, openness to experience and conscientiousness. Xu et al. (2011) examined the effect of personalization and privacy risk on the usage intention of location-aware marketing, which represents an application of LBS. Xu et al (2009) noted that three privacy intervention mechanisms, which include compensation, industry self-regulation and government regulation affect users' intention to disclose personal information in LBS. Xu and Gupta (2009) reported that performance expectancy, effort expectancy, privacy concern and personal innovativeness have effects on user adoption of LBS.

2.2 Perceived usefulness and mobile user behavior

Perceived usefulness is a main factor of TAM, which has been widely used to explain online and mobile user behavior due to its parsimony and effectiveness. Perceived usefulness represents a main extrinsic motivation, highlighting the behavioral outcomes such as the improvement of working effectiveness and efficiency. Perceived ease of use is another factor of TAM. Extant research has noted that perceived ease of use may not affect behavioral intention when users gain more usage experience (Davis et al. 1989; Bhattacherjee 2001). There is also empirical evidence that perceived ease of use has no effect on mobile services user intention (Chandra et al. 2010; Lu et al. 2010). Consistent with these findings, the present research does not include perceived ease of use into the model.

Prior research has revealed the significant effect of perceived usefulness on mobile user behavior in a variety of contexts including mobile payment (Kim et al. 2010; Schierz et al. 2010), short messaging services (SMS) (Lu et al. 2010), mobile shopping (Lu and Su 2009), mobile internet (Shin et al. 2010), mobile ticketing (Mallat et al. 2009), digital multimedia broadcasting (DMB) (Shin 2009), mobile TV (Jung et al. 2009), and 3 G services (Kuo and Yen 2009). Perceived usefulness not only affects the initial adoption and usage of mobile internet services, but also affects the continuance usage (Thong et al. 2006; Lee et al. 2007). Considering its significant effect on user behavior, the present study includes perceived usefulness into the model as an enabler.

2.3 Mobile trust

Due to the virtuality and uncertainty associated with online transactions, trust has received considerable attention in the electronic commerce context (Beldad et al. 2010). Many categories of factors including consumer-based, website-based and company-based factors are found to affect online trust, further predicting consumer behavior such as online purchase and information disclosure (Beldad et al. 2010). Recently, researchers have begun to explore trust effects in the mobile commerce context, especially in the mobile payment context. Kim et al. (2009) noted that structural assurance is the main factor affecting initial trust in mobile banking. Mallat (2007) conducted a qualitative study and found that trust significantly affects consumer adoption of mobile payment. Luo et al. (2010) examined the effects of trust and perceived risk on user acceptance of mobile banking. Their results indicated that trust has a significant effect on perceived risk and both factors affect the behavioral intention to use mobile banking. Li and Yeh (2010) argued that design aesthetics affect user trust in mobile websites. Vance et al. (2008) found that system quality including navigation structure and visual appeal affects user trust in mobile technologies.

3 Research model and hypotheses

Figure 1 presents the research model. Perceived usefulness, trust and privacy risk are proposed to mediate the effects of ubiquitous connection, contextual offering and privacy concern on usage intention.

3.1 Ubiquitous connection

Ubiquitous connection means that users can access LBS at anytime from anywhere (Lee 2005). Compared to electronic commerce, mobile terminals and networks have freed users from the spatial and temporal constraints. Users can access mobile internet for information and services at anytime from anywhere. However, due to the instability of mobile networks and back-end systems, users may be unable to always access mobile internet for what they need. This may affect their perception of LBS utility. For example, users employ LBS to acquire their car position. However, they only receive the "service unavailable" reply from the systems. This may lead users to feel that LBS cannot provide reliable services to meet their demands and are not much useful. Prior research has found the significant effect of mobility (similar to ubiquitous connection) on the perceived usefulness of mobile payment (Kim et al. 2010; Schierz et al. 2010).

> H1: Ubiquitous connection positively affects perceived usefulness.

Ubiquitous connection may also affect users' trust in mobile service providers. Ubiquitous services reflect mobile service providers' ability and benevolence, which may affect user trust. If users often encounter service interruption and unavailability, they may doubt service providers' ability to offer reliable and ubiquitous services. This may lower their trust in service providers. Lee (2005) suggested that ubiquitous connection affects user trust in mobile internet sites. Thus,

> H2: Ubiquitous connection positively affects user trust.

3.2 Contextual offering

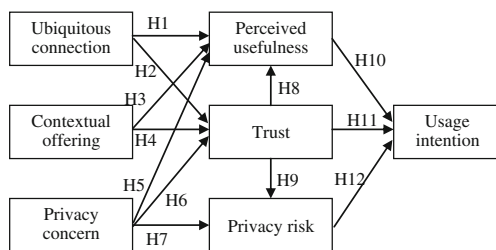Contextual offering means that mobile service providers present the optimal information and services to users based on their locations and preferences. Mobile service providers can use LBS to acquire users' current location information. Then they can match marketing information to users' location and preferences, and push the relevant information and services to them. This will reduce users' effort spent on information search and improve their living and working efficiency. In addition, the personalized information and services can better meet individual needs and bring a positive utility to users.

> H3: Contextual offering positively affects perceived usefulness.

Contextual offering may also affect user trust. The personalized information offered to users may signal service providers' trustworthiness as it entails service providers' effort and resource investment. If the information delivered to users is irrelevant or inaccurate, users may feel that mobile service providers lack enough ability or benevolence to provide LBS. This may decrease their trust in mobile service providers. Extant research has identified the effect of contextual offering on user trust in mobile internet sites (Lee 2005).

> H4: Contextual offering positively affects user trust.

3.3 Privacy concern

Privacy concern reflects a user's concern about service providers' collection, storage and usage of his or her personal information (Sheng et al. 2008). For example, users may be concerned whether this information is effectively protected from the unauthorized access. They may also be concerned whether mobile service providers properly use this information. They need to be assured that mobile service providers will not use this information for other purposes, or share it with third parties or even sell it for profit. Users with high privacy concern will perceive low utility of LBS because they worry about the negative outcomes such as privacy leakage associated with using LBS. The effect of privacy concern on perceived usefulness has been reported in previous research. Xu and Gupta (2009) reported that privacy concern affects performance expectancy (similar to perceived usefulness). Kumar et al. (2008) noted that privacy concern affects the perceived usefulness of software firewalls.

> H5: Privacy concern negatively affects perceived usefulness.

In addition, privacy concern will also affect user trust. Users with high privacy concern may doubt mobile service providers' ability and benevolence to protect their privacy. Privacy concern may directly affect perceived risk. Users worry about the uncertainty and potential losses associated with disclosing personal information. This increases their

Fig. 1 Research model

perceived risk. The effects of privacy concern on trust and perceived risk have been verified in a variety of contexts, including online healthcare services (Bansal et al. 2010), online social networking (Fogel and Nehmad 2009) and online shopping (Eastlick et al. 2006; Slyke et al. 2006). Thus,

H6: Privacy concern negatively affects user trust.
H7: Privacy concern positively affects privacy risk.

3.4 Trust

Trust reflects a willingness to be in vulnerability based on the positive expectation toward another party's future behavior (Mayer et al. 1995). Researchers have different understandings of trust, such as dispositional trust, institutional trust and interpersonal trust (McKnight and Chervany 2001). The present study is mainly concerned with user trust in mobile service providers. Trust as user belief includes three components: ability, integrity and benevolence (McKnight et al. 2002). Ability means that mobile service providers have enough knowledge and skills to fulfill their tasks. Integrity means that mobile service providers keep their promises and do not deceive users. Benevolence means that mobile service providers care users' interests, not just their own benefits. Trust provides a subjective guarantee that users may acquire positive results in future (Gefen et al. 2003). When users develop trust in service providers, they believe that service providers have the ability and integrity necessary to offer a positive utility to them. Otherwise, they may not expect to obtain utility from service providers. Thus, trust will affect perceived usefulness. Numerous studies have validated the effect of trust on perceived usefulness (Gefen et al. 2003; Chandra et al. 2010; Thatcher et al. 2011).

H8: Trust positively affects perceived usefulness.

In addition, trust will also decrease perceived uncertainty and risk. Trust enables users to believe that service providers will properly collect, store and use their privacy information. This may mitigate their worry on information privacy. Much research has revealed the effect of trust on perceived risk (Malhotra et al. 2004; Kim et al. 2008; Luo et al. 2010). Thus,

H9: Trust negatively affects privacy risk.

3.5 Usage intention

According to the theory of reasoned action (TRA), user beliefs affect behavioral intention (Fishbein and Ajzen 1975). Thus, perceived usefulness, trust and perceived privacy risk as user beliefs will affect usage intention. Further,

prior research has uncovered that perceived usefulness is a significant factor affecting both the initial usage and continuance usage (Shin et al. 2010). Trust may also facilitate user behavior (Beldad et al. 2010; Varnali and Toker 2010). In contrast, privacy risk will decrease users' adoption. Users with high perceived risk will be unwilling to adopt and use LBS because they worry about the potential losses associated with using LBS, such as information privacy leakage and abuse.

H10: Perceived usefulness positively affects usage intention.
H11: Trust positively affects usage intention.
H12: Privacy risk negatively affects usage intention.

4 Data collection

The research model includes seven factors. Each factor was measured with multiple items. All items were adapted from extant literature to improve the content validity (Straub et al. 2004). 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 sent to two e-commerce experts for review. Then researchers tested it among ten users that had LBS usage experience. According to their comments, we revised some items to improve the clarity and understandability. The final items and their sources are listed in Appendix A.

Items measuring ubiquitous connection and contextual offering were adapted from Lee (2005). Items of ubiquitous connection reflect that users can acquire information at anytime from anywhere. Items of contextual offering reflect that service providers present the personalized information or services to users based on their locations and preferences. Items of privacy concern were adapted from Son and Kim (2008) to reflect users' concern about mobile service providers' misuse of their personal information. Items measuring perceived usefulness were adapted from Davis (1989) to reflect the effectiveness and efficiency improvement by using LBS. Items of trust were adapted from Pavlou and Gefen (2004) to measure mobile service providers' ability, integrity and benevolence. Items of privacy risk were adapted from Xu et al. (2009) to reflect the risk, uncertainty and potential losses associated with personal information disclosure. Items of usage intention were adapted from Lee (2005) to reflect the usage, information disclosure and recommendation.

Data were collected at the service outlets of China Mobile and China Unicom, which are the two main telecommunication operators in China. These service outlets are located in an eastern China city, where mobile internet is

better developed than other regions. Researchers contacted users and explained the meaning of LBS to them. Then those users with LBS usage experience were asked to fill the questionnaire based on their usage experience. Totally, we contacted 400 users and about 72.5 % of them had LBS usage experience. We scrutinized the questionnaires and dropped those with too many missing values. As a result, we obtained 278 valid responses. Among them, 60.4 % were male users and 39.6 % were female users. In terms of age, most of them (38.1 %) were between 20 and 29 years old. The frequently used LBS include mobile navigation, location-based advertisements and location check-in services.

To test common method variance, I conducted two tests. First, I conducted a Harman's single-factor test (Podsakoff et al. 2003). The results indicate that the largest variance explained by individual factor is 11.7 %. Thus, none of the factors can explain the majority of the variance. Second, I modeled all items as the indicators of a factor representing the method effect, and re-estimated the model (Malhotra et al. 2006). The results show a poor fitness. For example, the goodness of fit index (GFI) is 0.601 (<0.90) and the root mean square error of approximation (RMSEA) is 0.182 (>0.08). Both tests indicate that common method variance is not a significant problem in the present research.

5 Data analysis and results

Following the two-step approach recommended by Anderson and Gerbing (1988), the data analysis includes two steps. First, I examined the measurement model to test reliability and validity of the scale. Then, I examined the structural model to test research hypotheses and model fitness.

First, I conducted a confirmatory factor analysis to test the reliability and validity of the scale. 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 1 lists the standardized item loadings, the average variance extracted (AVE), the composite reliability (CR) and Cronbach Alpha values. All item loadings are larger than 0.7 and the T values show that these 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 (Bagozzi and Yi 1988; Gefen et al. 2000). In addition, all Alpha values are larger than 0.7, showing a good reliability (Nunnally 1978).

To examine the discriminant validity, I compared the square root of AVE and factor correlation coefficients. As listed in Table 2, 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 (Fornell and Larcker 1981; Gefen et al. 2000).

Second, I adopted partial least square (PLS) to examine the structural model and test research hypotheses. Figure 2 presents the results. The explained variance of perceived usefulness, trust, privacy risk and usage intention is 30.4 %, 44.2 %, 11 % and 43 %, respectively.

The present study also conducted a post-hoc analysis to examine the mediation effects of perceived usefulness, trust and privacy risk on usage intention (Baron and Kenny 1986). Table 3 summarizes the results. Except the path from contextual offering to usage intention ($\gamma=0.32$), other two paths are not significant. This suggests that perceived usefulness and

Table 1 Standardized item loadings, AVE, CR and Cronbach Alpha values

Factor	Item	Standardized loadings	AVE	CR	Alpha
Ubiquitous connection (UC)	UC1	0.835	0.74	0.89	0.82
	UC2	0.906			
	UC3	0.829			
Contextual offering (CO)	CO1	0.841	0.75	0.90	0.83
	CO2	0.904			
	CO3	0.851			
Privacy concern (PC)	PC1	0.861	0.74	0.90	0.83
	PC2	0.888			
	PC3	0.836			
Perceived usefulness (PU)	PU1	0.780	0.74	0.89	0.82
	PU2	0.888			
	PU3	0.906			
Trust (TRU)	TRU1	0.914	0.85	0.95	0.91
	TRU2	0.948			
	TRU3	0.910			
Privacy risk (PR)	PR1	0.870	0.74	0.89	0.82
	PR2	0.894			
	PR3	0.808			
Usage intention (USE)	USE1	0.868	0.76	0.91	0.84
	USE2	0.901			
	USE3	0.851			

Table 2 The square root of AVE (shown as bold at diagonal) and factor correlation coefficients

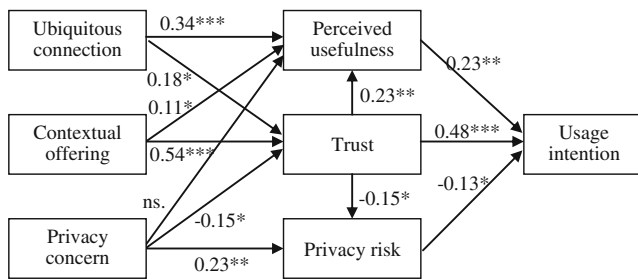|	UC	CO	PC	PU	TRU	PR	USE
UC	**0.857**						
CO	0.397	**0.865**					
PC	−0.094	−0.071	**0.862**				
PU	0.472	0.373	−0.155	**0.860**			
TRU	0.406	0.524	−0.207	0.438	**0.924**		
PR	−0.057	−0.108	0.260	−0.023	−0.199	**0.858**	
USE	0.326	0.464	−0.180	0.448	0.512	−0.231	**0.873**

Fig. 2 Results estimated by PLS (Note:*, $P<0.05$; **, $P<0.01$; ***, $P<0.001$; ns, not significant)

trust partially mediate the effect of contextual offering on usage intention.

To compare the effects of ubiquitous connection and contextual offering on perceived usefulness, the present study conducted a constraint test (Byrne 1998; Kim et al. 2004). The original model is used as the base model. Then I set the path from ubiquitous connection to perceived usefulness to be equal to the path from contextual offering to perceived usefulness, and re-estimated the model. Table 4 lists the results. Chi-square test indicated that there exist significant differences between the original model and constrained model. This indicates that two paths are statistically different. Similarly, I also compared the paths linked to trust and usage intention, and obtained significant results.

6 Discussion

As shown in Fig. 2, except H5, other hypotheses are supported. Ubiquitous connection and contextual offering significantly affect perceived usefulness and trust. Privacy concern affects trust and privacy risk, but has no effect on perceived usefulness. Trust has effects on perceived usefulness and privacy risk. These three factors predict the usage intention.

Compared to the effect of contextual offering on perceived usefulness ($\gamma=0.11$), ubiquitous connection has a larger effect ($\gamma=0.34$). This shows that whether users acquire ubiquitous services will affect their evaluation of LBS utility. Users always expect to acquire LBS at anytime from

anywhere. If service providers cannot provide reliable and ubiquitous services, users may perceive low utility of LBS. For example, users access LBS to inquire the nearby hotels when they are on tourism. If the services are unavailable or the systems cannot provide prompt responses to their requests, users will form a poor impression toward LBS utility. Thus, mobile service providers need to enhance their back-end systems and deliver ubiquitous services to users.

Among the factors affecting trust, contextual offering has the largest effect ($\gamma=0.54$). The personalized information and services offered by LBS demonstrate service providers' ability and benevolence, thus building user trust. This is consistent with previous findings suggesting the significant effect of service empathy (similar to personalization) on online consumer trust (Gefen 2002). Thus, mobile service providers need to improve the accuracy and relevance of recommendation. Contextual offering requires service providers to not only collect users' location information, but also acquire users' preferences. They need to obtain and analyze users' consumption history. Then they can identify users' preference and habit, and recommend the relevant information or services to users. For example, when users employ LBS to find the nearby hotels, service providers may recommend all the surrounding hotels to users if they do not hold users' preferences. However, if they hold users' preference information, they can select the hotels with the appropriate prices and environment and recommend them to users. This will improve recommendation accuracy.

Privacy concern significantly affects privacy risk and trust. Privacy concern reflects users' worry about personal information, such as the inappropriate collection, storage and usage. This increases their perceived uncertainty and risk from disclosing personal information. Thus, mobile service providers need to adopt measures to decrease users' privacy concern. For example, they need to get users' permission before collecting their personal information. They can post privacy statements or policies to inform users about their privacy practices (Tsai et al. 2011). In addition, they can also display privacy seals to demonstrate that their privacy practices are certified by the trusted third-party organizations (Hu et al. 2010). Privacy statements and seals

Table 3 Mediation test

	Direct effect		Mediation effect					
	Path	Coef.	Path	Coef.	Path	Coef.	Path	Coef.
	UC→USE	0.44***	UC→USE	ns.	UC→PU	0.61***	PU→USE	0.29***
					UC→TRU	0.53***	TRU→USE	0.60***
	CO→USE	0.72***	CO→USE	0.32***	CO→PU	0.51***	PU→USE	0.19**
					CO→TRU	0.73***	TRU→USE	0.37***
	PC→USE	−0.26**	PC→USE	ns.	PC→PU	−0.19**	PU→USE	0.30***
					PC→TRU	−0.27**	TRU→USE	0.57***
					PC→PR	0.30***	PR→USE	−0.15*

Coef. is the abbreviation of coefficient; ns, not significant

*$P<0.05$; **$P<0.01$; ***$P<0.001$

Table 4 Constraint test

Original model		Constrained model	Chi-square test				
χ^2	df	The constrained path	χ^2	df	$\Delta\chi^2$	Δdf	Sig.
338.37	174	(UC→PU) = (CO→PU)	343.87	175	5.5	1	0.05
		(UC→TRU) = (CO→TRU) = (PC→TRU)	417.16	176	78.79	2	0.001
		(PU→USE) = (TRU→USE) = (PR→USE)	405.88	176	67.51	2	0.001

will help alleviate users' privacy concern and decrease their perceived risk. This research does not find the direct effect of privacy concern on perceived usefulness. However, privacy concern indirectly affects perceived usefulness through trust. This indicates that trust fully mediates the effect of privacy concern on perceived usefulness.

Trust significantly affects perceived usefulness and privacy risk. These three factors determine usage intention. Among them, trust has the largest effect on usage intention (β=0.48). Trust ensures users to acquire a positive outcome in future. This will improve their perceived utility and decrease perceived risk. Thus, mobile service providers need to offer reliable and accurate LBS to users in order to establish their trust.

7 Theoretical and managerial implications

From a theoretical perspective, this research identified the factors affecting LBS user behavior from a dual perspective of enablers and inhibitors. Enablers include perceived usefulness and trust, whereas inhibitors include privacy risk. As noted earlier, prior research has focused on the single effect of perceived risk on LBS user adoption. The present study identifies that LBS user behavior is not only affected by inhibitors such as perceived risk, but also affected by enablers such as trust and perceived usefulness. Especially, the results demonstrate that trust has the largest effect on LBS adoption. Users need to build trust to guarantee the expected utility and mitigate their privacy risk, further deciding their adoption and usage of LBS. Thus, this research enriches extant findings and advances our understanding of LBS user behavior. Future research can generalize these results to other contexts, such as mobile shopping and mobile payment. The present study finds that contextual offering is the main factor affecting trust. This extends previous research that has revealed the effects of structural assurance (Kim et al. 2009), design aesthetics (Li and Yeh 2010), and system quality (Vance et al. 2008) on mobile user trust.

From a managerial perspective, the results imply that mobile service providers need to concern both trust and perceived risk to facilitate LBS user behavior. Specifically, trust has the largest effect on usage intention. This means that service providers should pay close attention to trust to

promote user adoption and usage. The results suggest that they can focus on contextual offering to build user trust. Mobile service providers should present the personalized and accurate information or services to users based on their preferences and locations. They should also provide reliable services to users, thus enabling users to acquire LBS at anytime from anywhere. This can increase user trust. On the other hand, mobile service providers cannot neglect the effect of privacy risk on user behavior. They need to get users' permission in advance before presenting LBS to users. Otherwise, users may feel that their privacy is violated when they receive LBS without their knowledge. Mobile service providers can also post privacy statements and privacy seals to alleviate users' privacy concern, thus mitigating their privacy risk.

8 Conclusion

As the killer application of mobile commerce, LBS can present the optimal information and services to users. However, LBS may also arouse users' privacy concern and increase their perceived risk. From a dual perspective of enablers and inhibitors, this research examined the factors affecting user adoption of LBS. The results indicate that ubiquitous connection is the main factor affecting perceived usefulness, whereas contextual offering is the main factor affecting trust. Privacy concern affects privacy risk. Trust affects perceived usefulness and privacy risk. These three factors predict user behavior. Thus, mobile service providers need to present the ubiquitous and accurate LBS to users. Then they can build users' trust and mitigate their perceived risk, further promoting their adoption and usage of LBS.

This research has the following limitations. First, this research is conducted in China, where mobile internet is developing rapidly but still in its infancy. Thus, the results need to be generalized to other countries that had developed mobile internet. Second, the research model mainly included ubiquitous connection, contextual offering and privacy concern as the determinants. Besides these factors, there exist other factors possibly affecting user adoption, such as switching cost and perceived value. Future research can examine their effects. Third, this research collected cross-

sectional data. However, user behavior is dynamic. A longitudinal research may provide more insights on user behavior development.

9 Appendix A. Measurement scales and items

Ubiquitous connection (UC) (adapted from Lee (2005))

> UC1: I can acquire information from this service provider at anytime.
> UC2: I can acquire information from this service provider from anywhere.
> UC3: If needed, I can acquire information from this service provider at anytime from anywhere.

Contextual offering (CO) (adapted from Lee (2005))

> CO1: This service provider presents real-time information to me.
> CO2: This service provider presents specific location information to me.
> CO3: This service provider can present the optimal information or services to me based on my interests and location.

Privacy concern (PC) (adapted from Son and Kim (2008))

> PC1: I am concerned that the information I disclosed to the service provider may be misused.
> PC2: I am concerned that other people may find the private information about me on internet.
> PC3: I am concerned that my personal information may be used in a way I did not foresee.

Perceived usefulness (PU) (adapted from Davis (1989))

> PU1: LBS improve my living and working efficiency.
> PU2: LBS improve my living and working effectiveness.
> PU3: I feel that LBS are useful.

Trust (TRU) (adapted from Pavlou and Gefen (2004))

> TRU1: This service provider is trustworthy.
> TRU2: This service provider keeps its promise.
> TRU3: This service provider keeps user interests in mind.

Privacy risk (PR) (adapted from Xu et al. (2009))

> PR1: It is risky to disclose personal information to this service provider.
> PR2: There will be much uncertainty associated with disclosing personal information to this service provider.
> PR3: There will be much potential loss associated with disclosing personal information to this service provider.

Usage intention (USE) (adapted from Lee (2005))

> USE1: I am willing to use the services provided by this service provider.

> USE2: I am willing to disclose my personal information to this service provider.
> USE3: I will recommend this service provider to other people.

References

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: a review and recommended two-step approach. *Psychological Bulletin, 103*(3), 411–423.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74–94.

Bansal, G., Zahedi, F. M., & Gefen, D. (2010). The impact of personal dispositions on information sensitivity, privacy concern and trust in disclosing health information online. *Decision Support Systems, 49*(2), 138–150.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182.

Beldad, A., de Jong, M., & Steehouder, M. (2010). How shall I trust the faceless and the intangible? A literature review on the antecedents of online trust. *Computers in Human Behavior, 26*(5), 857–869.

Bhattacherjee, A. (2001). Understanding information systems continuance: an expectation-confirmation model. *MIS Quarterly, 25*(3), 351–370.

Byrne, M. B. (1998). *Structural equation modeling with LISREL, PRELIS, and SIMPLS: basic concepts, applications, and programming.* NJ: Lawrence Erlbaum Associates, Publishers.

Chandra, S., Srivastava, S. C., & Theng, Y.-L. (2010). Evaluating the role of trust in consumer adoption of mobile payment systems: an empirical analysis. *Communications of the Association for Information Systems, 27*, 561–588.

CNNIC (2012). 30th statistical survey report on the internet development in China, China Internet Network Information Center.

Davis, F. D. (1989). Perceived usefulness, Perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

Eastlick, M. A., Lotz, S. L., & Warrington, P. (2006). Understanding online B-to-C relationships: an integrated model of privacy concerns, trust, and commitment. *Journal of Business Research, 59*(8), 877–886.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research.* Reading: Addison-Wesley.

Fogel, J., & Nehmad, E. (2009). Internet social network communities: risk taking, trust, and privacy concerns. *Computers in Human Behavior, 25*(1), 153–160.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.

Gefen, D. (2002). Customer loyalty in e-commerce. *Journal of the Association for Information Systems, 3*, 27–51.

Gefen, D., Straub, D. W., & Boudreau, M. C. (2000). Structural equation modeling and regression: guidelines for research practice. *Communications of the Association for Information Systems, 4*(7), 1–70.

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: an integrated model. *MIS Quarterly, 27*(1), 51–90.

Hu, X., Wu, G., Wu, Y., & Zhang, H. (2010). The effects of Web assurance seals on consumers' initial trust in an online vendor: a functional perspective. *Decision Support Systems, 48*(2), 407–418.

Jung, Y., Perez-Mira, B., & Wiley-Patton, S. (2009). Consumer adoption of mobile TV: examining psychological flow and media content. *Computers in Human Behavior, 25*(1), 123–129.

Junglas, I. A., & Watson, R. T. (2008). Location-based services. *Communications of the ACM, 51*(3), 65–69.

Junglas, I., Abraham, C., & Watson, R. T. (2008). Task-technology fit for mobile locatable information systems. *Decision Support Systems, 45*(4), 1046–1057.

Junglas, I. A., Johnson, N. A., & Spitzmuller, C. (2008). Personality traits and concern for privacy: an empirical study in the context of location-based services. *European Journal of Information Systems, 17*(4), 387–402.

Kim, S. S., & Son, J.-Y. (2009). Out of dedication or constraint? A dual model of post-adoption phenomena and its empirical test in the context of online services. *MIS Quarterly, 33*(1), 49–70.

Kim, H. W., Xu, Y., & Koh, J. (2004). A comparison of online trust building factors between potential customers and repeat customers. *Journal of the Association for Information Systems, 5*(10), 392–420.

Kim, D. J., Ferrin, D. L., & Rao, H. R. (2008). A trust-based consumer decision making model in electronic commerce: the role of trust, perceived risk, and their antecedents. *Decision Support Systems, 44*(2), 544–564.

Kim, G., Shin, B., & Lee, H. G. (2009). Understanding dynamics between initial trust and usage intentions of mobile banking. *Information Systems Journal, 19*(3), 283–311.

Kim, C., Mirusmonov, M., & Lee, I. (2010). An empirical examination of factors influencing the intention to use mobile payment. *Computers in Human Behavior, 26*(3), 310–322.

Kumar, N., Mohan, K., & Holowczak, R. (2008). Locking the door but leaving the computer vulnerable: factors inhibiting home users' adoption of software firewalls. *Decision Support Systems, 46*(1), 254–264.

Kuo, Y.-F., & Yen, S.-N. (2009). Towards an understanding of the behavioral intention to use 3 G mobile value-added services. *Computers in Human Behavior, 25*(1), 103–110.

Lee, T. (2005). The impact of perceptions of interactivity on customer trust and transaction intentions in mobile commerce. *Journal of Electronic Commerce Research, 6*(3), 165–180.

Lee, I., Choi, B., Kim, J., & Hong, S.-J. (2007). Culture-technology fit: effects of cultural characteristics on the post-adoption beliefs of mobile internet users. *International Journal of Electronic Commerce, 11*(4), 11–51.

Li, Y.-M., & Yeh, Y.-S. (2010). Increasing trust in mobile commerce through design aesthetics. *Computers in Human Behavior, 26*(4), 673–684.

Lu, H.-P., & Su, P. Y.-J. (2009). Factors affecting purchase intention on mobile shopping web sites. *Internet Research, 19*(4), 442–458.

Lu, Y., Deng, Z., & Wang, B. (2010). Exploring factors affecting Chinese consumers' usage of short message service for personal communication. *Information Systems Journal, 20*(2), 183–208.

Luo, X., Li, H., Zhang, J., & Shim, J. P. (2010). Examining multidimensional trust and multi-faceted risk in initial acceptance of emerging technologies: an empirical study of mobile banking services. *Decision Support Systems, 49*(2), 222–234.

Malhotra, N. K., Kim, S. S., & Agarwal, J. (2004). Internet users' information privacy concerns(IUIPC): the construct, the scale, and a causal model. *Information Systems Research, 15*(4), 336–355.

Malhotra, N. K., Kim, S. S., & Patil, A. (2006). Common method variance in IS research: a comparison of alternative approaches and a reanalysis of past research. *Management Science, 52*(12), 1865–1883.

Mallat, N. (2007). Exploring consumer adoption of mobile payments - A qualitative study. *The Journal of Strategic Information Systems, 16*(4), 413–432.

Mallat, N., Rossi, M., Tuunainen, V. K., & Oorni, A. (2009). The impact of use context on mobile services acceptance: the case of mobile ticketing. *Information Management, 46*(3), 190–195.

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Review, 20*(3), 709–734.

McKnight, D. H., & Chervany, N. L. (2001). What trust means in e-commerce customer relationships: an interdisciplinary conceptual typology. *International Journal of Electronic Commerce, 6*(2), 35–59.

McKnight, D. H., Choudhury, V., & Kacmar, C. (2002). Developing and validating trust measures for e-commerce: an integrative typology. *Information Systems Research, 13*(3), 334–359.

Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.

Pavlou, P. A., & Gefen, D. (2004). Building effective online marketplaces with institution-based trust. *Information Systems Research, 15*(1), 37–59.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903.

Pura, M. (2005). Linking perceived value and loyalty in location-based mobile services. *Managing Service Quality, 15*(6), 509–538.

Schierz, P. G., Schilke, O., & Wirtz, B. W. (2010). Understanding consumer acceptance of mobile payment services: an empirical analysis. *Electronic Commerce Research and Applications, 9*(3), 209–216.

Sheng, H., Nah, F. F.-H., & Siau, K. (2008). An experimental study on ubiquitous commerce adoption: Impact of personalization and privacy concerns. *Journal of the Association for Information Systems, 9*(6), 344–376.

Shin, D. H. (2009). Understanding user acceptance of DMB in South Korea using the modified technology acceptance model. *International Journal of Human Computer Interaction, 25*(3), 173–198.

Shin, Y. M., Lee, S. C., Shin, B., & Lee, H. G. (2010). Examining influencing factors of post-adoption usage of mobile internet: focus on the user perception of supplier-side attributes. *Information Systems Frontiers, 12*(5), 595–606.

Slyke, C. V., Shim, J. T., Johnson, R., & Jiang, J. (2006). Concern for information privacy and online consumer purchasing. *Journal of the Association for Information Systems, 7*(6), 415–444.

Son, J.-Y., & Kim, S. S. (2008). Internet users' information privacy-protective responses: a taxonomy and a nomological model. *MIS Quarterly, 32*(3), 503–529.

Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems, 13*, 380–427.

Thatcher, J. B., McKnight, D. H., Baker, E. W., Arsal, R. E., & Roberts, N. H. (2011). The role of trust in post-adoption IT exploration: an empirical examination of knowledge management systems. *IEEE Transactions on Engineering Management, 58*(1), 56–70.

Thong, J. Y. L., Hong, S.-J., & Tam, K. Y. (2006). The effects of post-adoption beliefs on the expectation-confirmation model for

information technology continuance. *International Journal of Human Computer Studies, 64*(9), 799–810.

Tsai, J. Y., Egelman, S., Cranor, L., & Acquisti, A. (2011). The effect of online privacy information on purchasing behavior: an experimental study. *Information Systems Research, 22*(2), 254–268.

Vance, A., Christophe, E.-D.-C., & Straub, D. W. (2008). Examining trust in information technology artifacts: the effects of system quality and culture. *Journal of Management Information Systems, 24*(4), 73–100.

Varnali, K., & Toker, A. (2010). Mobile marketing research: the-state-of-the-art. *International Journal of Information Management, 30*(2), 144–151.

Xu, H., & Gupta, S. (2009). The effects of privacy concerns and personal innovativeness on potential and experienced customers' adoption of location-based services. *Electronic Markets, 19*(2–3), 137–149.

Xu, H., Teo, H.-H., Tan, B. C. Y., & Agarwal, R. (2009). The role of push-pull technology in privacy calculus: the case of location-based services. *Journal of Management Information Systems, 26*(3), 135–173.

Xu, H., Luo, X., Carroll, J. M., & Rosson, M. B. (2011). The personalization privacy paradox: an exploratory study of decision making process for location-aware marketing. *Decision Support Systems, 51*(1), 42–52.

Tao Zhou is an associate professor at School of Management, Hangzhou Dianzi University. He has published in *Information Systems Management, Internet Research, Journal of Electronic Commerce in Organizations, Behavior & Information Technology, Computers in Human Behavior,* and several other journals. His research interests include online trust and mobile user behavior.