Exploration of Location-Based Services Adoption

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Abstract

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 paper discusses a controlled experiment to explore aspects of user perceptions of their use of location-based services. This study examines a location-based service prototype experiment and analysis based on the UTAUT model. The results show significant indicators that suggest behavior patterns of early adopters of location-based services are being observed. We discuss these influences and attempt to explain their significance. Moreover, more curiously we discuss why some of our model was unsupported and postulate why.

1. 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 [1, 2]. The individual consumer will configure their mobile device to suit their own personality and aspirations for entertainment and information needs [3-6]. 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 consumers [7]. One such area is location-based services (LBS). These were initially identified as having the potential to offer great growth for mobile industry [8]. Despite their early failure [9], location-based services 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 [9]. 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 new 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.

This paper applies the unified theory of acceptance and use of technology (UTAUT) model [10] using a location-based service experiment to understand the underlying perceptions of individuals who may adopt location-based services. 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 location-based service simulation. Through this simulation and a following questionnaire, 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 controlled experiment. Finally, we discuss the results and conclude and propose topics for future research.

2. 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 [9]. At this time the literature on location-based services 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 behavior of groups who are potential early adopters in order to provide more indication of the rate of uptake of location-based services [11].

2.1. 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 [12, 13]. Mobile commerce has evolved to utilize end user's location data to deliver relevant, timely, and engaging content. For mobile network operators, location-based services represent a welcome additional

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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 [14]. LBSs are attractive as consumers do not need to enter location information manually, but instead are automatically pinpointed and tracked [12]. A location-based service 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 [15]. 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 [16].

Kaasinen [16] notes that user attitudes towards location-based services 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 [16]. Issues of Privacy and security should be also noted as a concern as such application and its user acceptance is frequently hampered by the perception of personal information and financial security over mobile devices.

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.

May et al. [9] further identifies a range of demographic, usage and additional data relating to location-based services, and in particular the extent to which early adopters are using, or are aware of location-based services and their general attitudes towards these services. As is generally noted in technology adoption models they note that the incidence of use of location-based services 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 [9], which concurs with Carlsson et al.'s [17] findings. May et al.'s [9] results show that within all consumer segments commonly used by telecom operators[1], 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, location-based games, 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.

2.2. Mobile technology adoption

Aarnio et al. [18] 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 [18].

Studies of adoption and use of mobile services have indicated that traditional adoption models must be extended and modified when applied to mobile services [19]. In investigating the early adoption of mobile commerce services, Pedersen [19] applied a modified version of the decomposed theory of planned behavior to the adoption behavior 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.

Nysveen et al. [20], 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. [20] found that perceived

[1] Young social group; older professionals without children; and older professionals with children

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 [3-6], such as excitement and fun, when developing mobile services.

Lin and Shih [21] 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 [21]. Furthermore, Lin and Shih [21] 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 [21].

Koivumäki et al. [22] 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.

Finally, there have been a number of modifications to the Technology Acceptance Model (TAM) over the years [17]. The most prominent of these modifications is the Unified Theory of Acceptance and Use of Technology (UTAUT) [10]. Park et al. [23] and Carlsson et al. [17] have applied UTAUT model in mobile research. Park et al. [23] 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* [10]. 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 [23]. Carlsson et al. [17] 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.

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

3. Research methodology

3.1. City wanderer

For the purposes of this study we developed a prototype LBS application based on a previous study called "City Wanderer" [24], which uses location information to guide and entertain the user. 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.

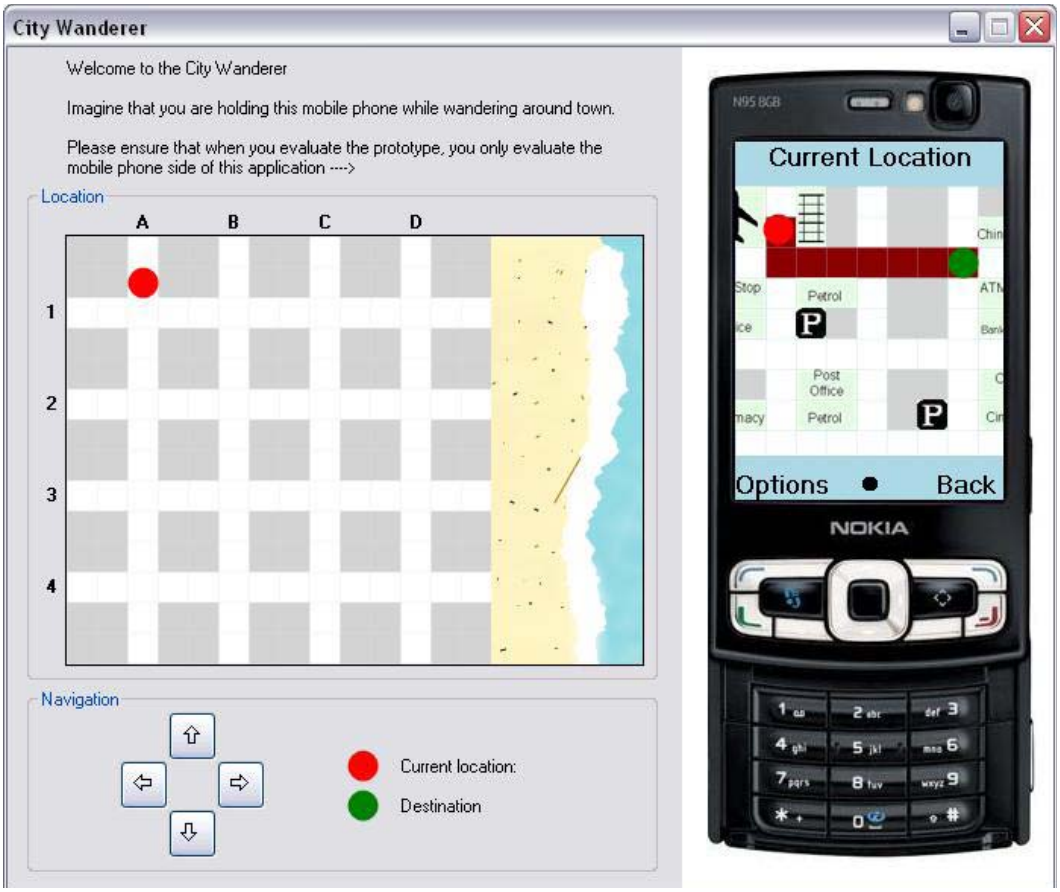

Figure 1. City Wanderer prototype

The prototype was designed and built as a desktop simulation. We used Visual Studio 2007 and Visual Basic.NET for the implementation. The database was created using SQL Server 2005. The features implemented in the application are listed in table 1. Figure 1 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.

Table 1. City Wanderer LBS prototype features

List of attractions, festivals and events
See your current location
Detail information about destination
Send attraction / event etc. generic / personalized information when you approach it
Show me nearby ATM or bank branch
Define what information I want to receive
Historical knowledge
Ticket reservation for events
More information about the movie – reviews etc.

The consumer will then use the directional arrows to navigate through the city towards the destination. As the consumer walks, the route will update to the current location of the consumer. Figure 1 demonstrates how the consumer can locate the nearest ATM. Once the consumer has selected that it is an ATM they are looking for, the application will find the nearest ATM to the consumer, 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.

3.2. Research model and hypotheses

The research model and the hypotheses used in the quantitative evaluation are presented in Figure 2. We have based our model on the UTAUT model. UTAUT was chosen as an analysis model as it has been proven to outperform eight prominent IS models of adoption research [17].

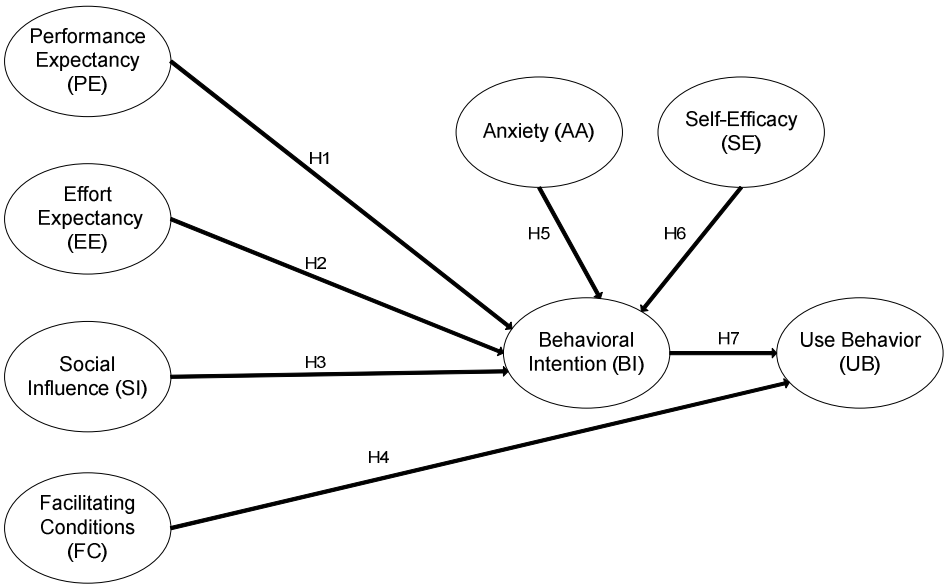

Figure 2. Research Model

In a recent UTAUT study by Carlsson et al. [17], the hypotheses were simplified to contain only the relationships between constructs without their moderators. We have taken a similar approach to this and used hypotheses similar to those in the Carlsson et al. [17] paper who modified them to fit a mobile services context. Additionally, we have included elements, which look at usability as an extra facet to the model. The research model is illustrated in Figure 2.

The expected relationships for direct effects in our model are:

H1: Performance Expectancy has an influence on behavioral intention.

H2: Effort Expectancy has an influence on behavioral intention.

H3: Social Influence has an influence on behavioral intention.

H4: Facilitating Conditions has an influence on use behavior.

H5: Anxiety has an influence on behavioral intention.

H6: Self-Efficacy has an influence on behavioral intention.

H7: Behavioral Intention has an influence on use behavior.

3.3. Controlled experiment

Our experiment used a scenario-based approach. According to literature [see, e.g., 25, 26, 27] 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. Initially, participants were shown a 2-minute video that explained how to use City Wanderer 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 completed the tasks in sequence. A full list of the tasks can be found in the appendix.

At the end of the experiment, participants were asked to complete a questionnaire based on their experiences in using the prototype. The majority of questions used a 7-point Likert scale, with 1 being ‘strongly disagree’ and 7 being ‘strongly agree’. The only question, which did not use a Likert scale, was if the participant would use the service in the future (which was a yes/no question). 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.

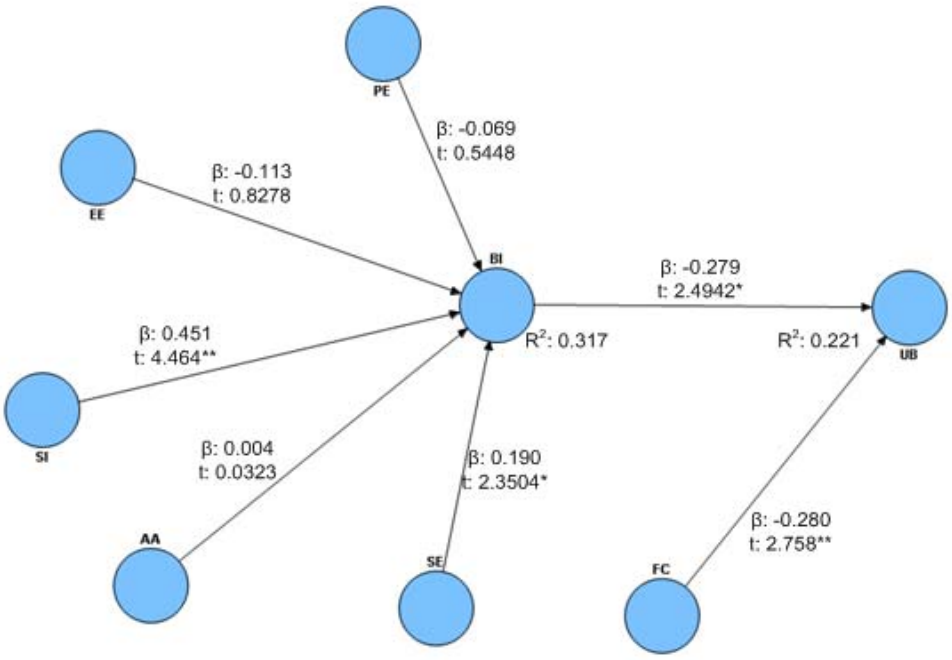

Figure 3. Results of the experiment

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 [28]. 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 City Wanderer 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 [10, 17, 29].

4. Data analysis and results

We used SmartPLS 2.0 (M3) Beta [30] to perform the Partial Least Square (PLS) analysis. Item reliability, internal consistency, and discriminant validity were used as criteria to ensure that the model had acceptable measurement properties[2]. 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 [31]. We also examined the moderators of the various relationships in the model. The moderators examined include: gender, experience, and voluntariness of use.

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 behavioral intention (BI) and the subsequent user behavior (UB) are illustrated in Figure 3 and the outcomes of the hypothesis testing is illustrated in Table 2. The model explains about 31% of the total variability of behavioral intention, and about 22% of the total variability of usage behavior.

Based on our data analysis, the following hypotheses were supported. Hypothesis H3, social influences had a very strong positive influence on behavioral intention (p-value 0.000). Hypothesis H4, facilitating conditions had a very strong negative influence on use behavior (p-value 0.006). Hypothesis

[2] Omitted due to space limitations. These can be obtained from the corresponding author.

H6, self-efficacy had a strong positive influence on behavioral intention (p-value 0.019). Hypothesis H7, behavioral intention had a strong negative relationship with use behavior (p-value 0.013).

In addition, our analysis shows that the following hypothesis cannot be supported. Hypothesis H1, performance expectancy had no influence on behavioral intention (p-value 0.586). Hypothesis H2, effort expectancy had no influence on behavioral intention (p-value 0.408) and hypothesis H5, anxiety had no influence on behavioral intention (p-value 0.974). 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.

5. Discussion

In this research we attempted to investigate what influences individuals when considering the adoption and use of a location-based service. Our findings show support for a number of our hypotheses. We feel that these both support previous research in the areas of mobile technology 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 location-based services. 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 location-based services. We see that this as the key finding for our study. Tuunanen et al. [1, 2] have argued that social nature of use will impact on how consumer perceives the value of service co-creation [32, 33]. More specifically, they have proposed that the social nature of use have an impact on utility of consumer information systems based service, such as LBS use on a mobile. Furthermore, the findings indicate that hedonic utility [1-6] can play a major part in how consumers perceive these kinds of services. Interestingly, Tuunanen el al. [2] have proposed that hedonic utility may play more major part in consumer value proposition perception of such services. Our findings concur with this 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 [34] and that social norms have an influence on the intention to use mobile services [35, 36].

Furthermore, we found a high level of self-confidence in the use of both mobile technologies and location-based services. According to our study location-based services need to be able to be used on their own, and often in different environments. Hence, we can present that these location-based services 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.

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 not play an important role in the participants' perceptions of the usage of location-based services. 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 maybe 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 location-based services.

6. 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 location-based services by conducting a controlled experiment. Our findings suggest that hedonic utility, and the confidence level of individuals using the system primarily drive the adoption and use of location-based services.

The paper contributes by arguing that consumers are socially motivated to adopt location-based services. We find this very interesting when considering the recently published article on consumer information systems development [1, 2], 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 [33]. Additionally, we can also confirm the findings of earlier research [10, 16, 17, 19, 22] 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. [1, 2].

We find it intriguing to see that how technology acceptance and consumer behavior 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 [32, 33].

What's more, the availability of support and facilitating conditions were not considered to be

important by our experiment 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. 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 [37-39]. We note from Carlsson et al. [40], 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. 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.

Finally, we should also consider investigating whether there are national and/or social culture influences our findings as suggested by [24]. 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 controlled experiment applying the UTAUT model [10] to explore perceptions of users adoption of location-based services. The results of this experiment have been analyzed 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.

7. References

[1] T. Tuunanen, M. D. Myers, and H. Cassab, "Challenges of Consumer Information Systems Development: The Case of Interactive Television Services," in *Advances in Information Systems Research, Education and Practice*. vol. 274, D. Avison*, et al.*, Eds., ed Boston: Springer, 2008, pp. 89-100.

[2] T. Tuunanen, M. Myers, and H. Cassab, "A Conceptual Framework for Consumer Information Systems Development," *Pacific Asia Journal of the Association for Information Systems,* vol. 2, p. 5, 2010.

[3] R. Agarwal and E. Karahanna, "Time Flies When You're Having Fun: Cognitive Absorption and Beliefs about Information Technology Usage," *MIS Quarterly,* vol. 24, pp. 665-694, December 2000.

[4] A. V. Hill, D. A. Collier, C. M. Froehle, J. C. Goodale, R. D. Metters, and R. Verma, "Research opportunities in service process design," *Journal of Operations Management,* vol. 20, pp. 189-202, April 2002.

[5] R. A. Westbrook and R. L. Oliver, "The Dimensionality of Consumption Emotion Patterns and Consumer Satisfaction," *Journal of Consumer Research,* vol. 18, pp. 84-91, June 1991.

[6] M. Pihlström, "Committed to Content Provider or Mobile Channel? Determinants of Continuous Mobile Multimedia Service Use," *Journal of Information Technology Theory and Application (JITTA),* vol. 9, pp. 1-23, 2007.

[7] P. J. O'Connor and S. H. Godar, "We Know Where You Are: The ethics of LBS Advertising," in *Mobile Commerce: Technology, Theory and Applications*, B. E. Mennecke and T. J. Strader, Eds., ed Hershey, PA, USA: Idea Group Inc. , 2003.

[8] D. Mountain and J. Raper, "Positioning techniques for Location-Based Services (LBS): characteristics and limitations of proposed solutions," *ASLIB Proceedings,* vol. 53, pp. 404-412, 2001.

[9] A. May, S. H. Bayer, and T. Ross, "A survey of 'young social' and 'professional' users of location-based services in the UK," *Journal of Location Based Services,* vol. 1, pp. 112-132, 2007.

[10] V. Venkatesh, M. G. Morris, G. Davis, and F. Davis, "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly,* vol. 27, pp. 425-278, 2003.

[11] E. M. Rogers, *Diffusion of Innovations*, 5th ed. New York: Free Press, 2003.

[12] A. Küpper, *Location-Based Services Fundamentals and Operation*. West Sussex: John Wiley & Sons Inc., 2005.

[13] J. Raper, G. Gartner, H. Karimi, and C. Rizos, "A critical evaluation of location based services and their potential," *Journal of Location Based Services,* vol. 1, pp. 5-45, 2007.

[14] B. Rao and L. Minakakis, "Evolution of Mobile Location-based Services," *Communications of the ACM,* vol. 46, pp. 61-65, 2003.

[15] D. Billsus, C. Brunk, C. Evans, B. Glandish, and M. Pazzanu, "Adaptive interfaces for ubiquitous web access," *Communications of the ACM,* vol. 45, pp. 34-38, 2002.

[16] E. Kaasinen, "User needs for location-aware mobile services," *Personal Ubiquitous Computing,* vol. 7, pp. 70-70, 2003.

[17] C. Carlsson, J. Carlsson, K. Hyvönen, J. Puhakainen, and P. Walden, "Adoption of Mobile Devices/Services - Searching for Answers with the UTAUT," presented at the Proceedings of the 39th Hawaii International Conference on Systems Sciences, Hawaii, USA, 2006.

[18] A. Aarnio, A. Enkenberg, J. Heikkilä, and S. Hirvola, "Adoption and Use of Mobile Services Empirical Evidence from a Finnish Survey," in *Proceedings of the 35th Hawaii International Conference on System Sciences*, 2002.

[19] P. E. Pedersen, "Adoption of Mobile Internet Services: An Exploratory Study of Mobile Commerce Early Adopters," *Journal of Organizational Computing and Electronic Commerce,* vol. 15, pp. 203-222, 2005.

[20] H. Nysveen, P. E. Pedersen, and H. Thorbjørnsen, "Intentions to Use Model Services: Antecedents and Cross-Service Comparisons," *Journal of the Academy of Marketing Science,* vol. 33, pp. 340-346, 2005.

[21] Y.-M. Lin and D.-H. Shih, "Deconstructing mobile commerce service with continuance intention," *International Journal of Mobile Communications,* vol. 6, pp. 67-87, 2008.

[22] T. Koivumäki, A. Ristola, and M. Kesti, "Predicting consumer acceptance in mobile services: empirical evidence from an experimental end user environment," *International Journal of Mobile Communications,* vol. 4, pp. 418-435, 2006.

[23] J. Park, S. Yang, and X. Lehto, "Adoption of Mobile Technologies for Chinese Consumers," *Journal of Electronic Commerce Research,* vol. 8, pp. 196-206, 2007.

[24] T. Tuunanen, K. Peffers, C. Gengler, W. Hui, and V. Virtanen, "Developing Feature Sets for Geographically Diverse External End Users: A Call for Value-Based Preference Modelling," *Journal of Information Technology Theory and Application,* vol. 8, pp. 41-55, 2006.

[25] T. Bohnenberger, A. Jameson, A. Krüger, and B. A, "Location-aware shopping assistance: Evaluation of a decision-theoretic approach," in *Proceedings of Mobile HCI 2002*, 2002, pp. 155-196.

[26] J. Kjeldskov and J. Stage, "New techniques for usability evaluation of mobile systems," *International Journal of Human-Computer Studies,* vol. 60, pp. 599-620, 2004.

[27] D. D. Salvucci, "Predicting the effects of in-car interfaces on driver behaviour using a cognitive architecture," in *Proceedings of CHI'2002*, 2002, pp. 120-127.

[28] W. W. Chin and P. Newsted, "Structural Equation Modelling Analysis with Small Samples Using Partial Least Sqaures," in *Statistical Strategies for Small Sample Research*, R. H. Hoyle, Ed., ed Thousand Oaks, California: SAGE Publications, Inc., 1999, pp. 307-341.

[29] B. Shneiderman and C. Plaisant, *Designing the User Interface: Strategies for effective human-computer interaction*, 4th ed. New York: Pearson Education, Inc, 2005.

[30] C. M. Ringle, S. Wende, and S. Will, "SmartPLS 2.0 (M3) Beta," ed. Hamburg, http://www.smartpls.de, 2005.

[31] W. W. Chin, "The partial least sqaures approach to structural equation modeling," in *Modern Methods for Business Research*, G. A. Marcoulides, Ed., ed Mahwah, NJ: Lawrence Erlbaum Associates, 1998, pp. 295-336.

[32] A. L. Ostrom, M. J. Bitner, S. W. Brown, K. A. Burkhard, M. Goul, V. Smith-Daniels, H. Demirkan, and E. Rabinovich, "Moving Forward and Making a Difference: Research Priorities for the Science of Service " *Journal of Service Research,* vol. 13, pp. 4-36, 2010.

[33] S. L. Vargo and R. F. Lusch, "Evolving to a New Dominant Logic for Marketing," *Journal of Marketing,* vol. 68, pp. 1-17, 2004.

[34] A. Dickinger, M. Arami, and D. Meyer, "Reconsidering the Adoption Process: Enjoyment and Social Norms - Antecedents of Hedonic Mobile Use," in *Proceedings of the 39th Hawaii International Conference on System Sciences*, 2006, pp. 1-10.

[35] S. Y. Hung, C. Y. Ku, and C. M. Chang, "Critical Factors of WAP Services Adoption: An Empirical Study," *Electronic Commerce Research and Applications,* vol. 2, pp. 42-60, 2003.

[36] M. Kleijnen, M. Wetzels, and K. de Ruyter, "Consumer Acceptance of Wireless Finance," *Journal of Financial Services Marketing,* vol. 8, pp. 206-217, 2004.

[37] S. Taylor and P. A. Todd, "Understanding information technology usage: A test of competing models," *Information Systems Research,* vol. 6, pp. 144-176, 1995.

[38] C. Kuhlthau, "Inside the Search Process: Information Seeking from the User's Perspective," *Journal of The American Society for Information Science,* vol. 42, pp. 361-371, 1991.

[39] J. van Iwaarden, T. van der Wiele, L. Ball, and R. Millen, "Perceptions about the quality of web sites: a survey amongst students at Northeastern University and Erasmus University," *Information & Management,* vol. 41, pp. 947-959, 2004.

[40] C. Carlsson, K. Hyvönen, P. Repo, and P. Walden, "Asynchronous adoption patterns of mobile services," presented at the Proceedings of the 38th Hawaii International Conference on System Sciences, 2005.

Appendix

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).