CLASSIFYING, PROFILING AND PREDICTING USER BEHAVIOR IN THE CONTEXT OF LOCATION BASED SERVICES

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ABSTRACT

Motivated by the technology evolutions and the corresponding changes in user-consumer behavioral patterns, this study applies a Location Based Services (LBS) environmental determinants' integrated theoretical framework by investigating its role on classifying, profiling and predicting user-consumer behavior. For that purpose, a laboratory LBS application was developed and tested with 110 subjects within the context of a field trial setting in the entertainment industry. Users are clustered into two main types having the "physical" and the "social density" determinants to best discriminate between the resulting clusters. Also, the two clusters differ in terms of their spatial and verbal ability and attitude towards the LBS environment. Similarly, attitude is predicted by the "location", the "device" and the "mobile connection" LBS environmental determinants for the "walkers in place" (cluster #1) and by all LBS environmental determinants (i.e. those determinants of cluster #1 plus the "digital" and the "social environment" ones) for the "walkers in space" (cluster #2). Finally, the attitude of both clusters' participants towards the LBS environment affects their behavioral intentions towards using LBS applications, with limited, however, predicting power observed in this relationship.

Keywords: Location based services; Mobile commerce; User behavior; Consumer behavior

1. Introduction

Motivated by the increasing use of user-consumer "location" as an important variable in the design and provision of attractive consumer services, enabled by the evolution and rapid diffusion of relevant technologies and applications (e.g. smart phones equipped with NFC, mobiles apps, proximity technologies, etc.), the present study aims to explore user-consumer behavior in the context of this evolving landscape. Also, the increasing blending of the digital with the physical environment creates several interesting research questions and corresponding business challenges that call for research studies that will shed more light on this emerging phenomenon. Moreover, the diffusion and mass adoption of smart mobile devices by consumers along with their increasing familiarity to electronic commerce practices in the context of omnichannel retailing (e.g. high Internet usage rates within physical stores), create a suitable setting for proceeding to the inclusion of user-consumer "location" in the agenda of the variables exploited to meet consumer preferences and needs.

The promising role of smart mobile devices and Location Based Services (LBS) is illustrated both in academic research and business practice. Several research calls available in academic literature provide a strong motivation for conducting studies in this unexplored topic. Indicatively, the promising role of smart mobile devices in the context of omnichannel retailing is underlined [Piotrowicz and Cuthbertson 2014], while LBS constitute an essential component of mobile commerce [Zou and Huang 2015]. Similarly, Alt and Österle [2013, p.1] note that "the future will increasingly see LBS which are dependent on the user's context". Along these lines, Brennan and Martin [2012] highlight the crucial role of investigating humans' thoughts about their real world surroundings for designing easy to use computer systems.

Juniper Research [2014] forecasts that LBS Market will reach $43.3Bn by 2019, driven by Context Aware Mobile Services. Growing at a compound annual growth rate of 65.2 percent, the real-time Location Based Advertising (LBA) market is forecasted to be worth €6.5 billion in 2017, corresponding to 32.8 percent of all mobile advertising and marketing [Berg Insight Report 2013].

The present study investigates user-consumer behavior in the context of the LBS environment in the entertainment industry, adopting a multidisciplinary approach. Specifically, the study aims to classify LBS users according to the importance they attach to the environmental determinants of LBS applications, and provide evidence regarding the variables that best discriminate between different LBS user-consumer clusters/types as well as provide a detailed profiling and labeling for these clusters. Also, the study aims to compare the resulted clusters in terms of their attitudes towards the LBS environment as well as measure the predicting power of the LBS environmental determinants on users' attitude towards the LBS environment and investigate whether this relationship is moderated by the resulted users' clusters. Finally, the study aims to investigate whether the users' attitude towards the LBS environment affects their behavioral intention towards using LBS applications.

2. Literature Review and Conceptual Framework

2.1. Background Research Material

The study reported in this paper extends the work of Koutsiouris and Vrechopoulos [2009a and 2009b] and investigates the role of LBS environmental determinants on classifying, profiling and predicting user behavior through an integrated approach. The approach followed by the present study is well justified by relevant research calls and initiatives that underlined the challenge of adopting multidisciplinary approaches in mobile business research (e.g. [Mylonopoulos and Doukidis 2003; Vrechopoulos 2010]). More recently, the increasing use of socioeconomic-focused research in the field of mobile commerce is highlighted [Kourouthanassis and Giaglis 2012], while several researchers discuss and underline the promising role of mobile Marketing in retailing [Strom et al. 2014; Hui et al. 2013; and Shankar et al. 2010]. Similarly, other studies applied an Environmental Psychology approach in the investigation of online consumer behavior in the context of electronic commerce (e.g. [Manganari et al. 2011]), while Benou et al. [2012] call for interdisciplinary research initiatives combining Marketing and Information Systems in the study of mobile contexts' environmental effects on user-consumer behavior.

Several recent studies call for investigating users' behavior towards mobile apps in order to develop more precise Marketing strategies [Hsu and Lin 2015]. To this end, location awareness is recommended as an important mobile feature for companies to market their brands and products through the mobile apps channel [Zhao and Balague, 2015].

From another perspective, Zhao et al. [2012] highlighted the fast evolving development of LBS for social network purposes calling for research attempts that focus on the investigation of peoples' behaviors toward such services. More recently, Chorley et al. [2015] conducted a study investigating personality and use of location based social networks. They report (p.45) that "personality traits help to explain individual differences in LBSN usage and the type of places visited". In sum, the need to consider location information in the context of social media research is emphasized [Schwartz and Halegua, 2014].

Furthermore, the need to effectively customize navigational and environmental information for mobile applications in order to fulfill individual needs [Millonig and Gartner, 2011] and to investigate and understand consumer behavior towards designing new and attractive mobile application services is underlined [Cheng and Sun, 2012]. Ström et al. [2014] conducted a thorough literature review on the topic of mobile marketing emphasizing on the ways that it creates value to consumers and retailers. Similarly, Al-Debei and Al-Lozi [2014] explored ways that mobile data services could offer value to consumers. More recently, Botzenhardt et al. [2016] study in the context of Mobile Data Services revealed that design-form and function positively affect satisfaction while consumer age and usage frequency moderate the relationship between form and satisfaction.

The behavioral intention towards LBS usage is affected by performance expectancy and perceived risk [Zhou, 2012a] while one of the key success factors for LBS diffusion is the regulatory environment [Petrova and Wang 2011]. However, they found that innovative business approaches also play an important role for creating customer

demand for LBS. Similarly, Yun et al. [2013, p. 225] state that "privacy concerns may not always be the main causes of slow LBS diffusion". More recently, it was found that privacy risk constitute an inhibitor of location based services user adoption affected by privacy concerns [Zhou 2015], while Wernke et al. [2014, p. 163] note that "location privacy concepts become mandatory to ensure the user's acceptance of location-based services".

2.2. Definitions and Conceptual Framework

There are several available definitions for LBS. From a Marketing perspective, LBS is type of retailing in which the retailer and the customer communicate through an interactive location-based mobile network [Levy and Weitz, 2001]. From a more technical perspective, LBS are applications that combine a mobile device's position with other relevant data in order to offer value added services to users [Schiller and Voisard, 2004]. Pedrana [2014, p. 753] recently reports that "Location-based services (LBS) are applications that concern all services linked to geographical location". Finally, Evans [2011] reports that location-based services (LBS) significantly contribute to the transformation of the users' experience of the world, shifting users' views of the physical space. Based on the review of the LBS definitions from previous studies, the LBS definition used in the present study is formulated as follows: *"LBS are applications that provide context specific electronic services to users-consumers blending physical with electronic environments"*.

The conceptual framework of the present study is based on the SOR model architecture [Mehrabian and Rusell 1974]. The SOR model has been widely used both in conventional and electronic retailing studies for measuring retail store environmental effects on consumer behavior [Jeong et al. 2009; Manganari et. al. 2011]. The model considers that the environmental stimuli (S) influence consumers' internal states (O), which in turn influence consumers' overall responses (R). In addition, consumers' internal states mediate the relationship between the stimulus and individuals' responses. Thus, for the case of the present study, the (S) part of the model refers to the LBS Environmental Determinants, the (O) to the Attitude towards the LBS Environment, while the (R) part of the model to the Behavioral Intention towards the LBS Environment (thoroughly discussed in the next sections). It should be clarified, however, that the variables of pleasure and arousal (included in the organism state of the SOR model) were not measured in the context of the present study since emphasis was placed on the attitude dimension both as a dependent and as independent variable.

Physical and Social Environment as LBS Environmental Determinants

Bitner [1992] discussed about the environmental factors that may affect the *organism* and the *response* phases of the model. She notes that spatial layout, atmospherics and physical evidence are the most important determinants of the traditional (i.e. *physical)* service environment. Elaborating on that, Tombs and Kennedy [2003] emphasized the importance of the *social* dimension parameter. They support that human presence (i.e. emotions of other people, social density affect consumer behavior in a retail setting. Also, they note that susceptibility to emotional influences is a personal characteristic that moderates the effects of social dimension on users' behavior. Similarly, Fortunanti [2001] puts forward the idea that people treat their mobile phone in an emotional way that is different to their attitude towards other types of technology, while Yang and Forney [2013, p.334] found that "consumers with a high level of technology anxiety rely more on social influence in the use of mobile shopping than consumers with a low level of technology anxiety". In sum, Ling [2002] underlines the crucial role of *location* and *social environment* in which the mobile phone is used, as major determinants of the overall user performance and experience.

Digital Environment as a LBS Environmental Determinant

Several researchers underline the important role of the *digital environment* (i.e. graphical user interface) as a major consumers' behavior influencing factor and as an important online store evaluation determinant [Stewart and Malaga 2009; Su 2008 and Massad et al. 2006]. Indicatively, Hooten et al. [2013] suggest that visual aids should be treated as the main communication tool for mobile interfaces that employ maps. From an Environmental Psychology perspective, spatial/environmental interfaces domain focuses on interpreting the way that users interact with a graphical user interface of a mobile device [Charitos, 2007]. He reports that LBS provide a similar to the traditional retailing situation experience in the sense that users' *location* is part of the shopping experience and included in the list of determinants that comprise the service environment. In the same vein, Weiser [1991] notes that users feel as elements of both the *digital* and the *physical* environment when they use their mobile phones to *consume* voice or other mobile services. Similarly, Streitz and Nixon [2005] and Rizopoulos and Charitos [2006] note that the *digital* mobile interface and the *physical location* constitute two independent dimensions that along with the *social* one [Tombs and Kennedy 2003] constitute major determinants of a mobile service environment.

ICT Environment as a LBS Environmental Determinant

Schmidt [2005] states that the mobile *device* is a separate element of the mobile service environment that along with mobile *connection* [Roto 2006] constitute two independent "Information and Communication Technologies (ICT) intensive" entities of a LBS retailing environment.

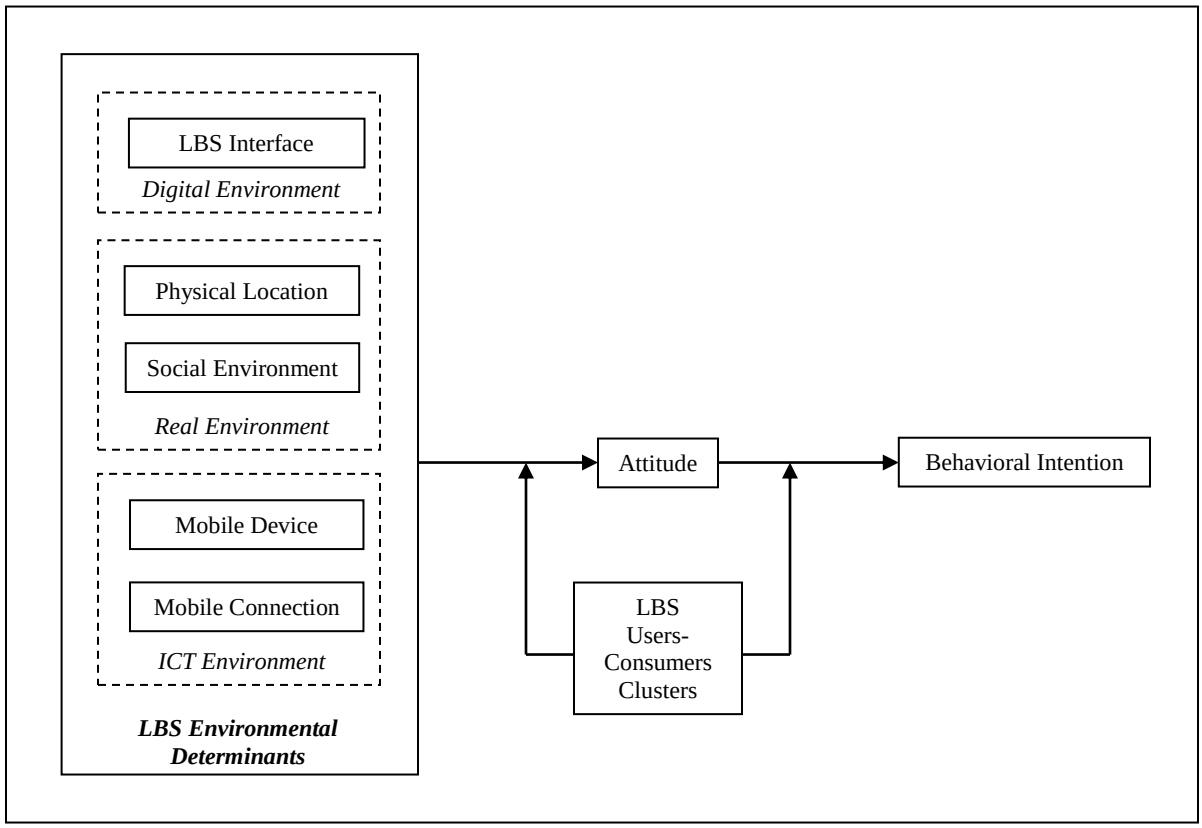

Figure 1: The Conceptual Framework of the Study

The LBS Environmental Determinants Conceptual Framework

Figure 1 includes the LBS Environmental Determinants' Conceptual Framework derived through the aforementioned discussion and tested within the context of the present study. Specifically, the *social* and the *physical* (i.e. location) determinants are grouped in to one main category labeled *Real* environment. Similarly, the *device* and the *connection* LBS environmental determinants are grouped under the label *Information and Communication Technologies* (ICT), while the graphical user interface is labeled as *Digital* environment.

However, it should be clarified that, apparently, some or all of these LBS environmental elements are also applicable to other fields/types of B2C activities (e.g. m-commerce, e-commerce), implying that they are not unique for LBS usage. It should be also clarified that several other aspects (e.g. legal environment, economic environment, culture) could be also included in the LBS environmental determinants (Figure 1). However, according to the research objectives, approach and positioning of the research it was out of the scope of the present study to include other aspects in the list of the LBS environmental determinants. Specifically, according to relevant theory discussed above, the selected aspects form a blended environment in which the user-consumer directly interacts with. In other words, the co-existence of these aspects differentiates the LBS environment from a typical electronic commerce one (i.e. shopping online from home) and thus, the emphasis of the present study was to focus on them. Apparently, other aspects could also be included in this list and, thus, future research should investigate their role in this context (thoroughly discussed in the last section of the paper).

2.3. Research Hypotheses

Several studies in the past have developed consumer typologies using consumers' evaluations on a specific set of retail settings variables. Indicatively, The Pew Internet & American Life Project [2009] clusters the mobile users in five types according to their assets, actions and attitudes, while Laukkanen [2007] developed a consumer typology in mobile banking based on the scores consumers attach to specific dimensions of this retail format. Vlachos et al. [2011] cross-national empirical study on mobile Internet services proved that consumers attach different importance in their evaluation of these services, while McGoldrick and Collins [2007] attempted to cluster multichannel shoppers using both behavioral and psychographic data. Similarly, Park et al. [2011, p. 172] report for mobile services that the "classification of consumers' basic and innovative benefits can serve as a parsimonious guideline for developing such services and devices". Along these lines, Oulasvirta et al. [2011] compared

experienced, novice and professional smart phones users and found that experienced users performed better than the other two groups in executing the study's tasks. However, they attributed this finding to other than psychographic characteristics (e.g. better knowledge of the interface terminology, etc.).

Davis [1989] introduced the well established Technology Acceptance Model (TAM) and discussed about the influencing role of users' perceived ease of use and usefulness of information technology on their attitudes towards it. Vrechopoulos et al. [2003] conducted a cross-national study and found significant differences regarding consumer attitudes towards mobile commerce, while Hansen [2006] investigated why consumers repeat their online purchases form a particular web based grocery store and found that personal characteristics and attached importance to store selection criteria (e.g. physical effort) influence their attitudes towards shopping goods online. According to Love [2005] mobile users' characteristics determine their performance and experience with a LBS application. Along these lines, Lim and Kumar [2008] proved that consumers' attached importance on selection criteria of mobile services is affected by gender. Similarly, Tsang et al. back in 2004 investigated consumer attitudes toward mobile advertising and the relationship between attitude and behavior. They found that attitudes are affected by personal characteristics and situational factors. More recently, Varnali et al. [2012] found that consumer characteristics have the strongest impact on consumers' responses to mobile marketing activities confirming, thus, the results of previous studies. More recently, research studies underline the crucial role of users' personal characteristics as important factors towards the adoption and usage of mobile commerce and location based services [Yang and Forney 2013; Chorley et al. 2015].

In sum, it is expected that the attitude of users-consumers towards LBS environmental determinants (e.g. physical location, social environment, etc.) is moderated by a series of different variables. To that end, the importance users-consumers attach to the LBS environmental determinants (e.g. some people attach higher importance to technological aspects than others, etc.) it is expected to determine the effects of the environmental determinants of a LBS application to their attitudes. Thus, hypotheses 1 and 2 are formulated as follows:

H1: There are significant differences between LBS users/consumers (i.e. different clusters) in terms of their attitudes towards the LBS environment.

H2: The predicting power of the LBS environmental determinants (Figure 1) on users'/consumers' attitude towards the LBS environment varies among different user/consumer clusters as these (i.e. the clusters) are derived according to the importance users/consumers attach to the LBS environmental determinants.

Park et al. [2007] found that consumers' psychographic characteristics moderate the effects of on-line shopping environments on their behavioral intentions. Similarly, Mahatanankoon [2007] found moderating effects of personality traits on behavioral intentions in the context of mobile commerce, while other empirical results also underline the strong effect that psychological characteristics have on the behavioral intention towards using new mobile services [Kim et al. 2012]. Tsang et al. [2004] found significant effects of consumer attitudes to behavioral intentions in the context of mobile advertising, and Zhou [2012b] found that trust, flow and perceived risk affect the behavioral intentions towards the usage of location based services. Similarly, Zarmpou et al. [2012] study's findings indicate that consumers' behavioral intention towards the adoption of mobile services is directly affected by perceived usefulness, innovativeness and relationship drivers. More recently, several research studies report that the diffusion and user adoption-acceptance of location based services are affected by users' attitude as this is formed by personal beliefs and attached importance to specific criteria [Zhou 2015; Wernke et al. 2014; Yun et al. 2013]. Finally, according to the TAM model [Davis 1989] the users' attitudes towards an Information System affect their behavioral intentions towards using it.

In sum, similarly to hypotheses 1 and 2 argument, it is expected that the relationship between attitude and behavioral intention to be determined and affected by the profile of different users-consumers as this profile is derived through the importance they attach to the LBS environment determinants. Thus, hypothesis 3 is formulated as follows:

H3: The predicting power of users'/consumers' attitude towards the LBS environment on their behavioral intention towards using a LBS application varies among different user/consumer clusters as these (i.e. the clusters) are derived according to the importance users/consumers attach to the LBS environmental determinants.

3. Research Methodology

3.1. Field Trial Setting

For conducting the research, a laboratory LBS application was designed and developed (section 3.3). This application served as the research instrument in the context of a field trial setting. Through this laboratory LBS application (instead of a real commercial application) any potential undesired brand loyalty effects were totally controlled.

The sampling frame was the Athens University of Economics and Business. Finally, 110 subjects selected through simple random probability sampling and participated in a 2 hours field trial (i.e. each subject spent approximately 2 hours in different time slots – total 220 hours). Subjects were asked to fill out a series of questionnaires and tests before the trial that served as the data collection instruments for gathering information about their psychographic, behavioral and demographic data (e.g. personality, spatial ability, previous experience, etc.) useful for the detailed profiling and labeling of the resulted clusters. Then, subjects were asked to use the LBS application in the city center for approximately 30 minutes. Finally, as soon as the subjects returned to the lab, they were asked to fill out the final questionnaire which focuses on the evaluation of the particular application in terms of a series of relevant to the context of the study variables (section 3.2). Moreover, subjects were asked to express the importance they attach to each element of a LBS environment when they decide to select and use such an application in the future.

3.2. Measures

The mobile *digital interface* dimension of the LBS environment was measured through the 7Cs framework for mobile commerce graphical user interfaces (see [Lee and Benbasat 2004]). This framework (derived through [Rayport and Jaworksi 2001]) is one of the most integrated ones for measuring the digital interface components of a mobile application. Then, for measuring the *social* determinant of the model we adapted the *social density* and *the displayed emotions of others* variables proposed by Machleit et al. [1994] and Mayer et al. [1998], respectively, as reported in Tombs and McColl-Kennedy [2003]. The spatial location variable was employed for measuring the *physical* determinant of the LBS environment. However, it should be clarified that this particular variable was actually controlled within the field trial setting in the sense that all subjects used the application *"on the move"* in a specific location (i.e. around the University) in the city center. Nevertheless, subjects were asked to evaluate both the performance and the importance of this variable as they also did for the other LBS environmental variables. Finally, for measuring the *device* and the *connection* determinants we employed Roto's [2006] corresponding dimensions (i.e. *Usability, Connectivity, Performance, Memory, Battery, Appeal, and Customer Care* for the mobile device, and *Availability, Speed, Cost, Trust, Customer Care* for the mobile connection). Table 1 summarizes the scales used in the study. Finally, it should be clarified that all the constructs used for measuring the LBS Environmental Determinants (Figure 1 and Table 1) adopt and 1-5 interval scale [according to the corresponding references where these constructs derived from).

Table 1: The Measurement Scales used in the Study

LBS Environmental Determinants	Constructs/Scales	References
LBS Interface (*DIGITAL ENVIRONMENT)*	7Cs: Context, Content, Community, Customization, Communication, Connection, Commerce	Lee and Benbasat [2004]
Physical Location (*REAL ENVIRONMENT)*	Spatial Location	Controlled by the study
Social Environment (*REAL ENVIRONMENT)*	Social Density Displayed Emotion of Others	Machleit et al. [1994] Mayer et al. [1998]
Mobile Device (*ICT ENVIRONMENT)*	Usability, Connectivity, Performance, Memory, Battery, Appeal, Customer Care	Roto [2006]
Mobile Connection (*ICT ENVIRONMENT)*	Availability, Speed, Cost, Trust, Customer Care	Roto [2006]
Mobile User Characteristics	Definitions and Examples	Love [2005]
Spatial Ability	The extent to which individuals can deal with spatial relations and the visualization of spatial tasks. The ability to move through the physical environment without bumping into objects	Lohman [1989], Carroll [1993] *Test:AH4 Group Test of General Intelligence, Part 2 [Heim,1970]*
Personality	Personality describes the characteristics patterns of behavior and modes of thinking that determine an individual's adjustment to the environment. [Atkinson et al., 1983] - Personality Dimensions: Extroversion, Agreeableness, Conscientiousness, Neuroticism, Openness to experience	Turkle [1984], Reeves & Nash [1999] Fortunanti [2001] *Test: NEO Five Factor Inventory [McCrae and Costa,1987]*
Working Memory	Working Memory is regarded as having limited capacity and it can only hold information for a short period of time. How can someone remember the correct choice in a speech-based mobile phone service	Baddeley & Hitch [1974; 1976]
Verbal Ability	The ability to comprehend spoken or written words. *What does it mean?*	Vicente et al., [1987] *Test:AH4 Group Test of General Intelligence, Part 1[Heim,1970]*
Previous Experience	The user experience with the actual interface used to perform a specific task. Typing ability after getting a new mobile phone in a different brand.	Egan & Gomez [1985]
Age		

Regarding the mobile user characteristics (Table 1) we employed the following dimensions [Love 2005]: (*a) spatial ability, (b) personality, (c) working memory, (d) verbal ability, (e) previous experience and (f) age.* It should be noted that according to Carroll [1993], it is widely accepted that *spatial ability* is made up of a number of sub-factors. To that end, the present study employs the Lohman's [1989] three factor model of spatial ability which is perhaps the most widely accepted. He notes that spatial ability is made up of the following sub-factors of: *(a) spatial relations, (b) spatial orientations and (c) visualization.* Finally, it should be clarified that mobile user characteristics were measured through specialized and detailed psychometric tests derived through the sources included in Table 1 and applied in the context of the data collection phase of the present study. It should be also clarified that the factors included in Table 1 as "mobile user characteristics" are apparently not comprehensive in the sense that several other factors (e.g. user preferences, privacy concerns) could be also included in this list. However, we employed Love's [2005] existing list of mobile user characteristics as a suitable one for the purposes of the present study since this list includes variables that are directly related to the blended environment in which users navigate using their mobile

phones. For example, age is a demographic characteristic which is directly related to *innovation* which is a highly relevant dimension to the investigated topic. Also, the selected list includes variables that are directly related to abilities (e.g. spatial ability) and are crucial in the context of the present study (i.e. using LBS "on the move").

The overall attitude score was derived through the multi-attribute model of consumer choice [Fishbein 1963; Mason et. al., 1991] adapted to the present study's context. This model is frequently used to help retailers understand the importance of various store features to consumers and can be applied as follows:

$$\text{As} = \sum_{i=1}^{n} Bi\ Wi$$

where:

As = Attitude toward the store

Bi = Belief by a consumer that a store possesses a particular attribute

Wi = The weight or importance of the attribute to consumers

n = Number of attributes important to consumers in their choice of a store

Specifically, the Bi was measured based on the users' evaluations of the LBS environmental factors (always in the context of the specific LBS mobile application used in the field trial), while the Wi was measured based on the users' attached importance on the LBS environmental factors. Finally, the n represents the number of constructs/scales used to measure the LBS environment (Figure 1, first part of Table 1). It should be underlined that, in the context of the present study, this multi-attribute model of consumer choice served just the purpose of measuring users'-consumers' attitude towards the LBS environment in an integrated manner (i.e. taking into account all the different LBS environmental determinants).

In sum, the measures used for the different dimensions of the conceptual framework are sufficient since they: (a) measure the framework's variables in a integrated manner including several aspects of the investigated dimensions, (b) are quite relevant to the framework's variables and (c) have been widely applied and well tested in several research studies in the past.

3.3. Description of the LBS Application Developed for the Field Trial

The LBS mobile application developed in the lab for the field trial follows the client-server architecture model. The server includes the Windows 2008 Server Operating System and the Oracle Database 10g with spatial capabilities for the deployment of the necessary database scheme. Moreover, the communication with the mobile clients is succeeding through the Java Platform, Standard Edition (Java SE) with NetBeans. The web pages that demonstrate the results and the details about the entertainment spots of the LBS application are published through the IIS Server of the Operating System. The mobile phones used for the needs of the field trial run Windows Mobile operating systems. For this reason, the client-side application is deployed through the Microsoft Visual Studio .Net application suite. Visual C++ is the main development language for the mobile client application that provides the communication with the server and the necessary operation of the built-in GPS receiver. Initially, the mobile user activates his/her GPS locator and via satellites of GPS system he/she receives the geographic coordinates of his/her position. Afterwards, the installed application in his/her mobile device, undertakes to promote his/her spatial information in the Application Server. The dispatched message includes also the user's identity (e.g. MSID). Through the Oracle database system and the Java Suite, the user receives all the requested information according to his/her position, after the processing of the list with the points of interest for which the mobile user has declared preference. This list includes all necessary information about the points of interest, the events in them and, most important, their geographical position. The context of the field trial was the entertainment industry, implying that the information managed through the application (i.e. users' preferences, delivered information to users, etc.) refer to such type of data (e.g. restaurants, live music events, etc.).

4. Analysis of Results and Discussion

4.1. Exploring and Classifying User-Consumer Behavior

Cluster Analysis and Multiple Discriminant Analysis (MDA) were employed for clustering the field trial participants and explore which variables best discriminate the resulted clusters. Specifically, hierarchical cluster analysis (agglomeration schedule and dendrogram) provided two groups of respondents with 55 (fifty-five) subjects classified in each of the groups. Results indicate that 100% of the observations are correctly classified in both clusters. Then, for investigating how clusters differ, Multiple Discriminant Analysis (MDA) and t-Tests were employed. As far as the MDA's assumptions are concerned, there was not any significant violation observed (Box's M >.001, low correlations between variables). MDA findings show that the two user groups are significantly discriminated by the *physical (i.e. location)* and the *social* environment with respondents classified in cluster #1

displaying greater average scores (1-5 likert scale) from those of cluster #2 on both variables (4,34 and 3,44 for cluster #1 compared to 2,16 and 2,95 for cluster #2). However, as far as the remaining environmental variables are concerned, both groups provided high scores in all these variables (i.e. greater than the average) without any significant differences observed between the two groups. This implies that both groups attach high importance to the *digital* interface, *device* and *connection* criteria when they select a LBS application. Finally, it should be noted that we also compared the two clusters in terms of each of the LBS environmental determinants through separate t-Tests (total #5 tests) and the results confirmed those of MDA.

We also run MDA using the two social constructs (i.e. *social density* and *displayed emotions of others*) separately. We found that only the *social density* variable (along with *location*) discriminates the two clusters (i.e. not the *displayed of emotions of others*). Trying to explain this finding we can claim that *location* and *social density* are closely related in the sense that a city center (i.e. *location*) has high social density, while a park (i.e. *location*) has not. This finding may imply that users/consumers grouped in cluster #1 attach higher importance to the *real* environment in terms of the traffic and the crowding conditions this environment possess. Similarly, also in this case, we conducted separate t-Tests for each of the LBS environmental factors in order to test whether there are significant differences between the two clusters. These results also confirmed the MDA results discussed above.

Furthermore, in order to investigate whether there are significant differences between the two clusters in terms of psychographic data, t-Tests are employed (instead of ANOVA) since the resulting clusters are two. Assumptions (e.g. normality, etc.) are not violated and results indicate that clusters significantly differ in terms of *spatial* and *verbal ability* (t=2,341 with p=,021 and t=2,422 with p=,017, respectively). Inspecting the means, we observe that the average scores for cluster #1 are higher than cluster's #2 scores for both variables (25.60 to 22,93 and 32,53 to 30,64, respectively). It should be also clarified that spatial ability scores could range from 0 to 36 and for verbal ability from 0 to 40 according to the measurement scales used. In sum, despite the fact that both groups scored high in both variables, those subjects clustered in cluster #1 seem to be more skillful in moving within the physical environment (*spatial ability*), while they use words, phrases, menus, interfaces, etc. (*verbal ability*) more efficiently. Love et al. [1997] and Vicente et al. [1987] report that users with high verbal ability are expected to perform better than those users with lower verbal ability in using services with hierarchical structures like the one employed by the LBS application used in the field trial and like several LBS applications possess. Finally, cluster's #1 mean scores on the *working memory* test were higher than those of cluster's #2 ones (32,75 vs. 28,38) without, however, significant differences observed between the two clusters regarding this dimension.

According to all these results, it seems that cluster #1 users attach significantly more importance than cluster's #2 ones to the *physical* and the *social* dimensions not because they are not skillful to manipulate them but the opposite. Specifically, they seem to consider *location* and *social density* (displayed emotions of others proved to not significantly differ between the two groups) as important variables in their selection process of whether to use or not a particular LBS application because they are "good on that" (i.e. in navigating through the physical space and in social communication activities). Furthermore, their high verbal ability also supports the previous claim. Specifically, while these consumers-users can effectively navigate through a crowded physical environment (*spatial ability*) they do not face any particular problems in using a LBS digital interface simultaneously, simply because of their high *verbal ability*, as explained above.

For each cluster separately we also tested through ANOVA with Post-Hoc Comparisons whether there are any significant differences observed among the five dimensions of the personality. Results, however, could not serve to further differentiate the two clusters since "agreeableness" dominates the personality of both groups' participants.

Finally, results (ANOVA with Post-Hoc Comparisons) also indicate that both clusters' participants are capable in terms of rotation and orientation with significant differences observed between these dimensions and the visualization one for both clusters (average scores for cluster #1: rotation=9,4/12, orientation 8,8/12 and visualization=7,4/12 - average scores for cluster #2: rotation=8,6/12, orientation 8,1/12 and visualization=6,2/12). All these results are used in the detailed profiling and labeling of the resulted clusters discussed in section 4.3. below.

4.2. Hypotheses Testing

For testing hypotheses #1 we employed independent samples t-tests (Table 2). Assumptions (e.g. normality, etc.) are not violated and results indicate that clusters significantly differ in terms of the overall attitude their participants possess towards the LBS environment (t=5,919, p<.05). It is observed that cluster's #1 participants have significantly more positive attitudes than corresponding respondents from cluster #2 (average scores: 75,17 to 61,86 – minimum score: 35,46, maximum score: 99,83), thus, confirming H1. Elaborating on the previous discussion (section 4.1.), this finding could be probably explained by the fact that the field trial took place in the city center where the *social density* was high (i.e. crowding) and obviously the *location* was more or less constant during the whole field trial. Therefore, it is expected for cluster's #1 users to form more positive attitudes for the particular

LBS setting than those of cluster #2. However, both groups displayed in general more positive than negative attitudes towards the environmental determinants of the LBS application. The H1 testing results also confirm existing knowledge (e.g. [Chorley et al. 2015; Hansen 2006; Vrechopoulos et al. 2003]) since significant differences were observed in terms of consumer/user attitudes towards online environments as a result of both their evaluations of these environments and their personal characteristics.

Table 2: Independent Samples t-Test for testing Hypothesis #1

	Levene's Test		t - Value	Sig.
	F	Sig.		
Clusters' Attitude towards the LBS Environment	,677	,412	5,919	,000

Then, hypotheses #2 and #3 are tested through multiple and single regression models, respectively. Specifically, two multiple (H2) and two single (H3) regression models are employed for the two clusters (Tables 3 and 4). For the cluster #1 case, there are not any assumptions' violations (ratio of cases, normality, etc.) observed. Multiple Regression results (Sig.= ,000) indicate that for cluster #1 the variation in consumers' attitudes towards the LBS environment can be explained (predicted) in terms of variation in their evaluations of the *physical environment* (i.e. *location*), the *device* and the *connection* (scores: 6,693 at sig=,000, 5,552 at sig=,000 and 4,262 at sig=,000, respectively). The R square implies that 87,5% of the variation in consumers' attitudes towards the LBS environment can be explained by the evaluation they attach to the *location* they use the LBS application, to the *device* and to the *connection* (Table 3).

Table 3: Multiple Regression Model Results for Clusters #1 and #2 (Hypotheses #2)

	LBS Environmental Determinants	Beta Value	t-Value	Sig.
Cluster #1	Physical Location	,369	6,693	,000
	Social Environment	,010	,192	,848
	Digital Environment	,119	1,933	,059
	Mobile Device	,442	5,552	,000
	Mobile Connection	,314	4,262	,000
Cluster #2	Physical Location	,355	4,636	,000
	Social Environment	,216	2,775	,008
	Digital Environment	,269	2,754	,008
	Mobile Device	,318	3,406	,001
	Mobile Connection	,284	3,185	,003

The fact that the *digital interface* proved to not predict attitude for cluster #1, could be explained by the fact that these consumers scored significantly higher scores than those of cluster #2 in the "verbal ability" test (see section 4.1.). This implies that they have high skills in interacting with a graphical user interface (GUI) of an information system regardless of the physical environmental conditions (e.g. high social density in the city center where the field trial took place). Therefore, the digital environment of a LBS application (i.e. the interface) seems to not affect their attitude towards the LBS environment simply because they can perform quite well irrespectively of the GUI a particular LBS application employs. Furthermore, while location affects their attitude, the social environmental determinant does not. This could be explained by the fact that in the *"presence of other variables"* situations applied in multiple regression models, the *location* variable seems to absorb the social environment predicting power on the attitude dependent one. It should be also reminded that MDA results (section 4.1.) showed that only the *social density* (directly associated with any specific location) and not the *displayed emotions of others* discriminate the two groups.

This finding may be also explained by the fact that since the *spatial ability* of cluster #1 respondents is significantly higher than those of cluster #2 (as provided through the t-Test) and since *location* is one of the variables that discriminates the two clusters (provided through MDA) with users classified in cluster #1 attaching significantly higher importance to location, users in this cluster care about the location probably because navigating

through the physical space is something that they know to do it effectively. Along these lines, the fact that the *social environment* (i.e. *social density* and *displayed emotions of others*) does not predict the attitude of cluster's #1 participants, may reflect the underlying importance those users attach to the *physical* dimension of the *real* environment rather to the *social* one (i.e. emphasis on the social density which is directly associated with the location one). As far as for cluster #2 is concerned, Multiple Regression Results (Sig. =,000) indicate that all environmental variables (total 5) predict users' attitudes towards the LBS environment with a high R Square score (73,9%). This result implies that for users classified in cluster #2 all LBS environmental variables are important. Thus, it is clear that the environmental variables of the tested model (both for cluster #1 and #2) explain (predict) a high percent of the variation of users' attitudes towards a LBS environment (high R Square scores). This finding further strengthens the completeness of the conceptual model tested by the present study (i.e. the one including the five environmental determinants). In sum, hypotheses #2 is accepted since the attitudes of cluster's #1 participants towards the LBS environment is predicted by different LBS environmental determinants than those of cluster's #2 ones. Thus, H2 testing confirms existing knowledge regarding the moderating role of personal characteristics (i.e. different clusters) in the relationship between mobile service settings and users'/consumer' attitudes (e.g. [Varnali et al. 2012; Manganari et al. 2011; Love 2005; Tsang et al. 2004]).

Table 4: Single Regression Model Results for Clusters #1 and #2 (Hypotheses #3)

	Independent Variable	Beta Value	t-Value	Sig.
Cluster #1	Users'/Consumers' Attitude towards the LBS Environment	,342	2,654	,010
Cluster #2		,342	2,651	,011

For testing hypothesis #3, Single Regression Models were employed for each cluster separately (Table 4). Results indicate that the attitude towards LBS environmental determinants affect behavioral intention for both clusters (cluster #1 model: Sig.=,010 and cluster #2 model: Sig.= ,011). Thus, hypothesis #3 is rejected since the predicting power of users'/consumers' attitude towards the LBS environment on their behavioral intention towards using a LBS application is not determined by the users'/consumers' profiles (i.e. different clusters). However, the low R Square (0,117 for cluster #1 model and 0,100 for cluster #2 one) implies that customers' intention towards using LBS services is also determined by other important factors (e.g. price, reputation, privacy, security, etc.), since attitude in the case of the present study was measured by employing data concerning only the LBS environmental determinants.

It should be also clarified that despite the fact that beta value is the same in both of the aforementioned cases (i.e. ,342), this does not imply that both clusters have no differences. Specifically, this finding just implies that there are not any differences observed between the clusters as far as their *attitudes' effects on their behavioral intentions* is concerned. In other words, while these clusters significantly differ in many dimensions (also in their attitudes towards the LBS environment - see H1 testing results), their attitudes' effects on their behavioral intentions towards using a LBS application is the same. This finding may imply that different attitudes towards an LBS environment do not generated different behavioral intentions towards using an LBS application. However, when attitude is combined with other organism variables like pleasure, arousal and dominance (i.e. variables included in the Affective level of the Organism state of the SOR model) in a multiple regression model (i.e. 4 independent variables), the results of attitude effects on behavioral intention may be different due to the *simultaneous presence* of other independent variables in the prediction model. Thus, future research could further investigate this issue, as thoroughly discussed in the last section. Part of H3 testing results, however, are not in line with existing knowledge. Specifically, several researchers (e.g. [Zhou 2015; Kim et al. 2012; Park et al. 2007]) have underlined the determining role of attitude and personal characteristics towards the formation of behavioral intentions, while in the present study the different users'/consumers' clusters seem to not moderate the *attitude – behavioral intention* relationship. In sum, however, despite the low R Square value, the H3 testing results as far as the predictive power of attitude on behavioral intentions is concerned, confirms the well established existing knowledge regarding the *attitude – behavioral intention* chain (e.g. [Davis 1989; Tsang et al. 2004]).

4.3. Profiling and Labeling the Resulted Clusters

Based on the descriptive statistics results, both clusters include mostly young participants, while gender is well balanced within each group. All participants seem to be experienced enough in using mobile devices either for voice or for mobile data services. Finally, all participants belong to the higher education level. Despite the fact that cluster's #2 participants attach comparatively lower importance to the real environmental dimensions (i.e. *location* and *social density*) than those of cluster #1, they seem to be less skillful than cluster's #1 participants in navigating through the real environment while interacting with the interface of a LBS mobile application (i.e. lower *spatial ability, verbal ability and working memory*). Probably, cluster's #2 respondents attach low importance to these specific selection criteria having mainly in their mind the voice services or some basic data services they usually use through their mobile phones, and not the LBS ones. In other words, since they use their mobile phone mostly for voice or some basic mobile data services (this was the current mobile users' practice in the town where the field trial took place) *anytime* and *anywhere* without facing any particular usage problems, they probably feel that they will also perform effectively in using LBS services. Furthermore, the attitude of cluster's #2 users towards the LBS environment is predicted by all the LBS environmental determinants, while cluster's #1 users' attitude is not predicted by the digital interface implying (as also discussed above) higher skills in interacting with software applications.

Trying to further explain and justify cluster's #1 profile through combining all the available results, we could ultimately claim that these users are *location* and *social density-sensitive* ones because they can reliably and thoroughly *assess* the crucial role of the real environmental conditions when using a LBS application. In other worlds, taking for granted that both groups are technology literate, cluster's #1 respondents can probably better assess the potential influencing power of the *real environmental* determinants on the overall value offered through a LBS application than those of cluster #2. To that end, we could claim that these consumers may be more demanding ones as far as the LBS offered services are concerned. This implies that they will demand high quality services that match the location each user possess in any given time with the corresponding content delivered to him/her (e.g. personalized advertising messages). For example, it seems that a user of cluster #1 (compared to a cluster #2 one) can process information through the digital interface of a LBS mobile application while walking through the city center in a more effective manner, more quickly, more dynamically and with better results.

According to the discussion reported in this and in the previous sections, we attempt to label cluster #1 as *"walkers in place"* and cluster #2 as *"walkers in space"*. The above classification is originated from the different meanings of the "*place*" and "*space*". The "*space*" is the material dimension of the environment while the "*place*" is the space with a social meaning (personal or collective) or otherwise the "space with value" [Relph 1976].

5. Conclusions and Implications

The behavior of users-consumers towards LBS is differently affected by a series of LBS environmental factors that determine their evaluation of such applications. These effects are moderated by several demographic, behavioral and psychographic user-consumer data predicting differently users'-consumers' attitude towards the LBS environment which, in turn, affects their behavioral intention towards using such services.

The theoretical implications of the study are positioned into two main pillars. Firstly, from a methodological perspective, the study confirms the value of employing a multidisciplinary research approach on that topic. Specifically, the combined use of Marketing, Information Systems, Electronic and Mobile Commerce as well as Environmental Psychology theoretical insights, contributed to forming an integrated approach and innovative treatment of the investigated issue and further bridging the gaps between relevant disciplines. Secondly, the study contributes to theory building by testing an integrated LBS environmental determinants' framework and by introducing and applying an analytical classification scheme for LBS users-consumers along with relevant integrated prediction models that offer new knowledge to a fast evolving and yet not in depth explored topic.

Future Research

Future research could replicate the present study by developing an exhaustive and extended list of all the potential criteria that users-consumers use in order to select a LBS application (e.g. price, variety of services, reputation, security, etc.) and then derive corresponding factors (i.e. through factor analysis). Then, the study could proceed on developing a user classification scheme similarly to the method employed by the present study and execute the corresponding statistical tests conducted by the present research attempt. Similarly, future research could also include other factors (e.g. user preferences and privacy concerns) that measure mobile user characteristics (Table 1). Thus, this list will be more comprehensive, offering challenging opportunities for various analyses from different perspectives. Furthermore, future research could use the LBS environmental determinants presented herein as a pool of potential variables that could well serve as the manipulated ones (treatments) in the context of causal experimental designs measuring their effects on user/consumer behavior. To this end, several other aspects (e.g.

legal environment) could be also included in the LBS environmental determinants. Also, we strongly encourage further research that will investigate the attractiveness of LBS through a use-case-scenario approach (either through paper-and-pencil or field/lab experimental designs). Such a research attempt will provide valuable and straightforward theoretical and practical implications. While the entertainment industry constitutes an attractive field for offering LBS, future research should focus on investigating the potential of LBS in several other retailing formats (e.g. shopping in the city center or in a shopping mall, museums, thematic parks, social media contexts, consumer-to-consumer bartering systems, etc.). Future research could also include pleasure, arousal and dominance (i.e. variables included in the *Affective* level of the *Organism* state of the SOR model) along with the attitude variable in order to test whether in the presence of other variables, the predicting power of the attitude one on behavioral intention is different for different user-consumer clusters. Finally, future research could exploit well established persuasion theories (e.g. Theory of Reasoned Action, Theory of Planned Behavior) in the context of LBS in order to further investigate this topic through various perspectives. Indicatively, these theories could well serve as a useful theoretical ground towards formulating research hypotheses that aim to explain in depth how users'-consumers' characteristics affect and predict their attitudes and behaviors towards LBS.

Limitations

The study has some limitations. Firstly, employing a student sample is a limitation. However, the sample is suitable to the theme of the present study since mobile data services and more specifically *context aware systems* like LBS are mostly used and firstly adopted by young people that are familiar with technology (*"innovators"* according to the Diffusion of Innovation Theory - [Rogers 1983]). Furthermore, the use of a laboratory LBS application instead of a real one is a limitation in terms of the *external validity* dimension (i.e. generalization capability of the results). However, through that we achieved to totally eliminate any potential undesired brand loyalty effects as well as ensure *internal validity*. Finally, the selection of a specific sector (i.e. entertainment industry) could be a limitation since results must be interpreted with caution when applied in other sectors.

Managerial Implications

LBS application service providers could exploit the findings of the present study through various ways. Specifically, there is need to adjust the manipulation of the LBS environmental determinants according to the type of the user-consumer in order to meet different needs and preferences in the context of an interactive and blended communication environment. For example, for *"walkers in place"*, LBS providers could design and promote advanced LBS services that enable users to accomplish several innovative tasks in a dynamic manner while they navigate through the real environment. Furthermore, they could communicate to these consumers the attractiveness to adjust their LBS application according to the location and the social density that characterize their specific position in the real world at any specific time. Along these lines, LBS providers could motivate through Integrated Marketing Communication (IMC) activities the *"walkers in place"* to use such services. Specifically, LBS providers could explain and inform them that the interaction with the digital interface of these innovative applications requires experience and skills and designed for those users that are capable of using state-of-the-art mobile information systems regardless of the existing physical and social conditions. On the other hand, *"walkers in space"* could be approached though more basic and easy to use LBS applications. Similarly, LBS providers could emphasize to them that the transformation from voice to mobile data services offer new consumer experiences and attractive services. However, they should "protect" these users by communicating to them that such services constitute a "different" experience implying that some special skills (e.g. obtained through training and/or experience) may be required in order to "consume" these services effectively and be satisfied. LBS providers should also emphasize on all the environmental determinants of a LBS application offering high quality mobile devices, reliable and fast connections and easy to use digital interfaces. Finally, they should underline and promote the value added services that such applications could potentially provide by processing the physical and the social environmental data that are related to the specific position each user has at any given time.

Several examples (use case scenarios) also demonstrate the managerial implications of the present study. Indicatively, *"walkers in place"* could receive dynamically generated content through their advanced mobile interfaces while walking through the city center. This content could be adapted not only according to the personal profiles and location but also based on several other dimensions that continuously change during the consumer trip and time. These dimensions could be the following: (a) the atmosphere of the recommended stores that are close to them and play the music they like (temperature, social density, music volume, promotions, profile of other visitors, etc.), (b) social communication/networking capabilities (in case some other LBS users are close to them using their LBS applications in a similar manner), (c) advanced information search mechanisms, etc. On the other hand, for *"walkers in space"*, a LBS application should emphasize the *location* capability and the services that could be (*location-enabled)* offered to users. These users should perceive LBS applications as a new mobile enabled service that offers easy to use and value added services. For example, a standard car navigation system could be

characterized as an easy to use LBS application that targets these users. Similarly, LBS applications employing non-hierarchical structures (e.g. smart phones' interfaces like the i-phone) may be suitable for these users since they possess lower verbal ability [Vicente et al. 1987; Love et al. 1997]), always compared to *"walkers in place"*. Therefore, they are not so capable of effectively navigating through hierarchical structures, at least, as *"walkers in place"* are. However, this argument should be interpreted with caution and needs further research attention considering Oulasvirta et al. [2011] conclusion that "menu-based interfaces leave little room for higher levels of skill".

In order to enhance the value of the offered services, LBS providers should continuously collect, process and exploit data as well involve consumers in the co-creation process of attractive and innovative mobile applications [Khansa et al. 2012]. Indicatively, they could place social density, brightness, noise, etc. detectors at specific locations in the city center in order to be able to have this type of information at a 24/7 basis. Processing this information (following Permission Marketing guidelines – see Kavassalis et al. [2003]), they could adjust their offerings and satisfy their customers. For example, to users with lower spatial ability, LBS providers could send the relevant content combining the position of the customer (e.g. in a square vs. in a dark alley) with the existing social density, noise and brightness indexes. Similarly, *"walkers in space"*, may face problems in using a complicated mobile digital interface while walking with their fiends in a dark and noisy alley with high social density. On the other hand, *"walkers in place"* under the same circumstances would potentially use such applications more effectively. In sum, it is evident that there are plenty of variables that could be employed for effectively adjusting or even personalizing a LBS mobile application to meet the needs, preferences, and requirements of any given user (see [Vrechopoulos 2010; Sun et al. 2016]). For example, recently, Goh et al. [2015] conducted an empirical study in the context of mobile advertising. They investigated temporal and spatial differences in search behavior and advertising response and they suggest that marketers, when creating mobile ad content, they should place emphasis on the issue of time and location of the mobile device users. Also, Bentley et al. [2015] study found that different location based services are used in different places in a city.

For such services and options (e.g. customization/personalization) to be realized, providers should build strong trust and loyalty bonds with their customers in order for them to accept to use such applications/services and offer the needed data (e.g. similarly to the loyalty schemes programs). In sum, apparently, LBS providers must follow Permission Marketing guidelines and Regulatory/Legal Frameworks regarding data collection, processing and exploitation for all the involved players (e.g. consumers, businesses). Along these lines, Persaud and Azhar [2012] findings support that consumers' willingness towards mobile marketing business initiatives are determined by their brand trust, shopping style and value. More recently, Zhou [2015] found that enablers of location based services user adoption are trust and perceived usefulness, while trust has significant effects on perceived usefulness and perceived risk. Similarly, such applications must incorporate an "on-off" logic in the sense that users-consumers should be offered the option to decide whether they want to turn "on" or "off" their LBS application. Evidently, for those customers that may wish to participate in such "loyalty-scheme" type programs, there is no need and its not applicable to provide some type of the aforementioned data (e.g. verbal and spatial ability, working memory, etc.) in real time. These data could be collected at their registration in such programs and updated at a regular basis, always following Regulatory/Legal frameworks and Permission Marketing guidelines.

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