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Abstract

The recent profusion of smartphones in the mobile industry offers new opportunities for mobile services vendors. One of the most influenced service categories is location-based services (LBS). Based on insights from behavioural decision-making, a theoretical framework is developed to analyse individuals' decisions to use LBS. We focus on the cognitive processes involved in individual decision-making. Our research is based on two studies. First, we investigated the use of LBS through semi-structured interviews of smartphone users. Second, we explored daily LBS use through a study based on diaries. The findings highlight the distinct value dimension in specific contexts of use and the positive experiences of the service as the main drivers of LBS use. Thus, the user decision to use LBS can be described by either a comparative mode based on the value of LBS in relation to other available options, or by an intuitive mode where past experiences trigger the use of heuristics. These modes in turn underscore the positive influences on the continuance of LBS use.

Keywords: Smartphones, Location-based services, Use patterns, Behavioural decision-making

1 Introduction

The recent profusion of smartphones in mobile telecommunications markets around the world is offering opportunities for mobile data services that have not reached the mass market in many countries of the Western world until recently. One category of these services are location-based services (LBS). LBS are defined as services that use the current geographic position of a mobile user to provide personalised services (Perusco and Michael, 2005). LBS have been around for quite some time, although not available to private users. Initially, basic tracking of mobile location information was used in the 1980s for trucking and freight services (Pura, 2005). It is widely accepted that, until recently, LBS had failed to live up to the expectations of becoming mass-market products (Bellavista et al., 2008).

Nowadays, LBS have become highly popular due to various technical advances and new marketing strategies (May et al., 2007). A key driver of this popularity are new mobile devices, especially smartphones offering high resolution colour screens, increased processing power, new functionalities, and inbuilt high-performance positioning technologies such as GPS. Additionally, the widespread availability of broadband wireless infrastructure facilitates the use of mobile data services. Operators have also changed their pricing models with new attractive offers for fast data connections (e.g. flat rates for mobile internet instead of users paying by the megabyte). The success of smartphones and other portable devices has already led to an enormous increase in the amount of data being transferred on networks. According to Cisco Visual Networking, worldwide mobile data traffic will increase 39-fold between 2009 and 2014, reaching 3.6 exabytes per month by 2014. According to EITO's forecast, the number of global mobile subscribers (currently 5.1 billion) is set to reach to 5.6 billion in 2011.

Along with the proliferation of smartphones comes the growing popularity of mobile applications. Started by the Apple App Store, today nearly every mobile company offers complementary services developed by third-parties on their own app stores. Services vary in cost, from free downloads to expensive ones, depending on their purpose of use. The top ranked free services include LBS such as point of interest search tools (e.g. for restaurants, bars, hotels, banks, petrol stations, pharmacies and so on), train and public transport information and traffic jam warning. Top-selling services include LBS such as car navigation software, weather information, running applications and city guides.

The market trends suggest that LBS are now widely used by smartphone users. However, as LBS have only been used by mobile users for a short time, there is limited research on their actual use. Most previous studies have focused on the adoption of LBS, as the earlier low adoption rates of LBS motivated researchers and practitioners to investigate the reasons. Costs, security and privacy issues, quality of LBS information (e.g. information accuracy and update), and lack of knowledge about LBS were identified as the main barriers to LBS adoption (e.g. Chang et al., 2007; May et al., 2007). Users' privacy concerns have been studied as well (e.g. Sheng et al., 2008). LBS use was investigated by Pura (2005), who found that conditional value (i.e. use context), commitment, and monetary value had the strongest influence on behavioural intentions to use LBS. This indicates that the value of LBS is highly context-dependent and that people lack motivation to use LBS unless they create value in specific situations.

As LBS have become popular mobile services thanks to market developments, we are now able to analyse user behaviour by focusing on the adopted services. However, LBS use should not be viewed in isolation. Users have traditionally acquired location-related information through other means such as the stationary internet, paper maps or face-to-face interactions with others. These traditional channels are now being complemented by the new mobile channel. Thus, multiple channels, fulfilling user needs of location-based information, coexist. Hence, users do not choose to use LBS in isolation, but take into consideration available alternatives. In this paper we set out to investigate the cognitive processes involved in the decision to use LBS. Our research question is:

- *How do an individual's cognitive processes influence their use of location-based service?*

We address this question by adopting a theoretical approach based on behavioural decision-making (Kahneman, 2003) and conducting empirical research based on interviews as well as a diary study

accounting for daily-use. The contribution of this study is twofold. First, it contributes to mobile user behaviour research by underlining the cognitive (i.e. perceptual and intuitive) processes involved in LBS use and highlighting the importance of value dimensions. Going beyond traditional IS models and introducing an alternative theoretical perspective is expected to enrich our understanding of the IS post-adoption behaviours. Second, our study provides useful insights for the market players by underlining the importance of investigating the situations of LBS use in relation to its perceived value.
The rest of the paper is structured as follows. The next section describes the theoretical background in order to position the proposed framework. Section 3 includes the theoretical framework, which is based on insights from behavioural decision-making. The research approach is described in section 4. Sections 5 and 6 present the study findings, which are then discussed in section 7. The conclusions and the future research direction are presented in the last section.

2 Theoretical background

Research on LBS use falls into the core stream of IS research on user behaviour. Various theoretical perspectives have been used in IS research to understand the adoption and use of new services or technologies. Different models have been introduced to explain the adoption intentions, focusing on the user's perceptions of the technology's performance and his/her competences (e.g. TAM, UTAUT), as well as focusing on the social and cognitive determinants of the user (e.g. TRA, TPB). The models of TPB/TRA focus on the determinants of the adoption intentions rather than the actual use or on the value perceptions of the product or service under investigation. Besides, the underlying assumption of these models is that the adoption intentions are a good predictor of the user behaviour. Existing theories have proven useful when studying single applications and technologies, however, the use of LBS takes place in an environment where new mobile services compete with existing technological and non-technological means for acquiring similar information. Thus, the choice to use LBS is not made in isolation. While we acknowledge the importance of this type of research in explaining the individual determinants of adoption intentions, it is our contention that the decision process for LBS use is determined by value perceptions and heuristics, as well as the context of use. Drawing on behavioural decision-making theories is therefore an important approach that can provide new and valuable insights.
In this choice context the value perspective can supersede the technology perspective. Perceived value refers to the subjective value that the user receives or experiences in using the service (Bettman et al., 1998). Recent research findings suggest that mobile service use is value-driven instead of technology-driven (Constantiou, 2009; Pura, 2005). Consumers' evaluation of a mobile service is largely based on how valuable they perceive the content provided in a particular context of use and less on technology aspects such as technical complexity (Pura, 2005). We assume that such value-related dimensions are also prominent in LBS use. We view the decision to use LBS as the outcome of the individual's value assessment, which is based on some cognitive processes.
The context of use is an important parameter which influences the decision process because of the choice tasks involved in specific situations as well as the specific mode of assessing information in specific settings. For example, when people find themselves in a context of use already known and experienced, then their decision may be based on heuristics (Payne et al., 1992). Moreover, the individual decides in a constructive mode which decision strategy to use depending on the context of use, acting as an "adaptive decision maker" (Payne et al., 1993). Recent studies of mobile data services have focused on the effect of contextual factors on the use (e.g. Barnard et al., 2007; Mallat et al., 2009) and the user's value perceptions (Anckar and D'Incau, 2002). As mobile services are designed for use anytime and anywhere, it is reasonable to assume that their value may change in different use contexts and this in turn will influence usage behaviour. For example, Mallat et al. (2009) found that users particularly appreciate the benefits of mobile services in situations when they are in a hurry or when no other alternative are available.

3 A theoretical framework for individuals' use of LBS

Kahneman and Tversky (1979) made the first systematic attempt to analyse decision-making and preference formation in a descriptive manner. Individuals use different cognitive systems to assess information during the decision process (Kahneman, 2003). First, the perceptual system uses comparative processes affected by contextual stimuli. Second, the intuitive system uses heuristics to facilitate and accelerate the decision-making process by reducing the amount of information to be processed (Bazerman, 2008). Both the perceptual and intuitive cognitive systems are based on automatic reactions or impressions, which are monitored by the reasoning system during the evaluation, or judgement phase (Kahneman, 2003). An individual's choice of a specific LBS can be viewed as the outcome of a decision process using both the perceptual and intuitive cognitive systems, and lightly monitored by reasoning processes. The individual is not expected to spend a lot of cognitive effort in order to explicitly assess all the parameters or to process information in detail before using a LBS, as she may do before buying a house, for example.

The proposed theoretical framework is based on cognitive processes stemming from the perceptual and intuitive cognitive systems, which are introduced in the analysis of individuals' choices of LBS. Cognitive processes are clustered into two groups, the *referencing processes* which draw upon the perceptual system and the *heuristic-based processes* which are involved in the intuitive system.

The influence of the cognitive processes in the individual's decision is moderated by the external environment, where the choice is made. In the literature on preference construction, researchers have examined individuals' choices in relation to the external environment, or context (e.g. Lichtenstein and Slovic, 2006). For example, context effects may lead to assessment of tradeoffs or comparisons between services of different categories (e.g. Internet versus mobile enabled services) in various contexts of use (e.g. home versus working place with close substitutes available). These effects depend on the background and the local contexts.

The *background context* refers to an individual's experiences with the product and knowledge about products with similar characteristics. This information contributes to preference construction as well as to the subjective evaluation of a product/service's attributes and tradeoffs (e.g. price versus quality) (Simonson and Tversky, 1992). For example, an individual's experience with similar services offered on the Internet either for free and at a low quality of service, or for a flat price and good service quality, may set the background context (Constantiou, 2009). If LBS are offered at a flat price, the service quality should be at least as good as that provided by free Internet services.

The *local context* refers to the context of use, such as the situation in which the decision is made, which includes or not a set of available options. In case of LBS this particularly refers to the presence or absence of substitute products/services (Constantiou, 2009; Blechar et al., 2006). For example, the availability of online services at home through the Internet may defer LBS use at home. The context of use may also influence the cognitive processes involved in the choice by changing the stimuli experienced by the individual. For example, in case of an emergency, the different prices of available options for acquiring location-related information and the comparisons may be disregarded in the decision process because the immediate need for the service is more important than its cost. Consequently, a high price for the service may be accepted in the particular situation influenced by emergency (Constantiou, 2009).

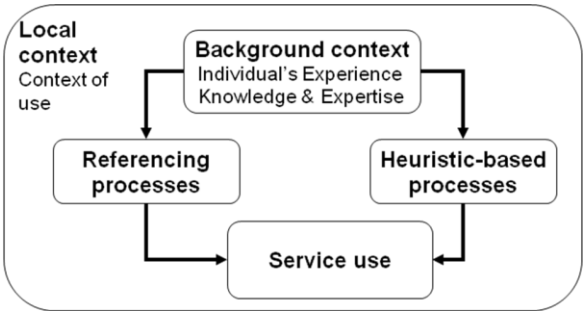

Figure 1. The theoretical framework for investigating the LBS use

3.1 Referencing processes in LBS use

Referencing processes, based on the perceptual system, are triggered by the value dimensions of a service and are reference dependent. A key cognitive process of referencing is triggered by the product or service price. Thaler (1980) introduced the concept of *transaction utility*. An individual's perception of the value of a transaction (e.g. service use) is shaped by comparing the service's actual price with the reference price, the price of the service in the "reference transaction". The reference transaction, and hence price, are influenced by both background effects, in terms of experiences and knowledge of the service attributes, as well as the local context, in terms of other options available to the individual in the specific situation. If the reference price is higher than the actual one, the individual perceives a gain (i.e. positive transaction utility) from the current service use. This in turn motivates the individual to use the service (e.g. positive decision) and vice versa. For example, if a LBS user has been using a service for free, the introduction of a price may lead to discontinuance of use.

Many LBS are offered for free. In this case, referencing processes may be activated in relation to the perceived effort of using the LBS compared to a "reference service" which constitutes the "status quo". Individuals are subject to loss aversion and thus have a strong tendency to remain with the "status quo" since the disadvantages of leaving it loom larger than the advantages. This behaviour is known as the "*status quo bias*" (Samuelson and Zeckhauser, 1988). For example, moving from a current LBS to a new service can be seen as a loss solely because of the negative subjective value of the individual having to change the "status quo" of his routines in mobile service use and put effort into developing new routines for the new service. Status quo bias may also influence the choice of a LBS that is already known to the user from another channel (e.g. Google Maps), and hence leads to a lower subjective loss, over alternative options (e.g. navigation services). In these cases the background context has a strong influence in the referencing processes and the subsequent decision of the individual (Kahneman et al., 1991).

Referencing processes are also influenced by the local context, the context of use. The value of a service may vary in different situations. Google Maps constitutes a typical example. The user may perceive the service use as very valuable when navigating in an unknown place and no other means are available to provide directions.

3.2 Heuristic-based processes in LBS use

Heuristic-based processes are based on the intuitive system of thinking. The individual choice of a LBS may be motivated by the specific context of use and can occur in an automatic and associative manner through the intuitive cognitive system. This involves the use of heuristics aimed at reducing the cognitive burden of information processing (Kahneman, 2003).

A central cognitive process in this category involves the use of the *availability heuristic* (Bazerman, 2008). An individual using the availability heuristic focuses on a specific "vivid" service's dimension, which in turn becomes the prominent reason for the choice of a specific option (Simonson and Tversky, 1992). The individual focuses on available information, which is easily accessible to her memory due to vividness. This type of information may come from the individual's experiences or knowledge about the service, the background context. For example, a positive experience with Google Maps, in which the user enjoyed finding a place easily (e.g. in less time than expected), may become a key reason that leads to the same service choice in a future situation.

The individual may also use the *representativeness heuristic* (Bazerman, 2008). This heuristic is used to simplify information processing in the decision process by focusing on representative information, rather than considering actual data and facts, a form of selective information processing. In such cases, people use stereotypic approaches to assess information as part of their decision process. Mobile users may generalise their opinion of LBS services of a specific category based on the knowledge they have for a single service in this category. For example, some "point of interest" search tools do not always display updated and complete information in specific locations (e.g. Qype, AroundMe). This low quality attribute may have a negative influence in the use of other LBS services in the same category even if the user does not know their respective content quality.

Another cognitive process involves the *affect heuristic* (Bazerman, 2008), which underlines the pivotal role of emotions in determining the prominent service dimension. The affect heuristic can be explored in services with hedonic value. For example, emotions like desire may highlight the hedonic dimension of a service and motivate its use. Alternatively, fear may also induce the use of specific LBS (e.g. being lost in an unknown area/city).

Finally, the local context has a strong influence on the activation of cognitive processes. An individual may choose to use a LBS in situations where it is the sole option or where there are multiple options available (e.g. Internet services). Depending on this context, different service dimensions become prominent. In the case of separate evaluation, the individual seeks, in an intuitive approach, an easy to understand, or a 'simple' service attribute (Hsee, 1996), which becomes the reason for making a choice (e.g. choosing a LBS with simple interface). Such a choice is more likely to be based on the use of heuristics. In the case of joint evaluations, when multiple options are available in a context of use (Hsee, 1996), the individual focuses on a more complicated dimension, since most of the services have more than one dimension. She then compares the different options and makes the choice (e.g. LBS with the highest information accuracy). Such a choice is more likely to be influenced by referencing processes.

4 Research approach

We investigated LBS use in the German mobile telecommunications market, one of the most advanced markets in Europe. In recent years there has been an impressive increase in the availability of smartphones and unit sales in Germany are expected to grow to 10.1 million in 2011 (Bitkom, 2010).

The study included two parts. First, we conducted semi-structured interviews to collect data for in-depth investigation (Lacity and Janson, 1994) of LBS use patterns. The interviewees described LBS use in their everyday life, as well as what they thought about LBS use, through open-ended questions. The interviews were conducted in German over a period of two months, and lasted between 30 and 45 minutes each. They were tape-recorded and subsequently transcribed and translated into English. The group of participants consisted of 40 people, 72% male and 28% female, covering a broad age range from 14 to 40 years, and diverse backgrounds (pupils at high school, students, or employees of private companies). Participants had been using a smartphone from 1 to 25 months. The sample was not representative of the German population, but did represent early adopters of smartphones, whose LBS use patterns we wish to investigate.

The interviews included two parts. The first part was dedicated to the general smartphone use. Following this, a definition of LBS was provided to participants, along with the example of Google Maps. The second part included questions on the LBS use: a typical situation of LBS use, the experiences of the interviewee, the alternative means available (such as the Internet or the radio) in specific situations. Participants were also asked about their reasons for using each service as well as their value perceptions in different situations and their willingness to pay. Finally, they were asked about frequency of use. These questions allowed us to collect information about the factors affecting users' cognitive processes and the context of LBS use.

Each of the authors analysed the empirical data by carefully reading and reflecting on the transcribed data, before comparing their analytical notes and resolving differences. The coding of the data was then made around the theoretical concepts/elements of the proposed framework (i.e. background context effects, local context effects, referencing processes, and heuristic-based processes) for each service. We focused on how the decision to use a specific LBS is shaped by the elements described in the proposed framework, following a pattern matching approach (Lee, 1999).

Second, we complemented the cross-sectional interviews with an event-contingent diary method (Bolger et al., 2003) in order to capture the dynamics of daily LBS use and its underlying cognitive processes. We used insights from the interviews to describe context of use, alternative means of getting location-related information and to specify measures of heuristics and referencing. The study included 16 participants and ran for two weeks. Respondents ranged in age from 25 to 35 years, were equally divided into men and women, were all employed or self-employed, and were all smartphone users. In this study we focused on young professionals and not on other groups to make sure that the

participants had a well-structured daily routine with repeated usage situations. While 16 subjects constitute a relatively small sample size, it is still appropriate for a diary study in which each person contributes in-depth data over the course of two weeks. Moreover, our aim was to gain a better understanding of the dynamic aspect of LBS use rather than to produce statistically generalisable results.

Prior to the diary survey, we met with each participant to explain how the study would proceed and how we defined location-related information. We also conducted semi-structured interviews with questions about the channels used for acquiring location-related information, channel availability in different use contexts, LBS use and experience as well as technical skills. Over the following two weeks participants were asked to fill in a diary entry every time they actively looked for location-related information (e.g. directions or points of interest nearby). Each entry was made through a brief online survey (< 2 minutes), which could be accessed through the user's mobile phone to facilitate prompt completion. The survey included three questions about the context (physical location, time, type of information needed and familiarity with the surroundings), one question about the channel choice (including LBS application, Internet applications through mobile device or PC or laptop, asking other people or car radio) and one question about the use of heuristics or referencing in the service choice. In particular, the availability heuristic was described by two items: "It came to my mind first" and "I used this channel a lot recently". The representativeness heuristic was described by two items: "It offers the best information" and "It's the most trustworthy/reliable channel". The affect heuristic was described by two items: "I just like the channel" and "I had an urgent need for the information." Finally, referencing was described by one item "After weighing the alternatives it was the quickest/easiest way to get the information." The measures for heuristics and referencing were developed by the authors based on a thorough literature review and were validated in a discussion with two domain experts (i.e. psychologists). After the diary study had been completed, a post-interview was held with each participant to assure that there weren't any content-related or technological difficulties with the diary and that the usage behaviour recorded in the diaries was representative. The empirical findings are presented in the next two sections.

5 Analysing the use of LBS

All the services used by the interviewees fall into the category of pull-based infotainment services (Schiller and Voisard, 2004), i.e. the mobile user submits a request to receive information. Push services, which provide information without an active request (e.g. location-based advertising), were not used by the respondents. Having observed the use patterns of the respondents, we present the services used in two groups based on static versus dynamic service use. The first group includes services for which the user's location during service use is (at least temporarily) static. The second group includes services that are mainly used when the user is moving. The services in this category only provide value to the user when she is moving, for example in a car or on foot, as they are meant to constantly track the user's location and provide updated information (e.g. navigation instructions). The services analysed in this study were used by at least three interviewees.

5.1 Static LBS use

This group includes services supporting information seeking about a specific location, or about arrival and departure times of public transportation means. Three service categories are analysed. The first category is of point of interest services, which provide information about the nearest restaurants, bars, banks, pharmacies or entertainment activities, available in close proximity to the user's location. The second category consists of city guides, providing information about historical, or other important buildings and places in a specific location. The third category concerns public transportation services. These services are mainly used when the user is situated in a specific location and wants to get information about time schedules and places around her.

Point of Interest Services are information services about available places around the user and constituted the most popular category. People perceived these services as particularly useful for spontaneous needs, for example when looking for a restaurant in the evening. *"LBS are good for fulfilling spontaneous needs. But if I plan to eat out with my friends or my girlfriend I think about it in advance and make a reservation." (Male, 30)*
People also used the services for time-sensitive decisions. *"I pretty much use it always when there is no time to do a lot of searching." (Female, 26)*
It seems that the point of interest services are particularly useful when the user explores new areas or looks for new places. *"I think it brings the highest value in unknown cities because in your home town you usually know your way." (Male, 30)*
Some people used the services even when other means are available (e.g. the Internet), because they perceived them as being more efficient. *"I am at home and I need the telephone number of a pizza place, which is just around the corner to order a pizza…with Around Me I get the result quicker and easier [than from Google]." (Male, 28 years)*
The user's experiences are pivotal in the use decision. Some people have positive experiences compared to other means. "*I prefer to use Around Me to look for restaurants in advance, because I can find the places quicker than through Google. When I search for 'Munich Chinese restaurant' in Google, a lot of things pop up about China, which is not relevant in this situation, or restaurants that are not in Munich." (Male, 18)*
Thus, the user compared the LBS with the other services constituting the status quo through referencing processes and chooses the LBS because of the higher perceived value in terms of ease of use, speed or accuracy of information retrieval. Despite the distinct value dimension of the services in specific situations, people do not seem willing to pay. The background context effects, from the use of similar services on the Internet for free, influence them. *"…if Around Me cost money I would get the same information through Google Maps, which is for free." (Male, 32)*
Some people indicated lack of trust in the services' accuracy and articulate negative generalisations about the service, which might be activated by the use of the representativeness heuristic. *"I used it more at the beginning. By now I prefer to ask someone in the streets, because this is often quicker… an important factor is that I don't really trust the service as I am not sure if it doesn't sometimes mislead me." (Female, 24)*

City guides provide information about specific buildings, or places near the location of the user. The services identified in this study are mainly based on Wikipedia. They are not used very frequently. The use depends on the frequency of the individual finding herself in specific contexts of use. *"I use Wikihood to kill time while waiting for a friend." (Male, 30)*
Other situations where the services were perceived as valuable involved information retrieval for social purposes. *"…I am there with guests and wanted to give them a city tour, but I didn't know much about the sights." (Female, 29)*
The users acknowledged the value dimension of these LBS compared to the Internet version in terms of targeted information about specific locations. However, they were not willing to pay for them. *"No, I don't think so, because it just connects services that are free of charge; on the one hand Wikipedia and on the other hand the localization functions." (Male, 27)*

Public transportation planners provide real-time information on arrival and departure times, and are popular services. Similar services are available on the Internet. People use the services on their smartphones when they are out because it is convenient. Participants underlined the services' value, based on previous experiences. *"The app can locate me and then it shows me perfectly visualized how I get from A to B with Berlin public transportation. That's a great app." (Male, 34)*
People described different situations in which the services were valuable. The ordinary situation of use involved planning to go somewhere by public transport. *"I use the app when I am at work or at a friend's place and it starts raining and I don't feel like going home by bike. Then I look what the next and best ways are to get home with public transport." (Female, 29)*

They also used the services when making a time-sensitive choice on transportation means. *"I am on my way somewhere and I wander if I catch the last subway around the corner in order to get back home. Or if I can use a bus instead, of which I don't know yet." (Male, 28)*
Overall, static LBS were valuable to the users in specific contexts of use where users were seeking information on their surroundings. This value enabled them to move away from the status quo in certain situations, and to use the services instead of those available on the Internet. However, the strong influence of the background effects through the free Internet use of similar services hindered the users' willingness to pay. For point of interest services, the users seemed to have their favourite service, and generalised about its good performance in line with the representativeness heuristic. Further, in some cases they used referencing to compare the effort it takes to get the information. Users' decisions to use public transportation planner were either made through referencing processes, in a comparative mode focusing on the accuracy of information provided, or in an emotional state of need or urgency which triggered the affect heuristic.

5.2 Dynamic LBS use

This group includes four service categories. These categories involve map services supporting navigation, traffic monitors, radar detectors of installed speed controls and services providing information on a user's running activities. Such services are mainly used when the user is moving (e.g. in a car or on foot).

Mapping and navigation services were the most popular LBS category, used by nearly all the respondents. The main advantage of these services is the provision of precise navigation instructions to the user while on the move. Maps services are also available on the Internet (e.g. Google Maps). For some people they were an important reason to buy a smartphone. We observed a strong background effect from the service use on the Internet, as people were already familiar with the functionalities and the value of online mapping and navigation services. *"Before I used Google Maps on my iPhone I used it through the stationary Internet, because in my opinion it is the best maps service." (Male, 26)*
People highlighted the services' value in specific situations compared to other means providing similar services. *"Before Google Maps mobile you had to look up and print out the route at home. With the mobile app, finding routes is a lot more efficient and time-saving." (Male, 27)*
People described positive experiences with this service category in unknown areas where they had to find directions. The availability heuristic seems to have been a strong determinant of the service use. *"I completely got lost in Hamburg and thought I either pay a taxi or I find the right direction in any other way. Then it crossed my mind that I've got Google Maps on my phone. It really rescued me in that situation!" (Female, 26)*
Some people had moved away from the status quo and were now treating the use of mapping and navigation services on the smartphone as a new status quo. *"Today I don't even look up directions in advance anymore, because I know that I've got the iPhone with me." (Female, 26)*
People were willing to pay for these services due to underlying value dimensions and the high frequency of use. *"If Google Maps wasn't preinstalled, I could imagine paying for it, because the service offers a great added value and is very helpful in a lot of situations. I use Google Maps very often, a couple of times per week, nearly daily." (Male, 27)*

Traffic monitors were not used very frequently, but mainly when people wanted to know whether there was high traffic on the highways. The respondents compared the services' convenience of information acquisition with the car radio. *"Some Autobahns [motorways] are notorious traffic jam routes, in such situations I don't want to rely on the radio, because the announcements are over very quickly." (Male, 40)*
The time-sensitive information provided by the services, which in turn affects the user decision, was another key dimension for the service use. *"I use the app in this situation, because it can save me time. I could also use the radio, but the information is available only temporarily and when you don't know the area you often do not know which streets are relevant." (Male, 26)*

The users seemed to use referencing processes and compare traffic monitors with other available options. This category had a well-defined value dimension in specific situations compared to other means and users were willing to pay a small amount (ranging from 0.79 to 2 Euros) for such services.

Radar detectors were not frequently used. They were mainly used when people were following routes known for speed controls, and/or they were in a hurry. *"I don't use it very regularly, but once in a while when I drive a longer distance or on streets known for radar controls." (Female, 29)*
"If I am late and I roughly know where I am going, I prefer the radar." (Female, 26)
There was disagreement between interviewees' perceptions of the services' value, because of their limited potential in providing location-based information (e.g. most services can only locate installed speed controls). Interviewees had mixed experiences. They were either unable to identify the service's value or they seemed pleased with its reliability. Some interviewees could imagine paying for this service category if it was further developed.

Running applications were used rather frequently. Similar services are available on the Internet, allowing people to measure the distance of specific routes (e.g. Gmaps Pedometer). With a LBS users can automatically record their route and their performance during activities such as running. The users identified the value of services that provide useful information about their sports activities. *"Run Keeper is very good and I like to use it, because I get a lot of information on my running."(Male, 30)*
People also compared different options available on the Internet and found additional value dimensions in the LBS. These services offer added value for the user, compared to her current situation, and they motivated the move from the status quo. "*But compared to Gmaps Pedometer it has the advantage that it works automatically and I don't need to enter my route manually." (Male, 28)*
Interviewees were willing to pay small amounts (ranging from 1.5 to 3 Euros) for the services.

Overall, the dynamic LBS were valuable to the users, and they often reported positive experiences and a willingness to pay for them. The services' value motivated users to move from the status quo, which in many cases is represented by an Internet service or the car radio.

6 Cognitive processes influencing LBS use

Over the two weeks of the diary study, participants reported a total of 104 instances in which they looked for location-related information. The number of instances per participant varied between 1 and 19. The results show that when looking for location-related information, users mainly searched for navigation information as well as for addresses and telephone numbers, weather information and arrival and departure times of transportation. There was a strong tendency for people to use their smartphone over other channels to acquire location-related information. LBS were mainly used when people were on the move, either by foot, bike or car, (45% of instances), followed by use at home (26% of instances). Interestingly, LBS were the preferred channel in all contexts of use, even when other channels were available. For example, at home or at work, people chose to use LBS on their smartphones over a PC or laptop.
On their smartphone, people clearly preferred specialized LBS apps instead of searching for information through the mobile Internet browser. In 60% of instances people chose LBS, in 16% they chose the mobile browser and in 10% the stationary Internet. The remaining instances involved use of the radio, the car navigation system and asking other people nearby.
When choosing a channel to access location-related information, users acted largely intuitively (80% of instances) based on heuristics. The availability heuristic was most prominent in all usage situations. In 41% of situations, people chose the channel that came to their mind first, or had been used a lot recently. In contrast to the theory, this was also true in contexts of use in which more than one channel was available (i.e. in a joint evaluation mode). The results indicate that the individuals hardly ever compared the different options available, but instead acted in a habitual way by choosing the service they always use. The experienced smartphone users (i.e. over one year of device use) mainly used the availability heuristic (47% of the instances). The novice smartphone users (i.e. less that one year of

device use) used both the availability and the affect heuristic. The representativeness heuristic was not used frequently. However, the experienced users used it more often than the novice users. Both users types also used referencing processes on some occasions (23% of instances).
Turning to specific LBS use, weather applications were mainly used at home and public transportation services were used equally in all usage situations. Mapping, navigation, weather and point of interest applications were mainly used due to the availability heuristic. The use of traffic information services was mainly triggered by the affect heuristic, suggesting that the services were used in situations with an urgent need for traffic jam information. In case of public transportation services, representativeness, availability and referencing processes were all equally used. Users weighed the options available according to how fast and easily they provided information. Additionally, users of this service category underscored information quality and service reliability.

7 Discussion

The study focused on LBS use by investigating users' cognitive processes leading to service choice. We introduced a theoretical framework to investigate a new research topic, namely LBS use. This topic could not be investigated earlier because of market characteristics (i.e. various technical challenges constraining the services availability). Motivated by current market opportunities leading to the widespread availability of LBS, we focused on users' decisions to use a service in specific contexts. We argue that existing adoption models are not the adequate research tools for this type of investigation because they have a different focus, namely the adoption decision. While we do not claim that technology is not an important element in the use of LBS, we argue that the use of LBS is more a technology-*enabled* than a technology-driven decision. Most smartphones have user-friendly interfaces and the applications provided build on Internet service use experience (e.g. Google Maps).
We introduced a new theoretical framework, based on insights from behavioural decision-making. This framework enabled us to analyse the influence of context of use, which is prominent in LBS use, as well as the user decision process when choosing a service. By focusing on the underlying cognitive processes, we highlighted the importance of the value dimension and heuristics in LBS use. The proposed framework was a useful tool in the investigation of LBS use and might be used to complement existing models in the domain of IS adoption and user behaviour.
The empirical findings of our research highlight interesting characteristics of mobile user behaviour that should be acknowledged and addressed in the marketing strategies of interested parties. The LBS use patterns indicate that popular services are related to information seeking and acquisition. It seems that most features of LBS are also available on the Internet. This in turn underlines the background context effects, especially for services that are frequently used on the Internet. There are positive influences on LBS choices, which can be seen through the use of the availability heuristic in the choice of LBS if the user has had a positive recent experience in using a similar Internet service (e.g. Google Maps).
The background context effects on the referencing processes are more complicated. The use of Internet services sets a status quo for users who seek extra value from the LBS use in order to include it in their use patterns. Thus, Internet services influence the users' perceived value of LBS. Additionally, in terms of pricing, the availability of free services through the Internet hinders the pricing opportunities for some LBS. However, new situations of service use (i.e. while on the move) create new pricing opportunities, as there is no direct substitute and thus no "clear" status quo for the user to compare the LBS with.
Local context effects are marked by the specific situation or context of use. For time-sensitive information needs, while on the move, people highly appreciate the positioning functionalities and the information accuracy of LBS. In many cases participants described LBS use as the outcome of a heuristic-based process. For example, the use of navigation and mapping services covers the need for instant information, which is intuitively required in order to make another decision (about the choice of a route). For static LBS use, the local context effects motivate the use of heuristic-based processes. Interestingly, when other options are available, such as in the home, users in the diaries study indicated a shift from the Internet as a "status quo" to LBS. It seems that users mainly choose LBS as

part of a habitual pattern when they find themselves in well-known contexts of use. This finding needs further research in order to identify the substitution effects and the new trends in channel conflicts.

8 Conclusions and further research

We set out to explore current LBS use as enabled by the current availability of smartphones. We proposed a theoretical framework describing the use of LBS in relation to cognitive processes, which has as a point of departure the perceptual and the intuitive cognitive systems. The framework enabled us to analyse the use of LBS in specific contexts and to identify the value dimension for users. The proposed framework contributes to research of user behaviour in the IS field by providing a new tool for analysing user choice based on insights of behavioural decision-making. The framework approaches the user as a consumer of services in different contexts of use where other options may or may not be available. As such, it underscores cognitive processes in decision-making rather than technology perceptions and beliefs. The research findings offer insights for practitioners into LBS use patterns. The findings underline marketing opportunities for the LBS developers, particularly in terms of pricing strategies. However, market players should interpret our findings with some caution, since our respondents were mainly using services available through Apple's App Store.

The diary study is subject to two limitations. First, there may be missing data. Even though participants stated that they filled in the entries reliably, they may have forgotten to record entries (e.g. because they were not aware that they were looking for location-related information) or were selective in reporting (e.g. because they thought some events were not important enough to report). Second, although a comparison of the electronic time-stamps of the diary entries and the time of channel choice stated by the participants showed that the majority of entries were made within an acceptable time span of one hour after the channel choice took place, a few entries were made within two to three hours after the channel choice. Those instances may have decreased reliability, since users might not have recalled the use situation and the exact process leading to their specific LBS choice.

Future research efforts should focus on testing the explanatory power of this framework for the use of LBS through a large-scale quantitative study, or longitudinal studies of smartphone users' behaviours, and sampling techniques that allow the estimation of the general population trends should be applied. Moreover, the theoretical arguments should be put under scrutiny and should be developed further to include the specific characteristics of communications markets such as network effects. Finally, we believe that the proposed framework can be used to analyse and predict the user behaviour in other digital services markets.

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