

EXAMINING LOCATION-BASED SERVICES USAGE FROM THE PERSPECTIVES OF UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY AND PRIVACY RISK

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ABSTRACT

As an emerging service, location-based services (LBS) have not received wide adoption among users. Drawing on both perspectives of Unified Theory of Acceptance and Use of Technology (UTAUT) and privacy risk, this research examined user adoption of LBS. We conducted data analysis with structural equation modeling. The results indicated that usage intention is affected by both enablers such as performance expectancy and inhibitors such as perceived risk. This implies that service providers need to concern both perspectives of technological perceptions and privacy risk in order to facilitate user adoption of LBS.

Keywords: location-based services; UTAUT; privacy concern; trust

1. Introduction

Mobile internet has been developing rapidly around the world. Especially, the application of third generation (3G) communication technologies triggers mobile internet development. According to a report issued by China Internet Network Information Center (CNNIC) in January 2012, the number of mobile internet users in China has exceeded 356 million, accounting for 69% of its internet population (513 million) [CNNIC 2012]. Attracted by the great market, service providers have released a variety of mobile services, such as mobile instant messaging (IM), location-based services (LBS), mobile games and mobile payment. Among them, a few services such as mobile IM have been widely adopted by users. However, many services such as LBS have not received wide adoption among users. Mobile service providers need to understand the factors affecting user behavior. Then they can take measures to facilitate user adoption and usage of these services.

LBS mean that mobile service providers present context-related information to users based on their location and preferences [Dhar and Varshney 2011]. This personalized service delivers a better experience to users. Due to this advantage, LBS are called the killer application of mobile business [Junglas and Watson 2008]. Typical LBS include location-based advertisement, navigation, emergency evacuation and location check-in services. LBS can bring great value to users and this may promote their usage behavior. However, LBS need to utilize users' location information. This may incur users' privacy concern and increase their perceived risk. Users feel that they are tracked by service providers. Their concern on privacy risk will negatively affect their usage of LBS.

The objective of this research is to identify the factors affecting user adoption of LBS from both perspectives of technological perceptions and privacy risk. On one hand, LBS represent a new technological application. Thus we may apply information technology theories such as the unified theory of acceptance and use of technology (UTAUT) to explain user behavior. UTAUT is mainly concerned with the effect of enablers such as performance expectancy and effort expectancy on usage behavior. On the other hand, LBS user behavior may be also affected by inhibitors such as privacy risk. If users have high privacy concern, they may perceive great risk and have low trust in service providers. Thus it is necessary to integrate both perspectives of enablers such as performance expectancy and inhibitors such as privacy risk to examine LBS user behavior. Extant research has focused on the single effect of privacy risk on user adoption of LBS [Junglas et al. 2008b; Xu et al. 2011], and has seldom combined both perspectives of enablers and inhibitors to explain user behavior. This research tries to fill the gap. The results support our hypotheses.

The rest of this paper is organized as follows. We review related literature in the next section. Then we develop research model and hypotheses in section three. Section four reports instrument development and data collection. Section five presents results and section six discusses these results. We present theoretical and managerial

implications in section seven. Section eight concludes the paper.

2. Literature review

2.1 UTAUT

UTAUT is developed by Venkatesh et al. [2003] to integrate eight theories, which include the technology acceptance model (TAM), innovation diffusion theory (IDT), the motivational model, the theory of reasoned action (TRA), the theory of planned behavior (TPB), a model combining the TAM and TPB, the model of PC utilization and social cognitive theory. UTAUT proposes that four constructs including performance expectancy, effort expectancy, social influence and facilitating conditions affect user adoption of an information technology. Among them, performance expectancy is similar to perceived usefulness and relative advantage. Effort expectancy is similar to perceived ease of use and complexity. Social influence is similar to subjective norm. Facilitating conditions are similar to perceived behavioral control.

Extant research has used UTAUT to explain user adoption of internet banking [Im et al. 2011], health information technology [Kijisanayotin et al. 2009], and digital library [Nov and Ye 2009]. Recently, UTAUT has also been employed to examine user adoption of mobile services, such as mobile banking [Luo et al. 2010; Zhou et al. 2010], mobile wallet [Shin 2009], and mobile technologies [Park et al. 2007]. As LBS represent an emerging mobile service, we may also adopt UTAUT to examine user adoption and identify the factors affecting user behavior. This will not only enrich extant research on UTAUT, but also advance our understanding of LBS user behavior, which may receive a dual influence from both enablers such as performance expectancy and inhibitors such as privacy risk.

2.2 Privacy concern

Privacy concern reflects user concern on personal information disclosure [Li 2011]. Extant research has inconsistent understandings of privacy concern. Smith et al. [1996] argues that privacy concern includes collection, unauthorized access, errors and secondary use. Due to their high correlations, these four dimensions may be combined into a second-order factor [Stewart and Segars 2002]. Malhotra et al. [2004] notes that internet users' privacy concern includes collection, control and awareness. Li [2011] proposed that privacy concern includes general concern and specific concern.

Extant research has reported that privacy concern has significant effects on user adoption of instant messaging [Lowry et al. 2011], web-based healthcare services [Bansal et al. 2010], electronic health records [Angst and Agarwal 2009], software firewalls [Kumar et al. 2008], and ubiquitous commerce [Sheng et al. 2008]. Various factors such as privacy awareness, personality and culture may affect users' privacy concern [Smith et al. 2011].

2.3 LBS user adoption

As an emerging service, LBS have not been widely adopted by users. Thus researchers have tried to identify the factors affecting user behavior. Junglas et al. [2008a] used task technology fit (TTF) as the theoretical base and found that only task characteristics fit technology characteristics will users adopt LBS. Task characteristics include location sensitiveness, whereas technology characteristics include locatability and mobility. Pura [2005] examined the effect of perceived value on LBS user behavior. Perceived value includes social value, emotional value, conditional value, monetary value and convenience value. Junglas and Watson [2008] noted that LBS include location-tracking services and location-aware services. They found that location-tracking services are perceived to be more useful and easy to use by users than location-aware services.

Due to the privacy risk associated with using LBS, extant research has paid much attention to the effect of privacy risk on user behavior. Privacy risk reflects the potential losses associated with the release of personal location information to the LBS provider. Xu et al. [2011] examined the effect of personalization and privacy risk on user adoption of location-aware marketing. Xu et al. [2009] identified the effect of three mechanisms including compensation, industry self-regulation and government regulation on the intention to use LBS. Xu and Gupta [2009] examined the effect of privacy concern and personal innovativeness on LBS usage. They also included two factors of UTAUT including performance expectancy and effort expectancy into the model. However, they did not examine the effects of social influence and facilitating conditions on user behavior. In addition, they did not explore the relationship among privacy concern, trust and perceived risk. Our research tries to fill the gap. Junglas et al. [2008b] noted that personality traits affect privacy concern, which in turn affects perceived risk and usage intention. Personality traits include agreeableness, extraversion, emotional stability, openness to experience, and conscientiousness.

3. Research model and hypotheses

3.1 UTAUT

UTAUT includes four constructs: performance expectancy, effort expectancy, social influence and facilitating conditions. Performance expectancy reflects the utility derived from using LBS. Mobile networks and terminals

enable users to acquire information at anytime from anywhere. This brings great convenience to users. In addition, LBS can present the optimal information and services to users based on their location and preferences. This personalized information will deliver utility to users. For example, LBS can inform users about the nearby automated teller machine and public bus station. On the other hand, if users cannot acquire accurate context-related information, they may feel that LBS are useless. Extant research has found the effect of performance expectancy on usage intention of mobile banking [Luo et al. 2010; Zhou et al. 2010]. Thus, we propose,

H1: Performance expectancy is positively related to usage intention.

Effort expectancy reflects the difficulty of using LBS. Due to the constraints of mobile terminals such as small screens and inconvenient input, it is relatively difficult for users to operate mobile applications [Lee and Benbasat 2004]. In addition, users may be unfamiliar with LBS, which represent an emerging service. This may also increase their difficulty of using LBS. These aspects highlight the need to present easy-to-use LBS to users. If users find LBS difficult to use, they may be unwilling to adopt LBS.

H2: Effort expectancy is positively related to usage intention.

Social influence reflects the influence of important people's opinion on individual user [Venkatesh et al. 2003]. When those people that are important to users recommend using LBS, they may comply with these people's opinion and adopt LBS. This process is called compliance in the social influence theory [Kelman 1974]. The effect of social influence on user behavior has been validated in extant research [Kim et al. 2011; Shen et al. 2011].

H3: Social influence is positively related to usage intention.

Facilitating conditions reflect that users have ability and resources necessary to use LBS [Venkatesh et al. 2003]. Users need to be equipped with mobile internet knowledge in order to use LBS. In addition, they also need to pay communication fees and service fees associated with using LBS. If they do not own these knowledge and resources, they cannot adopt LBS.

H4: Facilitating conditions are positively related to usage intention.

3.2 Trust and perceived risk

Trust reflects a willingness to be in vulnerability based on the positive expectation toward another party's future behavior [Mayer et al. 1995]. Trust often includes three beliefs: ability, integrity and benevolence [Gefen et al. 2003; Kim et al. 2008]. Ability means that service providers have the knowledge and skills to fulfill their tasks. Integrity means that service providers keep their promise and do not deceive users. Benevolence means that service providers care users' interests, not just their own benefits. Trust may directly facilitate usage intention as it ensures that users acquire positive outcomes in future. In addition, trust may mitigate perceived risk. When users develop trust in service providers, they believe that service providers have ability and integrity to protect their personal information from potential problems. Much research has revealed the effect of trust on behavioral intention and perceived risk [Beldad et al. 2010; Luo et al. 2010; Slyke et al. 2010].

H5: Trust is positively related to usage intention.

H6: Trust is negatively related to perceived risk.

Compared to the positive effect of trust on usage intention, perceived risk may negatively affect usage intention [Gupta et al. 2010; Glover and Benbasat 2011]. When users expect negative outcomes in future, they cannot adopt and use LBS.

H7: Perceived risk is negatively related to usage intention.

3.3 Privacy concern

LBS need to collect and utilize users' location information in order to deliver the optimal information to them. This may arouse users' concern on their privacy. They may be concerned with service providers' practice on information collection, storage and usage. For example, they probably doubt whether service providers will share this information with third parties without their knowledge. This may decrease their intention to use LBS.

H8: Privacy concern is negatively related to usage intention.

In addition, users with high privacy concern may also doubt service providers' integrity and benevolence to appropriately collect and use their personal information. Thus privacy concern will lower user trust in service providers. On the other hand, privacy concern may directly increase perceived risk. Users may worry about the potential losses associated with information disclosure, such as information leakage and sales. Extant research has reported the effect of privacy concern on user trust and perceived risk [Malhotra et al. 2004; Eastlick et al. 2006; Bansal et al. 2010].

H9: Privacy concern is negatively related to user trust.

H10: Privacy concern is positively related to perceived risk.

Figure 1 presents the research model.

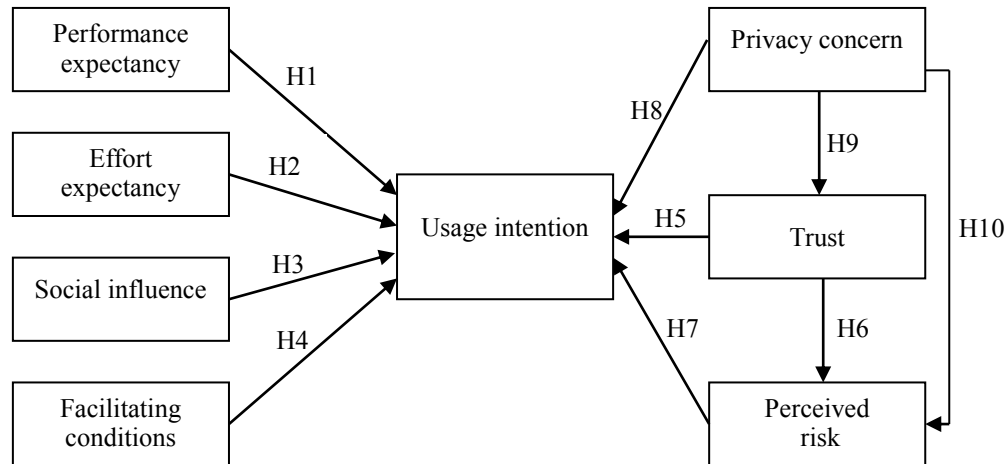


Figure 1. The Research Model

4. Method

The research mode includes eight constructs. Each construct was measured with multiple items. All items were adapted from extant literature to improve 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 tested among five users that had LBS usage experience. Then according to their comments, we revised some items to improve clarity and understandability. The final items and their sources are listed in Appendix A.

Items of four constructs of UTAUT were adapted from Venkatesh et al. [2003]. Items of performance expectancy reflect the improvement of living and working efficiency and productivity. Items of effort expectancy reflect the difficulty of learning to use and skillfully using LBS. Items of social influence reflect the influence of other important people’s opinion on individual user. Items of facilitating conditions reflect that users have resources and knowledge necessary to use LBS. Four items of privacy concern were adapted from Son and Kim [2008] to measure user concern on personal information usage. Items of trust were adapted from Pavlou and Gefen [2004] to reflect service providers’ ability, integrity and benevolence. Items of perceived risk were adapted from Xu et al. [2009] to reflect the potential loss derived from information disclosure. Items of usage intention were adapted from Lee [2005] to reflect user intention to use LBS.

Data were collected at the service outlets of China Mobile and China Unicom, which represent two main telecommunication operators in China. These service outlets were located in an eastern China city, where mobile internet is relatively better developed than other regions. We first inquired whether users had LBS usage experience. Then we asked those with positive answers to fill the questionnaire based on their usage experience. We scrutinized all responses and dropped those with too many missing values. As a result, we obtained 191 valid responses. Among them, 37.2% were male and 62.8% were female. Over half of them (53.9%) were between twenty and twenty-nine years old. A majority of them (71.2%) had used mobile internet for more than three years. The frequently used LBS include mobile navigation and location check-in services.

To examine the common method variance (CMV), we conducted two tests. First, we performed a Harman’s single-factor test [Podsakoff and Organ 1986]. The results indicated that the largest variance explained by individual factor is 13.52%. Thus none of the factors can explain the majority of the variance. Second, we modeled all items as the indicators of a factor representing the method effect and re-estimated the model [Malhotra et al. 2006]. The results indicated a poor fitness. For example, the goodness of fit index (GFI) is 0.474 (<0.90) and the root mean square error of approximation (RMSEA) is 0.218 (>0.08). With both tests, we feel that CMV is not a significant problem in our research.

5. Results

Following the two-step approach recommended by Anderson and Gerbing [1988], 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 to test the 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 1 lists the standardized item loadings, the average variance extracted (AVE), composite reliability (CR) and Cronbach Alpha values. As listed in the table, most item loadings are larger than 0.7 and T values indicate that all loadings are significant at 0.001. All AVEs exceed 0.5 and 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, suggesting a good reliability [Nunnally 1978].

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

Factor	Item	Standardized item loading	AVE	CR	Alpha value
Performance expectancy (PEE)	PEE1	0.872	0.62	0.83	0.82
	PEE2	0.780			
	PEE3	0.692			
Effort expectancy (EFE)	EFE1	0.845	0.67	0.86	0.86
	EFE2	0.816			
	EFE3	0.801			
Social influence (SOI)	SOI1	0.742	0.64	0.78	0.77
	SOI2	0.852			
Facilitating conditions (FAC)	FAC1	0.747	0.58	0.81	0.81
	FAC2	0.823			
	FAC3	0.714			
Privacy concern (PC)	PC1	0.783	0.70	0.90	0.90
	PC2	0.877			
	PC3	0.877			
	PC4	0.794			
Trust (TRU)	TRU1	0.839	0.67	0.86	0.86
	TRU2	0.894			
	TRU3	0.717			
Perceived risk (RISK)	RISK1	0.843	0.76	0.90	0.90
	RISK2	0.919			
	RISK3	0.843			
Usage intention (USE)	USE1	0.826	0.64	0.84	0.84
	USE2	0.852			
	USE3	0.724			

To test the discriminant validity, we 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, suggesting a good discriminant validity [Fornell and Larcker 1981; Gefen et al. 2000].

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

	PEE	EFE	SOI	FAC	PC	TRU	RISK	USE
PEE	0.785							
EFE	0.471	0.821						
SOI	0.447	0.443	0.799					
FAC	0.457	0.468	0.467	0.763				
PC	0.340	0.419	0.350	0.385	0.834			
TRU	0.225	0.151	0.319	0.164	-0.196	0.820		
RISK	0.034	0.079	-0.046	0.044	0.431	-0.511	0.869	
USE	0.531	0.496	0.558	0.544	0.153	0.401	-0.197	0.803

Second, we adopted structural equation modeling software LISREL to estimate the structural model. Figure 2 presents the results. Table 3 lists the recommended and actual values of some fit indices. Except GFI, other fit indices have better actual values than the recommended values. This indicates a good fitness [Gefen et al. 2000]. The explained variance of trust, perceived risk and usage intention is 3.3%, 37.6% and 43.9%, respectively.

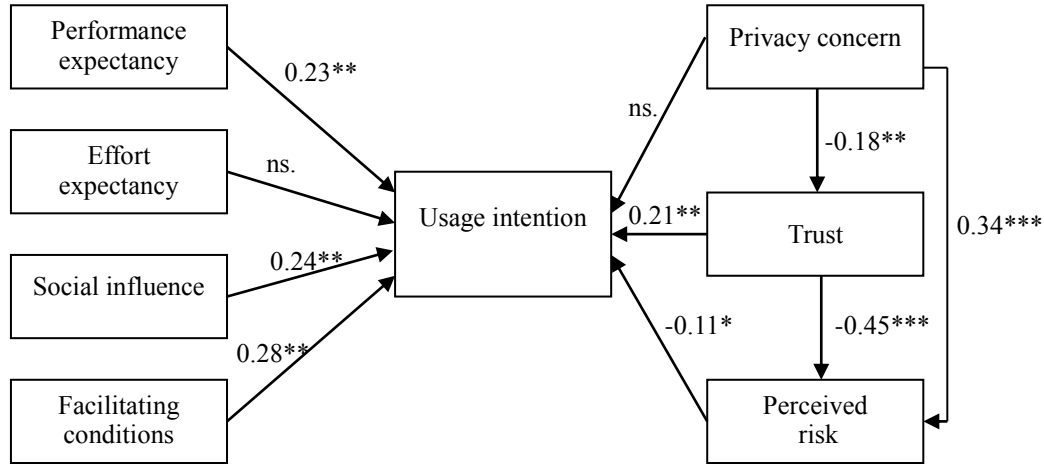


Figure 2. The results estimated by LISREL
 (Note: *, P<0.05; **, P<0.01; ***, P<0.001; ns, not significant)

Table 3. The recommended and actual values of fit indices

Fit indices	χ^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	1.57	0.862	0.821	0.971	0.931	0.966	0.055

(Note: χ^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)

6. Discussion

As shown in Figure 2, except H2 and H8, other hypotheses are supported. Performance expectancy, social influence and facilitating conditions affect usage intention. Privacy concern affects perceived risk and trust, both of which predict usage intention. We did not find the effect of effort expectancy and privacy concern on usage intention.

Among four constructs of UTAUT, facilitating conditions have a relatively larger effect ($\gamma=0.28$) on usage intention. Facilitating conditions reflect that users have resources and knowledge necessary to use LBS. Thus service providers need to reduce usage cost and equip users with LBS knowledge. Users are often charged with communication and service fees when they use mobile services. These fees mean a great cost burden for users and may inhibit their adoption of LBS. In addition, LBS representing an emerging service are novel to most users. They need to acquire the basic knowledge and operation skills before using LBS. Service providers can use propaganda and online help tutorial to increase user understanding of LBS. Social influence also has a significant effect on usage intention. This indicates that users will conform to important peers’ opinions when considering LBS usage. Service providers can encourage early users to invite their friends and colleagues to participate in LBS community. They can use incentives such as awards and member level to promote these early users’ recommendation intention. The results indicate that performance expectancy significantly affects usage intention. Performance expectancy reflects that users obtain expected utility associated with using LBS. They may expect to receive ubiquitous and relevant information catering to their contexts from service providers. This means that service providers should provide reliable and accurate information and services to users based on their location and preferences. Otherwise, users may lower their perception of LBS utility and drop their usage. We did not find the effect of effort expectancy on usage intention. This may be for the reason that our sample was mainly composed of experienced mobile internet users. They have relatively high self-efficacy and operating LBS does not mean a difficult task for them.

Privacy concern has significant effects on trust and perceived risk. These results are consistent with extant findings [Junglas et al. 2008b; Bansal et al. 2010]. Privacy concern reflects user concern on personal information disclosure. If service providers cannot ensure that users’ personal information is properly collected and used, users may lower their trust in service providers and increase their perceived risk. They are worry about the negative outcomes associated with information disclosure, such as information abuse and sales without their knowledge. Thus

service providers need to adopt effective measures to decrease users' privacy concern. They can post privacy policies to inform users about their privacy practice on information collection, storage and usage. They can also present privacy seals issued by the authoritative third-party organizations to signal trustworthiness. In addition, they can apply advanced encryption technologies such as secure socket layer to ensure personal information storage security. With these measures, users' privacy concern may be mitigated and their trust be established.

Trust affects perceived risk, and both factors affect usage intention. Trust provides a guarantee that users acquire positive outcomes in future [Gefen et al. 2003]. Thus trust may lower perceived risk. Compared to the effect of perceived risk, trust has a larger effect on usage intention. This may be good news for service providers. They can use measures such as contextual offering and ubiquitous connection to enhance user trust in service providers [Lee 2005]. The results indicate that privacy concern has no direct effect on usage intention. However, privacy concern indirectly affects usage intention through trust and perceived risk. Thus trust and perceived risk mediate the effect of privacy concern on usage intention.

7. Theoretical and managerial implications

From a theoretical perspective, this research integrated both perspectives of UTAUT and privacy risk to examine LBS user adoption. As noted earlier, extant research has always focused on the single effect of privacy risk on user behavior. This may be unable to fully disclose user decision process of adopting LBS. This research tries to fill the gap. The results indicate that LBS user behavior is affected by both enablers such as performance expectancy and inhibitors such as perceived risk. This advances our understanding of LBS user behavior. In addition, the effect of performance expectancy on usage intention ($\gamma = 0.23$) outweighs that of perceived risk on usage intention ($\beta = 0.11$). This highlights the necessity to take technological perceptions into consideration when examining LBS user behavior. On the other hand, UTAUT has been used to explain user acceptance of various technologies such as internet banking and mobile banking. This research generalizes it to an emerging service: LBS, and finds its validity in predicting user behavior. This enriches extant research on UTAUT. Future research can generalize it to more contexts.

From a managerial perspective, our results imply that service providers need to concern both perspectives of technological perceptions and privacy risk in order to facilitate usage intention of LBS. On one hand, they need to improve user perceptions such as performance expectancy and facilitating conditions. This entails investing effort and resources on providing useful services to users. Service providers also should reduce usage costs and familiarize users with LBS. On the other hand, they need to curb the effect of inhibitors such as privacy risk on user behavior. They can post privacy statements and present privacy seals to ease user concern on personal information disclosure. They can also build user trust to alleviate perceived risk.

8. Conclusion

As an emerging mobile service, LBS have not received wide adoption among users. Drawing on both perspectives of UTAUT and privacy risk, this research identified the factors affecting usage intention of LBS. The results indicate that LBS usage is affected by both enablers such as performance expectancy and inhibitors such as perceived risk. Thus mobile service providers need to concern both aspects of technological perceptions and privacy risk in order to promote user adoption of LBS.

This research has the following limitations. First, we conducted this research in China, where mobile internet is developing rapidly but still in its early stage. Thus our results need to be generalized to other countries that had developed mobile business. Second, besides four constructs of UTAUT and perceived risk, there exist other enablers such as satisfaction and inhibitors such as switching cost. Future research can explore their effects on user behavior. Third, our subjects are LBS users that had usage experience. This may bias the results as mobile users include both actual adopters and potential adopters. Thus our results need to be generalized to other samples, such as potential adopters. Fourth, we mainly conducted a cross-sectional study. However, user behavior is dynamic. A longitudinal research may provide more insights on user behavior development.

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Appendix A. Measurement Scales and Items

Performance expectancy (PEE) (adapted from Venkatesh et al. [2003])

PEE1: Using LBS improves my living and working efficiency.

PEE2: Using LBS increases my living and working productivity.

PEE3: I find that LBS are useful.

Effort expectancy (EFE) (adapted from Venkatesh et al. [2003])

EFE1: Learning to use LBS is easy for me.

EFE2: Skillfully using LBS is easy for me.

EFE3: I find that LBS are easy to use.

Social influence (SOI) (adapted from Venkatesh et al. [2003])

SOI1: People who influence my behavior think that I should use LBS.

SOI2: People who are important to me think that I should use LBS.

Facilitating conditions (FAC) (adapted from Venkatesh et al. [2003])

FAC1: I have the resources necessary to use LBS.

FAC2: I have the knowledge necessary to use LBS.

FAC3: A specific person (or group) is available for assistance with LBS system difficulties.

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

PC1: I am concerned that the information I disclosed to the service provider could be misused.

PC2: I am concerned that a person can find private information about me on Internet.

PC3: I am concerned about providing personal information to the service provider, because of what others might do with it.

PC4: I am concerned about providing personal information to the service provider, because it could be used in a way I did not foresee.

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 customer interests in mind.

Perceived risk (RISK) (adapted from Xu et al. [2009])

RISK1: Providing this service provider with my personal information would involve many unexpected problems.

RISK2: It would be risky to disclose my personal information to this service provider.

RISK3: There would be high potential for loss in disclosing my personal information to this service provider.

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

USE1: Given the chance, I intend to use LBS.

USE2: I expect my use of LBS to continue in the future.

USE3: I have intention to use LBS.