Exploration of Location-Based Services Adoption

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ABSTRACT

The purpose of this paper is to explore aspects of user perceptions of their use of location-based services. As mobile technologies become more ubiquitous in the general population, it is reasonable to assume that individuals will consume services and software to enhance their aspirations and entertainment desires. This study begins by constructing a location-based service prototype simulation. It then conducts an experiment and analysis based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model. A survey was developed to extract usage information from participants, followed by an analysis of the results using PLS. The analysis shows significant indicators that suggest behaviour patterns of early adopters of location-based services are being observed. This paper applies the UTAUT model using a location-based service experiment to understand the underlying perceptions of individuals who may adopt location-based services. The authors study the effects of multiple parameters on the use of a location-based service simulation. Through this simulation and a following survey, current perceptions of LBS are investigated and insights gained.

Keywords: *Location-Based Services, PLS, Prototype, Survey, UTAUT*

INTRODUCTION

With the increasing demand for mobile computing devices, individuals are becoming important factors in the consumption patterns for mobile service providers. As such consumption emerges it challenges the understood tenants of main stream organizational based information systems development (Tuunanen, Myers, & Cassab, 2010). The individual consumer will configure their mobile device to suit their own personality and aspirations for entertainment and information needs (Ritu Agarwal & Elena Karahanna, 2000; Hill et al., 2002; Pihlström, 2007; Westbrook & Oliver, 1991). Such consumption is highly volatile, it is dynamic and focuses on the instant needs of the individual. Furthermore, it is highly influenced by social pressures.

The increased ease of constructing push service technologies for mobile devices will increase mobile services offered to consum-

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ers (O'Connor & Godar, 2003). One such area is location-based services (LBS). These were initially identified as having the potential to offer great growth for mobile industry (Mountain & Raper, 2001). Despite their early failure (May, Bayer, & Ross, 2007), LBS are making a comeback due to the emergence of new mobile phones with increased processing power, high-resolution colour screens, faster data connections, high performance positioning technologies, and a greater emphasis by the telecom operators on data services (May, et al., 2007). The use of LBS is increasing. In the United States, 74% of smartphone owners used LBS, and 18% use LBS to "check-in" or share their location with their friends with LBS applications such as Foursquare or location sharing services through Facebook (Zickuhr, 2012). We also note that mobile service development has become more widely accepted and is therefore included in several mobile software development platforms, for example, Apple, released a Software Development Kit (SDK) in 2009 with built in support for push service provision. Small as this may seem it indicates the recognition of mobile service software as an emerging market for the future.

Mobile service providers need to understand the factors affecting user adoption in order to understand consumers usage behaviour (Zhou, 2013). We attempt this by applying the unified theory of acceptance and use of technology (UTAUT) model (Venkatesh, Morris, Davis, & Davis, 2003) using a LBS prototype to understand the underlying perceptions of individuals who may adopt LBS. This leads to our research question of *what influences users to adopt LBS based mobile services?* In doing this, we study the effects of multiple parameters on the use of a LBS simulation. Through this simulation and a following survey, current perceptions of LBS are investigated and insights gained.

The structure of the rest of the paper is as follows. The next section briefly reviews literature in the areas of LBS and of technology acceptance; this is followed by the research methodology and results of a participant survey. Finally, we discuss the results and conclude and propose topics for future research.

LITERATURE REVIEW

In this section we review literature to provide a theoretical basis for our empirical study. Firstly, we indicate salient evidence to support market groups, attitudes, awareness and use of these products (May, et al., 2007). At this time the literature on LBS is sparse and concentrates mainly on peripheral elements associated with these systems. Secondly, we review literature on technology acceptance and adoption and focus on understanding the characteristics and behaviour of groups who are potential early adopters in order to provide more indication of the rate of uptake of LBS (Rogers, 2003). Within this review we also refer to contemporary applications and their usage, Global Positioning Systems (GPS) and the use of social media based LBS.

LOCATION-BASED SERVICES

The term LBS refers to an IT service which provides information that has been filtered, selected, compiled, or created, taking into account the current locations of the device, other people, or mobile objects (Küpper, 2005; Raper, Gartner, Karimi, & Rizos, 2007). LBS can present optimal and customised information and services to users based on their current location (Petrova & Wang, 2011; Zhou, 2013). Mobile commerce has evolved to utilize end user's location data to deliver relevant, timely, and engaging content. This is advantageous for local commercial organisations to be able to attract consumers to their business. For mobile network operators, LBS represent a welcome additional revenue stream, which can be generated by leveraging their current investments in fixed infrastructure. For the consumer, such services can deliver high quality service options and improve individual service consumption (Rao & Minakakis, 2003).

LBSs are attractive as consumers do not need to enter location information manually, but instead are automatically pinpointed and tracked (Küpper, 2005). A LBS on a small device usually initially provides only small portions of information to the user who then has the opportunity to access further data as required (Billsus, Brunk, Evans, Glandish, & Pazzanu, 2002). User and usage situation, and location can further categorize information and services. For example, when searching for nearby hotels, information may be presented to the user by price and room availability; quality and facilities; or the location (Kaasinen, 2003).

Extant literature on LBSs is broad. Dhar & Varshney (2011) discussed the challenges and business models for LBS and advertising. Chen et al. (2013) constructed mobility profiles of LBS users. Hsieh and Li (2012) developed a LBS to track users travel paths. Ma et al. (2013) explored the delivery of LBS to users based on the past behaviour of those users. Ryu and Hur (2013) explored how LBS can be used for student safety networks. Lindqvist et al. (2011) sought to discover how and why people use Foursquare, a mobile information sharing app, which they found was used for elements of fun, exploration, and coordinating with friends.

De Vos et al. (2009) investigated the use of information about a user's context in LBSs. They found that adding context aware features to mobile services, such as location or availability, did not provide added value to users as it was offset by a user's reluctance to share location information with others. This is contradictory to an earlier study by Kaasinen (2003) who notes that user attitudes towards LBS are generally positive. Users, generally, do not mind receiving pushed services or information as long as it was pertinent to their needs, situation and location. It is also noted, however, that some criticism towards the proposed new LBS technologies exist where services are perceived to be too complex or irrelevant, for example, a proactive shopping and exhibition guide was seen as not being useful and went far beyond the needs of most people (Kaasinen, 2003). Thomas et al (2012) also found the attitudes towards LBS were positive, especially in younger generations.

Many of the proposed LBS services are often related to topical information, which changes while the user is on the move. Examples of such topical information are weather forecasts, last minute theatre ticket deals, traffic information, or online chat. A quick survey on iTunes using the keyword "location" found a large number of applications available to download and install on an iPhone. For example, AroundMe and Foursquare, which are applications that allow the user quickly to find out information about their surroundings. A similar survey of Nokia's Ovi store, although not yet as complex as iTunes, found 41 applications under the City Guides/Maps category. Similar investigations of Google's Google Play store found approximately 1000 applications listed. The market for utilizing LBS is clearly evident with the number of apps currently on offer.

May et al. (2007) further identifies a range of demographic, usage and additional data relating to LBS, and in particular the extent to which early adopters are using, or are aware of LBS and their general attitudes towards these services. As is generally noted in technology adoption models they note that the incidence of use of LBS was a third lower than their level of awareness in the services. This implies that although people are aware of such services, they do not use them (May, et al., 2007), which concurs with Carlsson et al.'s (2006) findings. May et al.'s (2007) results show that within all consumer segments commonly used by telecom operators, the majority of consumers liked to try out new technology and were motivated by the opportunity to change their lifestyle and that respondents were generally aware of the capabilities of checking local weather information via a mobile phone, but had not actually tried it. Furthermore, respondents were generally unaware of the existence of services such as "friend finder", location-based advertising or having access to safety/security information via a mobile phone.

In the following section we review how literature has understood how technology adoption has been studied within a mobile context.

MOBILE SERVICES ADOPTION

LBSs are a subset of mobile services. Therefore this section first looks at the literature relating to adoption of LBS, and then on mobile technologies in general. Zhou (2013) examined user adoption of LBS, from a trust perspective. The results showed that contextual offering, i.e. the optimal information is presented to users based on their locations and preferences, affects flow and trust, but did not affect perceived risk. Kofod-Petersen et al. (2010) examined the usage of location-aware social networks services. The findings show that users are willing to use such services, however there were some issues with regard to privacy. The literature relating to LBS adoption is sparse; therefore the remainder of this section is focussed towards mobile services adoption.

Aarnio et al. (2002) investigated the types of mobile and internet services that people aged between 9 to 34 years in Finland used. Their research focused on the present and future uses of Internet and mobile services. Their results showed that mobile services were mostly used for entertainment, information and news. Entertainment services were considered to be clearly the most popular, while the rest were only adopted by lead-users. Their conclusion was that mobile services are currently only being utilized by pioneering and early adopters, but their usage has not yet spread to the masses (Aarnio, et al., 2002). Mobile usage has also been investigated from an emergency services perspective. Aloudat et al. (2013), found that in Australia, people were willing to use location-based services in emergency management situations.

Studies of adoption and use of mobile services have indicated that traditional adoption models must be extended and modified when applied to mobile services (Pedersen, 2005). In investigating the early adoption of mobile commerce services, Pedersen (2005) applied a modified version of the decomposed theory of planned behaviour to the adoption behaviour of early adopters of mobile services. A significant relationship between external influences such as marketing and peer pressure and perceived personal usefulness affected the adoption of the product. The mobile services that are most frequently adopted are often simple services such as direct download of services and alert services. Zarmpou et al. (2011) examined how trust, perceived ease of use, perceived usefulness, innovativeness, demographics, and relationships influence the adoption of mobile services. They found that an individuals' relationship with the mobile service, their innovativeness, and educational level are the key factors to mobile service adoption.

Nysveen et al. (2005), in turn, have developed a model to explain consumers' intentions to use mobile services. The model proposes four overall influences on intention to use mobile services: perceived control, normative pressure, attitudinal influences, and motivational influences. The model was examined over four mobile services: text messaging services, contact services, payment services, and gaming services. Nysveen et al. (2005) found that perceived expressiveness, perceived usefulness, and perceived enjoyment have an effect on intention to use mobile services. According to them, the implication of perceived expressiveness is that mobile services should enable users to express their personal and social identity. Thus, services should be personalized and up-to-date according to individual user identities. This is particularly important for experimental and gaming services. This finding suggests that perceived enjoyment has a positive and significant effect on the intention to use both experimental and goal-directed mobile services. This, furthermore, implies that developers should pay close attention to aspects of hedonic utility (Ritu Agarwal & Elena Karahanna, 2000; Hill, et al., 2002; Pihlström, 2007; Westbrook & Oliver, 1991), such as excitement and fun, when developing mobile services.

Lin and Shih (2008) evaluated features of m-commerce services in relation to the consumer's intentions to continue use of the service. The features evaluated included perceived usability, perceived playfulness, perceived personalization, perceived responsiveness, and perceived instant message capabilities. Trust in m-technology and m-vender was also equally important in securing the consumers continuation of service use. M-technology trust relates to the consistency, security, and reliability in using the technology. Whereas trust in the m-vendor relates to service providers which are predictable, competent, and benevolent (Lin & Shih, 2008). Furthermore, Lin and Shih (2008) have developed m-commerce service satisfaction model for the usage and continuance intentions of mobile services in terms of perceived performance, m-vender trusting, disconfirmation, and personal trust expectations about the m-technology. Their findings showed that satisfaction increased through the consumer first developing technology trust expectations about the m-commerce service and their personal own values. After continued use of the service, consumers gained experience from using the service and established perceptions about its performance (Lin & Shih, 2008).

Koivumäki et al. (2006) have investigated the application of the extended Technology Acceptance Model to the prediction of consumer acceptance in mobile services. The results showed that usefulness is the most important factor in explaining the likelihood of future use of mobile services. However, ease of use did not directly affect the likelihood of future use. The results also showed that resource variables such as guidance and support are important factors as well as user skills. User satisfaction did not have any important predictive power over the likelihood of future use. However, user satisfaction was a strong significant predictor of the willingness to recommend the service to others. Ghobakhloo et al. (2013) presented an extension of the technology acceptance model to understand what determines mobile commerce and usage. They found that in the mobile commerce field, actual usage behaviour is predicted by the user's behavioural intentions, which in turn are affected by mobile commerce usefulness, perceived costs, and the perceived attitude towards mobile commerce. Cost was one of the most important predictors of mobile commerce adoption.

Finally, there have been a number of other modifications to the Technology Acceptance Model (TAM) over the years (Carlsson, et al., 2006). The most prominent of these modifications is the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, et al., 2003). Park et al. (2007) and Carlsson et al. (2006) have applied UTAUT model in mobile research. Park et al. (2007) applied it to the adoption of mobile technologies for Chinese consumers. UTAUT states that there are three direct determinants of intention to use: *performance expectancy*, *effort expectancy*, and *social influence*. There are two direct determinants of usage behaviour: *intention* and *facilitating conditions* (Venkatesh, et al., 2003). The research results showed that gender and educational level were both significant factors moderating the adoption of mobile technologies, while internet usage experience did not register as significant (Park, et al., 2007). Carlsson et al. (2006) in turn have found that the UTAUT can be used as a starting point to find some explanations for the adoption of mobile devices and services. Furthermore, Park et al. (2011) eamined the adoption of Internet phone services using UTAUT, and found that performance expectancy was the dominant driver of usage, with social influences and effort expectancy as significant, but minor, influences.

This section has outlined the literature and research in the fields of LBS and technology acceptance. The next section presents the application of the UTAUT model to a location based application built for a mobile device.

RESEARCH METHODOLOGY

This section describes the research methods utilised for this investigation. We use a design science (Hevner, March, & Park, 2004; Peffers,

Tuunanen, Rothenberger, & Chatterjee, 2008) informed approach to attempt to understand our identified research problem: Consumers are more interested in enjoyment and pleasure gained from using information services. In order to examine this further we first discuss the research model and the hypotheses. This is followed by a description of a prototype of "City Wanderer" app in the context of its use as a research tool. Within this section we describe the tool, its implementation and exploratory nature, we then describe its use in conjunction with our research model noted in Figure 1.

RESEARCH MODEL AND HYPOTHESES

We have based our research model on the UTAUT model. UTAUT was chosen as an analysis model as it has been proven to outperform eight prominent models of IT adoption (Carlsson, et al., 2006). There are few studies that relate to LBS adoption, namely Zhou (2013), and Kofod-Petersen (2010). Therefore we decided to explore LBS adoption with a robust model such as UTAUT. Since its conception, the UTAUT model has been used in many contexts such as mobile services (Carlsson, et al., 2006; Koivumäki, Ristola, & Kesti, 2008; Park, et al., 2007), in the workplace (Eckhardt, Laumer, & Weitzel, 2009), social media (Curtis et al., 2010), student use of communication technologies (Verhoeven, Heerwegh, & Wit, 2010), and virtual worlds (Goh & Yoon, 2011). Often the hypotheses under examination in these studies were modified to fit the context in which the model was being applied. In an UTAUT study by Carlsson et al. (2006), the hypotheses were modified to fit a mobile service context and contain only the relationships between constructs without their moderators. We have taken an approach similar to this and slightly modified the hypotheses found in Carlsson et al. (2006). This approach is justified as our application of UTAUT is within the domain of mobile services. The research model is illustrated in Figure 1. It is important to keep the model's hypotheses similar so that we can test the model in a different context, in this case we are testing the model with LBS.

A definition of each construct in the research model is provided in Table 1.

Figure 1. Research model

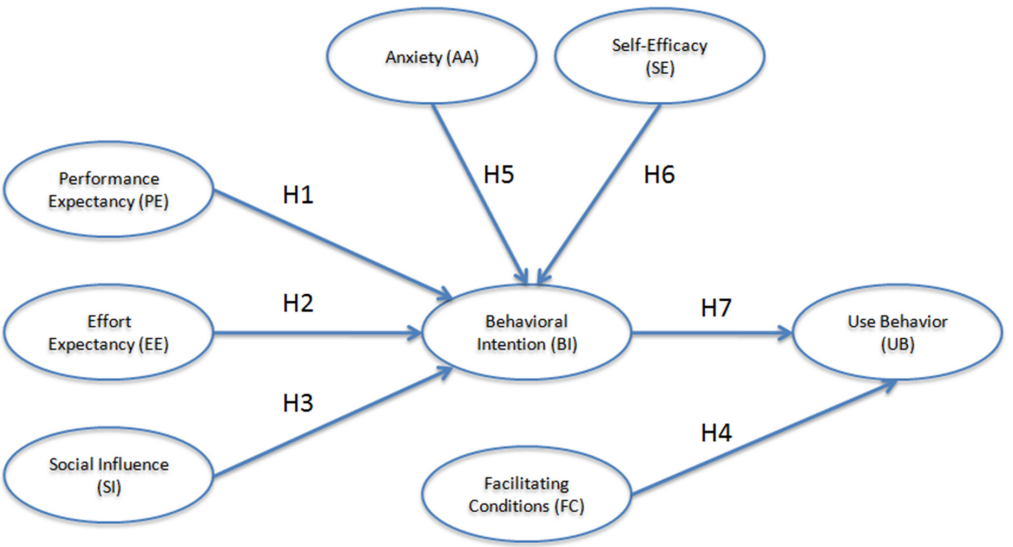


Table 1. Definitions of constructs in the model (Venkatesh, et al., 2003)

Construct	Definition
Performance Expectancy (PE)	Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job/personal performance
Effort Expectancy (EE)	Effort expectancy is defined as the degree of ease associated with the use of the system
Social Influence (SI)	Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system.
Facilitating Conditions (FC)	Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.
Behavioural Intention (BI)	Behavioural intention is defined as the degree to which an individual would intend to use the system
Use Behaviour (UB)	Use behaviour is defined as the degree to which an individual would use the system
Anxiety (AA)	Anxiety is defined as the degree to which an individual feels anxious about using the system
Self-Efficacy (SE)	Self-Efficacy is defined as the degree to which an individual feels as though they can use the system without the help of others

Based on the definitions noted in Table 1 we then propose the following expected relationships for direct effects in our model are:

H1: Performance Expectancy has an influence on behavioural intention;
H2: Effort Expectancy has an influence on behavioural intention;
H3: Social Influence has an influence on behavioural intention;
H4: Facilitating Conditions has an influence on use behaviour;
H5: Anxiety has an influence on behavioural intention;
H6: Self-Efficacy has an influence on behavioural intention;
H7: Behavioural Intention has an influence on use behaviour.

LBS PROTOTYPE DESCRIPTION

For the purposes of this study we developed a prototype LBS application based on a previous study, which focused on requirements development for 'presence' enabled mobile services using location information to guide and entertain the user (T Tuunanen, K Peffers, C Gengler, W Hui, & V Virtanen, 2006). However, Tuunanen et al. (2006) did not study behavioural aspects of such services. We noted that this and other prior research indicated that there were significant unexplored areas of LBS that merited exploration. This study developed a prototype and an expanded UTAUT research model to facilitate this exploration.

The prototype was designed and built as a desktop simulation. We chose to build a desktop simulation to allow for different consumer experiences with mobile devices. The advantage of the desktop simulation is that it provides a consistent platform on which participants to investigate the tool. This allowed for differing participant user experience, i.e. whether or not they used a smart phone and mitigated against it. The disadvantage in terms of the user experience of not using a mobile application on a mobile device were considered but thought to be a minor issue in comparison to the advantages noted.

We used Visual Studio 2007 and Visual Basic.NET for the implementation. The database was created using SQL Server 2005. Figure 2 presents a use case model for a particular LBS application derived from the earlier work by Tuunanen et al. (2006), namely a mobile service called 'City Wanderer'. A use case model is a common approach used to illustrate the main functionalities of a system and the users which interaction with it. From this model we note the main functional elements of the City Wanderer system from initial setting of its preferences and profile through to investigating local attractions and destination details. The use of this use case model is particularly pertinent to gathering the significant requirements for the development of the prototype.

Figure 3 illustrates City Wanderer simulation. This simulation was devised from a series of analytical models, which explored the basic requirements for the system. On the left hand side is a simple layout of a city, whereas on the right hand there is a simulation of the application running on a mobile device, which was programmed to operate exactly how mobile phone would. The simulation is uses a software development kit, developed by Nokia for this purpose. The Nokia SDK provides a virtual runtime environment, which fully complies with the actual mobile devices operating system and user interface.

The study participant will then use the directional arrows to navigate through the city towards the destination. As the prototype user walks, the route will update to the current location of the user. Figure 3 demonstrate how study participants can locate the nearest ATM. Once an user has selected that it is an ATM they are

Figure 2. Use case model for city wanderer

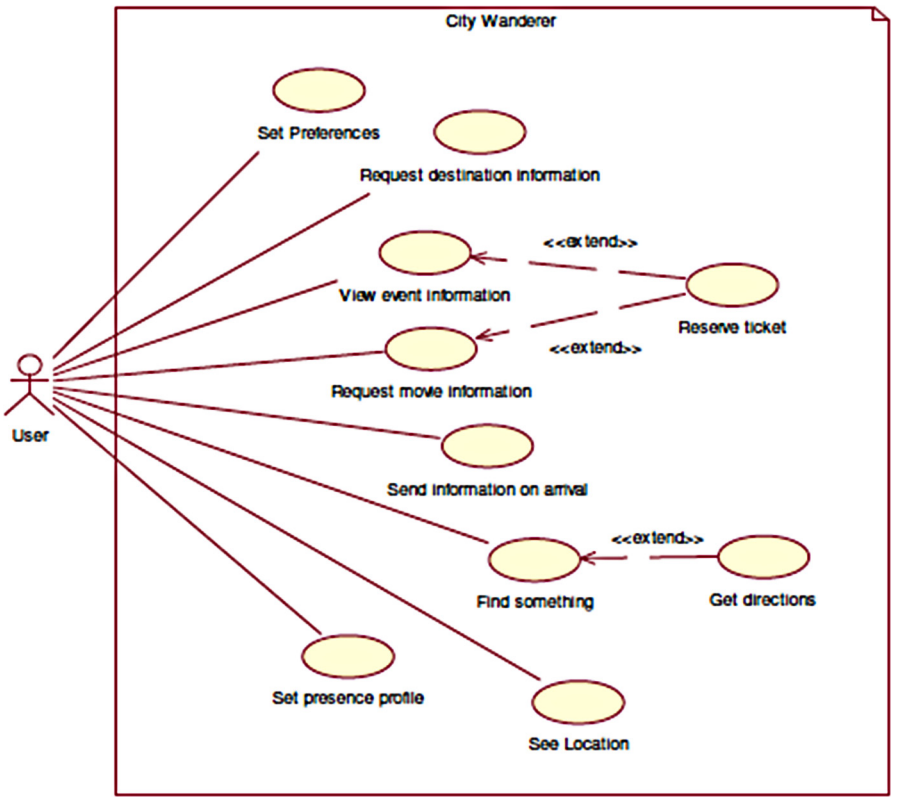
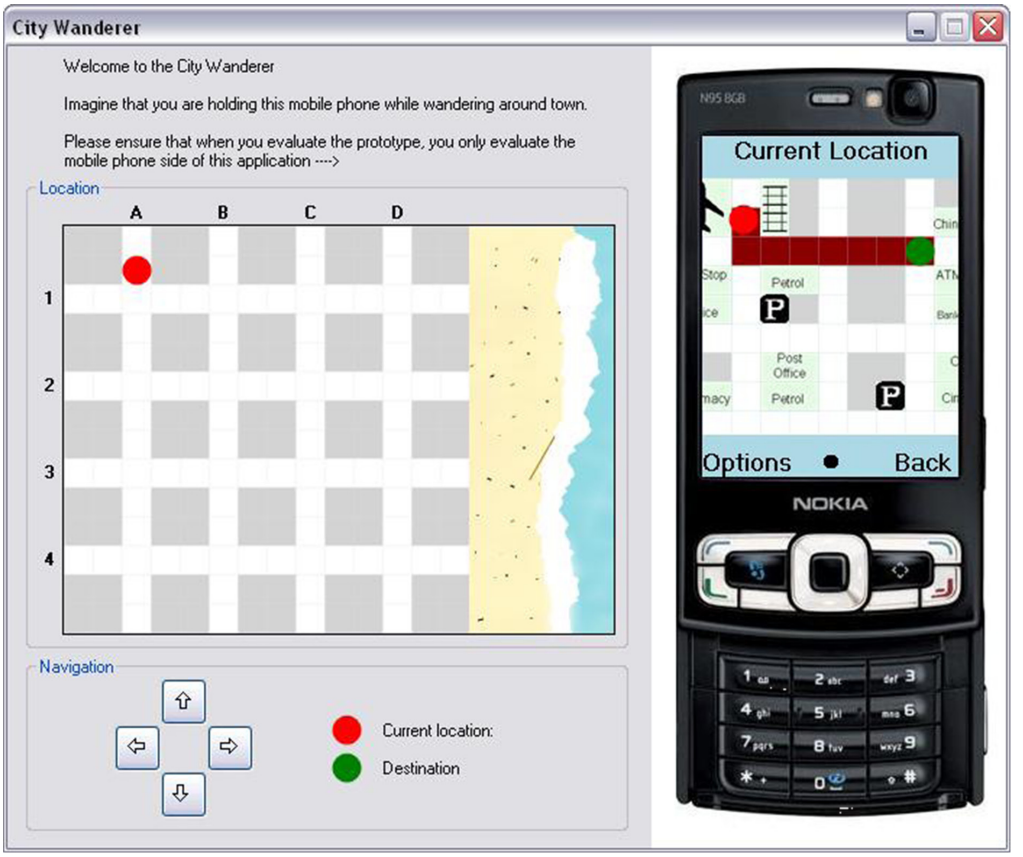


Figure 3. City wander simulation



looking for, the application will find the nearest ATM to the user, display its location on the map, which is shown by the green destination dot on the interface. It will also display the recommended route to get there illustrated by the brown line in this example.

We will briefly illustrate some examples of the usage of the prototype. Figure 4 illustrates the process, from left to right, of a user finding a friend nearby and then negotiating to meet. There are other intermediary steps involved, which have been omitted from the figure. The process begins by the user first selecting to find someone nearby to them. City Wanderer will first detect the user's location, and then search through the contact list and display any friends, which are nearby and then display their location on the map. The user can then see from their contact list that Jackie has set her presence profile to say that she is currently looking for coffee. The user can then send her text message asking her if she would like to meet up for coffee. Two-way communication has not been implemented in this prototype, so we will just assume that Jackie will reply and they can negotiate a time and place to meet.

Figure 5 illustrates the screens involved in searching for events within the city. The user is presented with two options. They can either search for events, which are nearby to their current location, or retrieve events, which are occurring city wide. If the nearby option is selected, City Wanderer will first detect the user's current location, and then it will display a list of events, which are occurring in the same area of the city. The user then has the option

Figure 4. Finding a friend and negotiating to meet

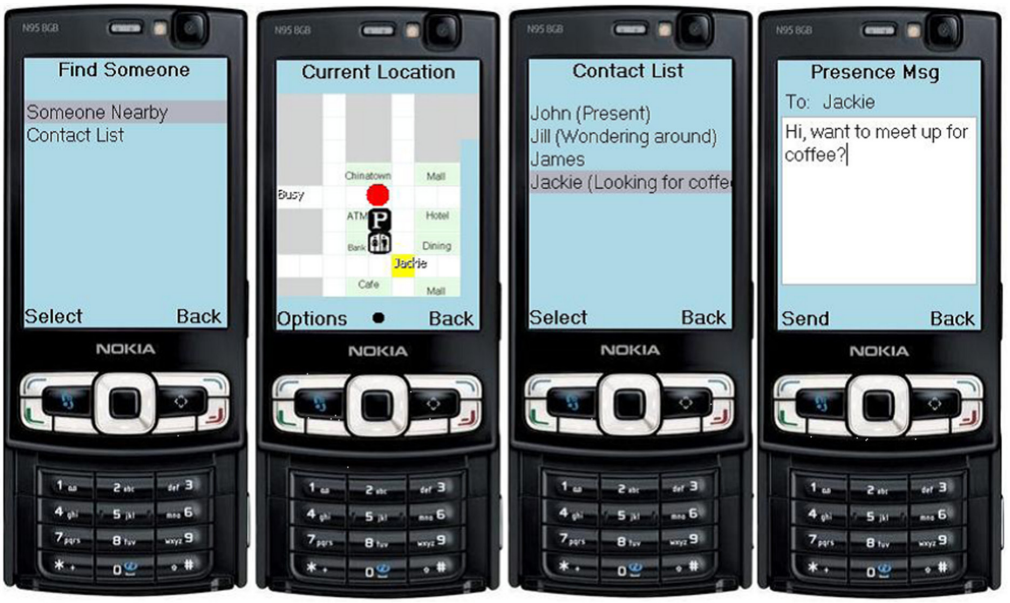
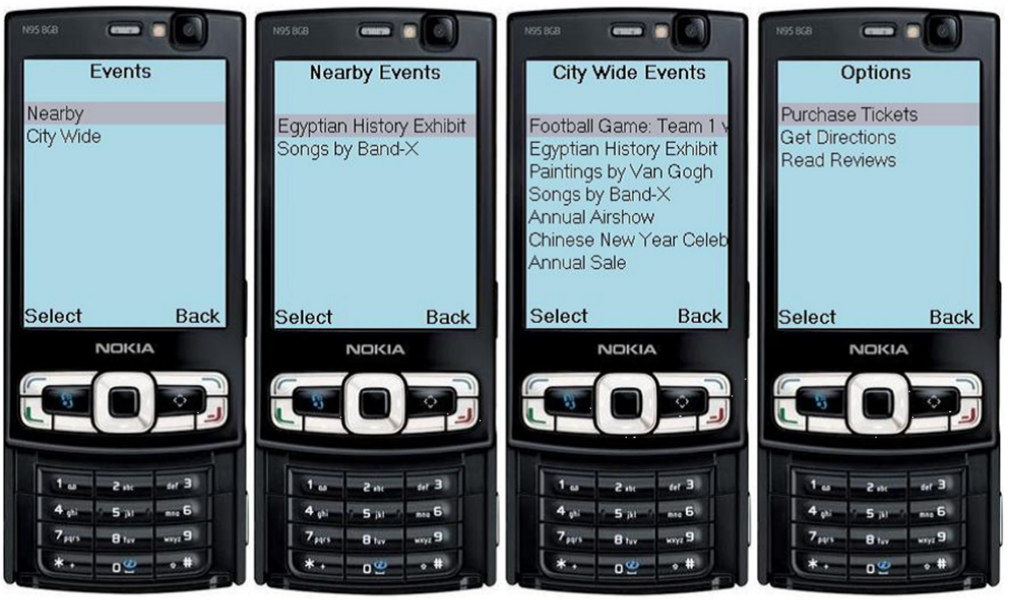


Figure 5. Searching for events



to purchase tickets to an event and/or receive directions on how to get there. Once again it is assumed that the price of the tickets will be charged to the user's account, which the user already established with the service provider.

RESEARCH MODEL TESTING

The LBS prototype was used to test our research model. We gave participants a link to download the prototype, and asked them to explore its usage while running it in a laboratory environment. According to literature (see, e.g., Bohnenberger, Jameson, Krüger, & A, 2002; Kjeldskov & Stage, 2004; Salvucci, 2002) this approach provides the possibility of recreating and simulating significant elements of real life use situations in a laboratory in place of in-field studies. According to Kjeldskov and Skov (2003), it is possible to recreate and simulate significant elements of real-life use situations in a laboratory setting and thereby increase the level of realism, while maintaining a high level of control and avoiding the complexities of field experiments, such as physical user movement in an environment, over which researchers have little control. Kaikkonen et al. (2005) compared mobile usability testing in laboratory and field studies. Their research found that testing in field studies is more time consuming than in a laboratory environment, and the number of problems discovered in field studies is equal to the number discovered in laboratory studies. These findings are consistent with those of Kjeldskov et al. (2004) and Sun and May (2013). Users within a laboratory environment are also able to concentrate on tasks just as easily as in a field study (Kaikkonen, et al., 2005).

Initially, participants were shown a 2-minute video that explained how to use LBS prototype and then they were asked to complete a series of tasks using the prototype. For example, they were asked to find the nearest movie theatre and book some tickets. Participants were also provided with a scenario brief which explained the context of the tasks. These tasks were devised to simulate what the participant might do in the field using this tool. Participants completed the tasks in sequence. Participants were provided with a link to download the prototype. Initially, participants were shown a 2-min video that explained how to use the LBS prototype and then asked to complete a series of tasks using the artifact. The questionnaire was based on the UTAUT constructs. A full list of the tasks can be found in Appendix 1.

After testing, participants were asked to complete a survey based on their experiences in using the prototype. The items used in the survey are presented in of Table 3 Appendix 2. They have been devised by using a modified version of Venkatesh et al (2003) and Carlsson (2006) research tool. The modifications reflect the focus on LBS rather than mobile devices in general. The questions used a 7-point Likert scale, with 1 being 'strongly disagree' and 7 being 'strongly agree'. The choice of this instrument was based on statistical data gathering techniques, which allowed the participants to clearly indicate their views on a fine scale.

Data for the study was collected from students in second and third year, and graduate classes at a university in New Zealand. The minimum required sample size based on our research model was considered to be sixty (Chin & Newsted, 1999). We reached a final sample size of one hundred (n=100). The gender distribution of the sample was 68% male and 32% female. The majority of participants were aged between 21-25 years (60%) with the next largest group being 16-20 years (25%). Potential participants were emailed a request to participate in the study and were provided with a link to download the LBS prototype. Participants were offered the option of becoming a VIP member of an event hosted by the university as a reward for completing the survey. On average it took the participants 20 to 30 minutes to complete the tasks and answer the survey. The survey constructs were drawn from existing literature (Carlsson, et al., 2006; Shneiderman & Plaisant, 2005; Venkatesh, et al., 2003).

DATA ANALYSIS AND RESULTS

We used SmartPLS 2.0 (M3) Beta (Ringle, Wende, & Will, 2005) to perform the Partial Least Square (PLS) analysis. Following Barclay et al. (1995), item reliability, internal consistency, and discriminant validity were used as criteria to ensure that the model has acceptable measurement properties and are illustrated in Tables 2 and 3. The individual item reliability was assessed by examining the loadings of the items. Following normal practice, a Cronbach's Alpha cut off point of 0.7 was used for internal consistencies (R Agarwal & E Karahanna, 2000; Barclay, et al., 1995; Compeau, Higgins, & Huff, 1999; Fornell & Larker, 1981), however one of the constructs, namely anxiety (AA), is closer to 0.6. According to Hair et al. (2006), values may decrease to 0.6 in exploratory research. Therefore, the researchers took a less conservative approach and also included this item with a loading close to 0.6. One construct, namely facilitating conditions (FC) had a value of 0.515, therefore based on this criteria was dropped from the model. The discriminant validity of the latent variables was tested using the procedure of Fornell and Larker (1981). The Average Variance Extracted (AVE) was found for each latent variable. AVE represents the average variance of the latent variable extracted by its indicators. It is commonly recommended that all AVE's should be more than 0.5. In order to test for the discriminant validity, the square roots of the AVE values were compared to the correlations among latent variables.

After the model was modified, the bootstrap procedure of PLS was then used to test the hypotheses. We used bootstrapping, with 500 subsamples, to test the statistical significance of each path coefficient using t-tests (Chin, 1998).

The test results showing the relationships between: performance expectancy (PE); effort expectancy (EE); social influence (SI); facilitating conditions (FC); anxiety (AA) and self efficacy (SE) and behavioural intention (BI) and the subsequent user behaviour (UB) are illustrated in Figure 6 and the outcomes of the hypothesis testing is illustrated in Table 2. The model explains 29.7% of the total variability of behavioural intention, and 44% of the total variability of usage behaviour.

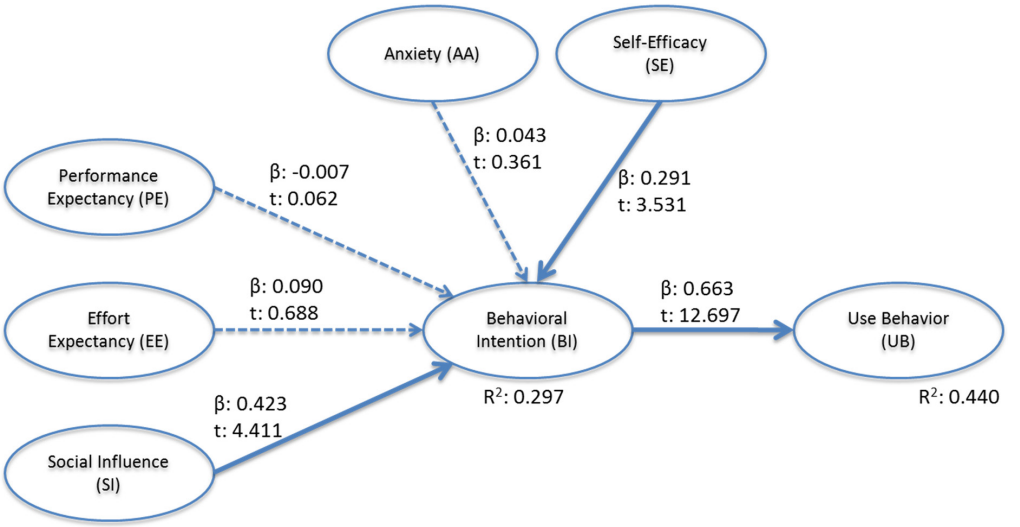
Based on our data analysis, the following hypotheses were supported. Hypothesis H3, social influences had a very strong positive influence on behavioural intention (p-value 0.000). Hypothesis H6, self-efficacy had a very strong positive influence on behavioural intention (p-value 0.000). Hypothesis H7, behavioural intention had a very strong positive relationship with use behaviour (p-value 0.000).

In addition, our analysis shows that the following hypothesis cannot be supported. Hypothesis H1, performance expectancy had no influence on behavioural intention (p-value 0.062). Hypothesis H2, effort expectancy had no influence on behavioural intention (p-value

Table 2. Ave and Cronbachs alpha values

Construct	AVE	Cronbach's Alpha
AA	0.6057	0.6092
BI	0.8652	0.8461
EE	0.6371	0.7485
PE	0.6365	0.8140
SE	1.0000	1.0000
SI	0.6490	0.8642
UB	0.7689	0.7107

Figure 6. Results of the test. The dashed line indicates the relationship is not significant. The solid like indicates the relationship is significant at p-value < 0.01.



0.688) and hypothesis H5, anxiety had no influence on behavioural intention (p-value 0.361). The results indicate a mix of influences on the individual's decision to adopt a location-based service. The issues surrounding these results are discussed next.

DISCUSSION

In this research we attempted to investigate what influences individuals when considering the adoption and use of a LBS. Our findings show support for a number of our hypotheses. We feel that these both support previous research in the areas of mobile service adoption, but also in the area of technology acceptance research in general. This, in turn, provides a strong argument of how each of these influences the adoption and usage of LBS. We also note that a number of hypotheses were not supported and discuss potential influences in this regard.

First of all, the findings show that social influences have an impact on the usage of LBS. We see that this as the key finding for our study. Tuunanen et al. (2008, 2010) have argued that the social nature of use will impact on how consumers perceive the value of service co-creation (Ostrom et al., 2010; Vargo & Lusch, 2004). More specifically, they have proposed that the social nature of use have an impact on utility of an IT enabled service, such as LBS use on a mobile. Our findings indicate that hedonic utility (Ritu Agarwal & Elena Karahanna, 2000; Hill, et al., 2002; Pihlström, 2007; T Tuunanen, et al., 2010; T Tuunanen, Myers, & Cassab, 2008; Van der Heijden, 2004; Westbrook & Oliver, 1991) can play a major part in how consumers perceive these kinds of services. Similarly, Tuunanen el al. (2010) have proposed that hedonic utility may play a more major part in consumer value proposition perception of such services. Our findings concur with the above view and thus validate the proposition at least partly. This also concurs with research about younger users of mobile services who are easily influenced by social norms, peers, and their surroundings (Dickinger, Arami, & Meyer, 2006) and that social norms have an influence on the intention to use mobile services (Hung, Ku, & Chang, 2003; Kleijnen, Wetzels, & de Ruyter, 2004).

However, our study did not investigate perceived enjoyment (Van der Heijden, 2004) of the LBS users. Moreover, we applied an approach used by Carlsson et al. (2006) which is a variation of the original UTAUT model (Venkatesh, et al., 2003). Philström (2007) has earlier studied the impact of hedonic and utilitarian values in terms of a mobile messaging service. Her findings showed that utilitarian values were related to selecting the particular technology platform whereas hedonic values more related a particular service provider. From this we can postulate that if a consumer takes the technology more and more as given, as Vodanovich et al. (2010) have suggested, then the value of the original UTAUT model may begin to decrease when studying IT enabled services for consumers. Our own findings support this view.

Therefore, we might need to consider alternative ways of understanding how consumers choose to use different IT enabled services, especially in the case of services that are more influenced by hedonic needs or values. Tuunanen et al. (2010) have presented a framework for that argues that value co-creation is an interplay of at least two issues. First, information system that make value propositions to the users, and second, the users have value or goals that drive their behavior. They develop the argument through a literature review and the findings from their research from the past ten years. The studies they mention have incrementally developed the idea. These studies include three different case studies: Mobile Financial Service (2005), Mobile Presence Services (Tuure Tuunanen, Ken Peffers, Charles Gengler, Wendy Hui, & Ville Virtanen, 2006), and Interactive Television Services (T. Tuunanen & Govindji, 2011). What is interesting, is that more recently Vartiainen and Tuunanen (2013) argued that it is possible to see distinct patterns in terms of hedonic and utilitarian values expressed by the IT enabled service users. They compared the results of their study and the above mentioned three case studies. Their conclusion was that there seems to be a continuum of hedonic an utilitarian needs and values of users and that this should be taken into account when developing different types of IT enabled services, but also information systems in general.

Gerow et al. (2012), Azjen (2002) and Trauth et al. (2008) have looked at intention to behave and the social, efficacy and background influences which influence individual behaviour, we postulate that further research may uncover deeper issues in these areas. Researchers who have investigated intention to behave has discovered that this is influenced by the level of technical confidence that a person has when embarking on their intended path. So here whether or not an individual has prior knowledge of technology may play a hidden but yet important role in our current investigation. The individual's background, level of education, socio-economic standing and familial influences will influence their intention to behave. Here studies conducted by Azjen (2002) and Trauth et al. (2008) have shown strong social and familial bonds strongly influence the individuals choices and intentions. It is also notable that the individual's peer group may influence choices and intentions from choice of clothing through to choice of career to technology uptake (Tain, 2010). So far we have not research social and familial influences on intention to behave patterns and therefore we believe that future work should investigate this further.

Some important managerial implications arise here as services are marketed towards certain target demographics, to ensure that these target consumers have the desire to influence their peers to use these services. Integration with other online tools, such as Facebook and MySpace, also become important as these are tools, which are commonly used for social groups to share information. Furthermore, we found a high level of self-confidence in the use of both mobile technologies and LBS. According to our study LBS need to be able to be used on their own, and often in different environments. Hence, we can present that these LBS should be designed to make the user as self-efficient as possible, so that they can complete tasks without the need to ask anyone for help. This has important managerial implications, especially

to the designers who now need to ensure these services are easy enough to learn without seeking help, and can be used in a variety of contexts.

Overall, we found that our study participants had a high degree of confidence in their abilities to work with these services and that the participants also strongly felt that the facilitating environment would play an important role in the participants' perceptions of the usage of LBS. Moreover, our participants seemed to assume that there are adequately available services to meet their needs, as well as the technical infrastructure to support it. This level of self-efficacy may be less common in the general population, but in this instance it may be influenced by the age range bias of the participants. To summarize, we have found that social peer pressure, and self-confidence all exert high positive influences on the adoption of LBS.

CONCLUSION

This paper has explored aspects of technology acceptance in a controlled simulated environment. The research used the unified theory of acceptance and use of technology to test factors affecting users' willingness to adopt LBS by conducting a survey to test user's usage behaviour. Our findings suggest that hedonic utility, and the confidence level of individuals using the system primarily drive the adoption and use of LBS.

The paper contributes by arguing that consumers are socially motivated to adopt LBS. We find this very interesting when considering the recently published article on consumer information systems development (Tuunanen, et al., 2010; Tuunanen, et al., 2008), which proposes that social nature of use is one of the key issues influencing how consumers derive utility from such services and how he or she perceives how the value is co-created in the service situation (Vargo & Lusch, 2004). Additionally, we can also confirm the findings of earlier research (Carlsson, et al., 2006; Kaasinen, 2003; Koivumäki, et al., 2006; Pedersen, 2005; Venkatesh, et al., 2003) on the importance of hedonic utility for consumers of such services. Therefore, our study can potentially show an avenue for future research of how to approach validating the conceptual framework for consumer information systems development by Tuunanen et al. (2008, 2010).

We find it intriguing to see that how technology acceptance and consumer behaviour research may be combined together towards creating a new understanding of technology based services and their consumption. This, in turn, may give insights for service researchers who have been recently calling for new ways for engaging users to co-creation of services (Ostrom, et al., 2010; Vargo & Lusch, 2004). One such approach to this has been advocated by Tuunanen et al. (2010) and Vartianen and Tuunanen (2013). Their focus has been on understanding how co-creation of value for IT enabled services happens and how it can be further theorized. Tuunanen et al. (2010)'s have proposed a framework that looks at value co-creation both from the point of the view of what the information system or the service offers in terms of functionality etc., but also from the point of view of users' value drivers.

What's more, the availability of support and facilitating conditions were not considered to be important by our participants. This finding contradicts with earlier studies on self-efficacy, which have suggested that there may be a perception of difficulty in the installation and usage of such services.

As limitations to our study we recognize a bias in our population sample in that the genders were significantly skewed towards males. We suggest therefore that some of the hypotheses may therefore be biased due the sample limitations and that a more balanced population sample may give different results. This bias in our sample implies the possibility that more hypotheses may be found positive especially where anxiety and effort expectation are concerned. Gender literature suggests that females do feel more anxious about their use of technology as well as having a lower perception of their self-efficacy when using technology.

Furthermore, we also recognize that our sample mostly contains students and we acknowledge that this is a limitation. However there are several examples in the IS literature, which have presented results using students as the sample (Kuhlthau, 1991; Taylor & Todd, 1995; van Iwaarden, van der Wiele, Ball, & Millen, 2004). We note from Carlsson et al. (2005), that mobile services are more actively used by younger people than older people, therefore we may have captured the usage patterns one would expect from this type of analysis and the general direction of the effect. Similar results were also found in Thomas et al (2012), while Tobbin & Adjei (2012) shows that early adopters of technology are young novelty seekers. Therefore, we see that this is not a major limitation to the current study as such. Nevertheless, we also recognize that in further research we should seek to use a larger representative sample in order to further test the presented research model. In a similar note, we also recognize the results should be further validated with field studies, such as experiments or observation studies, with a fully operational LBS available for the participants.

Finally, we should also consider investigating whether there are national and/or social culture influences our findings as suggested by Tuunanen et al. (2006). We were most puzzled by the lack of support for attitudes to performance expectations and the amount of time the individual might be required to spend to learn how to use the system. We therefore see that further research is required to determine why some of the constructs were found to be not significant.

In conclusion this paper has described the application of the UTAUT model (Venkatesh, et al., 2003) to explore perceptions of users adoption of LBS. The results of this test have been analysed and discussed in some detail. They indicate pioneer group of individuals who demonstrate early adopter behaviours. We suggest also that further investigations into this area are necessary to more fully understand some aspects of this phenomenon.

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APPENDIX 1

A List of Participants' Tasks

Task 1: You have just arrived in the city. View your current location on the map. You can zoom in and out from the map using the map options menu;

Task 2: Edit your preferences for receiving automatic messages. Select which types of services you would like to receive automatically when you approach a specific location. For now leave all the options selected. You will only ever receive text messages about these services if you are in the main menu;

Task 3: Return to the main menu. Take one step south. You will receive a text message. Read it;

Task 4: Return to the main menu. Walk down road A (note the road names A-D, 1-4) on the map. You will receive another text message. Read it. Click Options. View on the map where the concert will be held. Walk there;

Task 5: Read the local information about your current location;

Task 6: Now find your nearest ATM and walk there;

Task 7: You want to see a movie. Find a movie, read the reviews, book tickets, and walk there;

Task 8: Now you are feeling rather adventurous and feel like going scuba diving. Find the scuba diving shop. There are 2 possible ways to find it: 1) Through the Find Something menu (you can scroll further down the list than what you currently see on the screen), or 2) Through the Entertainment menu;

Task 9: Find out what events are happening nearby. Find out what events are happening citywide;

Task 10: Find if you have any friends nearby. Send a friend a text message. Note: 2-way communication has not been implemented on this prototype so they won't reply;

Task 11: Spend some time playing with the prototype yourself. Explore the city, find other landmarks. Attend some more events, view information about other areas of the city (there are 4 total).

APPENDIX 2

Table 3. Constructs and supporting research questions

Construct	Supporting Research Questions	Supporting Literature
Performance Expectancy	Using a location-based service is flexible since I may use it anywhere Using a location-based service is flexible since I may use it any time In my opinion, using a location-based service is useful I can use a location-based service in real time since it is always connected to the network I save time using the location-based service I may personalise the services that interest me Location-based services make the time fly, when there is nothing else to do	(Venkatesh et al., 2003; Carlsson et al., 2006)
Effort Expectancy	It is easy for me to use a location-based service In my opinion, using a location-based service is handy In my opinion, the screen size of a location-based service is generally adequate I have a clear understanding of what services are available to me on the location-based service I learn easily to employ new technologies (e.g. GPS).	(Venkatesh et al., 2003; Carlsson et al., 2006)
Social Influence	My friends/family members value my choice of a mobile device Using a location-based service makes me more trendy to my friends/family People who influence my behaviour think I should use the location-based service People who are important to me think I should use the location-based service People who use this system have more prestige than those who do not Having the location-based service would be a status symbol in my circle of friends/family members	(Venkatesh et al., 2003; Carlsson et al., 2006)
Facilitating Conditions	In my opinion, the initial costs do not inhibit the use of mobile services In my opinion, the operating costs do not inhibit the use of a mobile service In my opinion, there are adequately available mobile services that suit my needs I have control over using the location-based service I have the resources necessary to use the location-based service Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the location-based service Using the location-based service would fit well into my daily life	(Venkatesh et al., 2003; Carlsson et al., 2006)
Self-Efficacy	I can complete a task using the system if there was no one around to tell me what to do as I go I can complete a task using the system if I could call someone for help if I got stuck I can complete a task using the system if I had a lot of time to complete the task	(Venkatesh et al., 2003; Carlsson et al., 2006)
Anxiety	I feel apprehensive about using the system It scares me to think that I could lose a lot of information using the system by hitting the wrong key The system is somewhat intimidating to me	(Venkatesh et al., 2003; Carlsson et al., 2006)
Behavioural Intention	I use mobile services whenever possible I am among the first to employ new technologies and devices I want to be among the first ones to try out new mobile devices/services I aim to use mobile services instead of traditional ones	(Venkatesh et al., 2003; Carlsson et al., 2006)
Use Behaviour	I intend to use the location-based service in the future?	(Venkatesh et al., 2003)