

A Diary Study of Understanding Contextual Information Needs during Leisure Traveling

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ABSTRACT

The lack of knowledge about users' information needs will likely impede the applicability of mobile applications to more effectively support users' contextual search behavior. In this paper, we present results from a well-conducted diary study that aimed to learn persons' mobile information needs during their leisure traveling. The analysis of above 200 diary entries of subjects' information needs interestingly suggests question types, intents and topics that these needs exhibited. Moreover, the study reveals respective roles of different context factors, such as location, time and activity, in influencing and prompting users' information needs. Design implications are concluded at the end to show the insights of this study to improve current mobile services.

Categories and Subject Descriptors

D.3.3 [Information Systems]: Miscellaneous

General Terms

Experimentation, Human Factors.

Keywords

Contextual factors, mobile traveling, diary study, information needs, association rule mining.

1. INTRODUCTION

With the popularity of ubiquitous mobile applications that enable users to access Internet on the move, many researchers have been engaged in developing intelligent information seeking aids (such as mobile recommenders [9]) in order to be sensitive to users' contextual environments. In particular, multiple techniques specific to the tourism domain have been implemented, given that tourists usually need much more information to navigate, learn and perform situated actions. For instance, Hinze *et al.* have designed a system called TIP that considered a wider context of the sights [6]. Laporte *et al.* suggested guidelines and a task hierarchy for a mobile tourist guide interface due to users' limited attention capacity and the great variety of tasks that they need to perform on their trips [8]. Schering *et al.* proposed a strategy of combining mobile tourist assistance, recommendations and tourist community management on the top of complex networks [11].

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To date, there have been also studies that examined mobile search behavior [7], while most of related analyses were purely based on users' action logs when they interacted with a specific system, without capturing their actual information needs. Indeed, few studies have in depth explored what types of information users do require when they are in the leisure traveling situation and what contextual factors (e.g., time, location, activity) will more likely prompt their need desire. Thus, we believe that finding answers to this question can not only contribute to filling in the vacancy, but also suggest implications to develop more personalized context-aware mobile tools so as to support travelers' true needs within their current contexts.

We have hence adopted a qualitative method of dairy study to obtain the info at the spot, by asking fourteen users to record their information needs during their average eleven journey days. Our goal was to understand the topics that their needs may cover, and also all possible kinds of contextual factors that may prompt the needs and their impacts on users' intent behind. In the following, we will introduce how the study was conducted and how the results were analyzed from these aspects.

2. METHOD

2.1 Dairy Study Design

The diary study is a longitudinal method that allows self-reporting of specific aspects of users' natural behaviors and thoughts. The study method has been used in social network researches and mobile studies [2, 5, 10]. In the study, each participant was usually required to record the date and time of an event, her/his location or context, and information about the event.

The reason of why we chose this method is because travelers' activities can take place in various places and time, so it is difficult to conduct direct observations of their contextual behavior. In this regard, although some related works have also employed similar approaches to understanding users' mobile information needs [4,12], they have been mainly performed in users' normal life (when users were at home, at work and on the commuting), without the particular addressing of the travelling life with respect to its most influential contextual factors. As a matter of fact, [4] has indicated that the geographical factor is the second stronger intent (following the informational intent) behind users' mobile information needs during their daily life. We were hence interested in seeing whether there are any differences between mobile traveling and daily life respecting such kind of information intent.

To launch the study, we have prepared a paper notebook for each participant. It facilitated the user noting down any information needs that s/he thought to be sufficiently important to record,

regardless of whether s/he knew how to address it at that moment. Examples of the information needs were attached at the first page of the notebook for the reference, along with questions enquiring about specific context factors that were related to each need: "When did you have this information need?" (i.e., time), "Where were you?" (i.e., location), "What were you doing when the need arose?" (i.e., activity), and "Why did you have this information need?".

2.2 Participants

The criterion of selecting participants for the study was that they planned to take a journey for at least four days. We have finally recruited 14 persons (7 males and 7 females) who were prepared to have a leisure travel to some places (away from their residence regions) at the time of our experiment. Their average age is 24.93 (ranging from 20 to 50, SD = 7.69). They are all Chinese, but from different professions (e.g., student, software developer, accountant, electronic engineer, sales manager, factory worker, etc.). They all have mobile phones and have daily experiences with standard facilities such as phone calls and short messaging services (SMS). 11 of our users stated that they often used mobile phones to access internet (e.g., reading news, receiving/sending emails, and looking up addresses).

Before the diary study formally started, a consent form was signed by each participant and the administrator briefed her/him on the study's objective. A pre-study survey followed to gather the user's mobile phone experiences. Within the diary study, the user was allowed to write down information needs later in that day, in the case that s/he was unable to or forgot when the needs arose. We also sent a reminder to each participant every two days via short messaging. While collecting their diaries at the end, we asked participants to clarify any unclear entries.

3. RESULTS

This study finally collected 204 valid diary entries with average 14.57 entries per user (max= 30, min = 6, SD = 6.68). The study length varies from 5 days to 17 days (mean = 10.6 days, SD = 4.52) among the users, given their different journey durations. For each recorded entry, we mainly analyzed its need content and contextual factors.

3.1 Information Needs

As for the information need content, it was analyzed from three aspects: the question type, the intent and the topic.

3.1.1 Question Types

Since each need is in nature a question asked by the user with the objective of getting the answer, we first identified the question type it indicates. Overall, eight types were observed from our users' diary entries: yes/no, where, how-is, how-to, what, why, when, and choice question. Figure 1 shows entries' distribution w.r.t. these types. We can see that most of questions belong to "where" type (32.8%) requesting for a location (e.g., "Where is the nearest Bank of China?"). The entries with types "yes/no", "what" and "how-to" were nearly equally distributed (19.6%, 16.7%, and 15.2% respectively), for which the typical examples are: "Can my mobile phone receive signals on the plane?", "What is the special event in Lijiang old city?", and "How to take good photos in the evening?".

For the other question types (i.e., "how-is", "why", "when", choice question), although the associated entries were relatively less, there are still certain percents (5.9%, 4.4%, 3.9%, and 1.5% respectively). For example, "How is the weather today?", "Why can we see the eclipse?", "When will my friend come here?" and "Which transportation tool is better to go to the Yulong snow mountain, train or plane?"

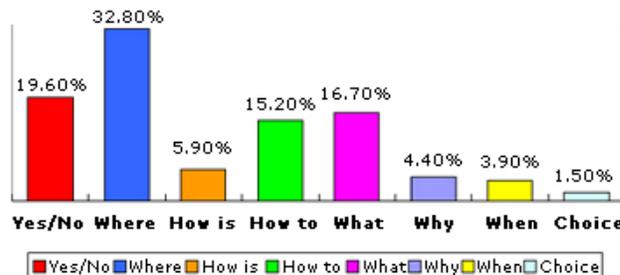


Figure 1. Classification of diary entries by question types.

The revealing of questions types as expressed by users in their information needs can be hence suggestive to related works on the design of more intelligent mobile interfaces to acquire users' desired queries and even suggest questions that users are more likely to ask. Moreover, we analyzed the context info involved in these questions. For instance, one diary entry is "Is there local event this afternoon?" where time (i.e., "this afternoon") is the explicitly mentioned context in this question. In total, 80% of entries include the contexts, for which the location (e.g., sight, street, city, or country) occupies the majority (53%), followed by the activity (17%) and the time (10%).

3.1.2 Intents

The understanding of question types drove us to further discover the intent/goal behind users' information needs. [4] has classified the intents into three groups: *informational intents* that aim at obtaining general information about a topic or something that are more open-ended; *geographical intents* that are to find an location or direction either explicitly or implicitly related to the current location; and *personal information management (PIM)* that is with the goal of finding out something private relevant to the person. After encoding all collected information needs in respect of these three categories, we found that around 60.5% were with geographical intents, among which 53.72% were explicitly dependent on the current location (e.g., "Is Xitang old town nearby?"), 26.28% were implicit (e.g., "Where is Cuihu hotel?") and 20.00% were needing for directions (e.g., "How can I get to the train station?"). The remaining 34.8% needs were targeting at general information (i.e., informational intents), such as "Is it harmful to watch the eclipse without special glasses?", and 4.70% were with the need of managing personal information (i.e., PIM of bank account, contact list, etc.). Table 1 lists this distribution and compares it with the results from [4] that mainly classified users' diary entries under this scheme during their normal daily life. In [4], the informational category occupies most of entries, whereas in our leisure travelling condition, the geographical intent is the dominant one, which hence suggests that in the traveling life, the location-sensitive information will be more likely required by people. This comparison result motivates us to conduct more user studies in the future to validate the difference.

Table 1. Classification of diary entries by intents.

Intent	Traveling life	Daily life (refer to [4])
Informational	34.8%	58.3%
Geographical	60.5%	31.1%
Local explicit	32.5%	12.8%
Local implicit	15.9%	14.8%
Directions	12.1%	3.5%
PIM	4.7%	10.6%

3.1.3 Topics

Regarding actual topics that were covered by these diary entries, eighteen topic categories were discovered from analyzing the information needs. The top category is General Information (GI) (23.04%), e.g., “Why is this place’s river pollution so severe?”. The following five topics that take totally 53.91% of all entries are about restaurant, sight, shop, hotel and transportation, such as “How is this restaurant?”, “Where is Qingcheng mountain?”, “Where is the nearest supermarket?”, “Where is Qingdao hotel?”, and “When will the train come?”.

The remaining topics are with less entries (23.05% in total), consisting of various concepts, such as weather, person, email, news, communication, bank, café, contact, price, movie, etc. Table 2 concretely lists the number of entries and the number of users who reported for each main topic.

Table 2. Classification of diary entries by topics.

Topics	Number of entries (% of all entries)	Number of users who reported (% of all users)
General info	47 (23.04%)	14 (100%)
Restaurant	33 (16.18%)	14 (100%)
Sight	24 (11.76%)	14 (100%)
Shop	19 (9.31%)	10 (71.43%)
Hotel	17 (8.33%)	13 (92.86%)
Transportation	17 (8.33%)	9 (64.29%)
Point of interest	14 (6.86%)	10 (71.43%)
Weather	14 (6.86%)	7 (50.00%)
Person	4 (1.96%)	2 (14.29%)
Others	Email, news, communication, bank, café, contact, price, movie, each is with 3 or less entries	

3.2 Contextual Factors

As mentioned in the experiment design, four extra questions were asked for each need in order to obtain contextual factors when the need arose. Specifically, two questions were about the objective situations including the location and the time, and two (e.g., “Why did you have this information need”) were with the aim to in depth examine which factor(s) primarily caused the need

3.2.1 Objective Contextual Factors

“When did you have this information need?”

“Where were you?”

Our analysis of users’ answers to the above two questions shows that more than half of information needs arose in the afternoon from 12:01 - 06:00 pm (51%), 37% were in the morning (06:01-12:00 am) and 12% were in the evening (06:01 pm - 00:00 am) (see Figure 2 left). Regarding the location, it indicates that most of information needs (47%) were activated when users were in **sightseeing**, implying that the location of sight spots will be more likely triggering a traveler’s information seeking need (see Figure 2 right). The second frequently noted location was **transportation** (28%), that is, some users had the information

need when they were in the airport, bus station, wharf, or on the move. The remaining 25% were in **accommodations**, such as hotels and friends/relatives’ houses as specified by users in their diaries.

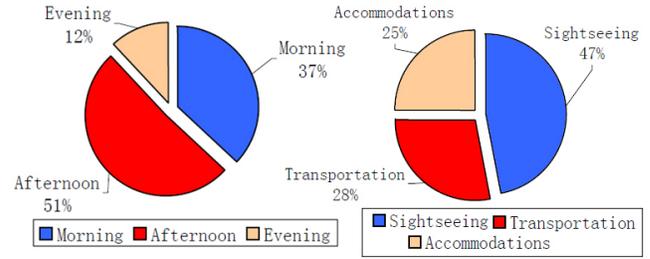


Figure 2. Classification of information needs by objective context factors: time and location.

3.2.2 Influential Contextual Factors

“Why did you have this information need?”

“What were you doing when the need arose?”

For the next step, we were interested in identifying whether these contextual factors (e.g., location, time, or both) essentially prompted the need, with users’ noted replies to the above two questions. The correlation analysis showed that around 74% of diary entries can be explicitly correlated with objective contextual factors, while the other 26% did not exhibit obvious relationship (see Figure 3 left).

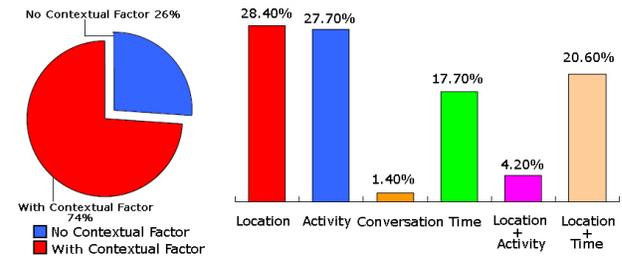


Figure 3. Percentage of diary entries that were influenced by contextual factors and these factors’ respective impact powers.

We subsequently classified all discovered influential factors into six categories: location, time, activity, conversation, location+time, and location+activity. Figure 3 (right) shows the distribution of these factors. From it, we can see that the location was most influential (28.4%), which is immediately followed by activity (27.7%), location+time (20.6%), and time (17.7%). The causal effects from location+activity and conversation were relatively less (respectively 4.20% and 1.4%).

Typical examples of information needs as influenced by these contextual factors are: “How can I go to the Hongqiao airport from where I am?” (influential factor: location, because the user’s current location led to this information need), “When will there be sunset?” (influential factor: time, because it was the late afternoon when the user asked the question), “Is there traffic jam ahead?” (influential factor: activity, because the user was driving on the road when the need was initiated), and “Why is the lobster so cheap here?” (influential factor: conversation, since the participant was talking to his friend about this topic at that

moment). The other two factors, location+time and location+activity, represent the combinative effects of either location & time, or location & activity. For example, one participant noted “*Is there a hotel nearby?*” which was found to be impacted by both time (it was in the evening) and his current location.

3.3 Association Analysis

Besides the above analyses on individual aspects, we have finally adopted the association rule mining technique in order to reveal the prominent associations between objective contexts, influential contexts, and information intents. Specifically, we applied the Apriori algorithm since it has been a successful tool to retrieve the association rules among users’ shopping transactions [1]. In our case, each entry is a transaction and we manually tagged it with the classification results from 3.1 & 3.2. The aim was hence to see under what objective context environments, which contextual factors will likely prompt users to have some specific intents of obtaining information. Table 3 lists the top three frequent tag sets with higher support values (“support” means the percent of entries that satisfy the association rule).

The ranked first association rule indicates the combined effect of “afternoon” and “sightseeing” on activating the *geographical intent*. That is, 6% of entries support that when users are in such circumstances, they will be prompted by both the time and location in order to obtain the geographical info. The second and third rules give two alternative associations from contexts to *informational intent*: one was without the contextual influence though in the situation of “afternoon” and “accommodation”; another was with the influence of “activity” when in the “afternoon” and “sightseeing” to get general information.

Table 3. Most frequent associations (and supports %) between context variables and users’ information intents.

	Objective context		Influential context	Intent
	Time	Location		
1 (6%)	Afternoon	Sightseeing	Location+time	Geographical
2 (4%)	Afternoon	Accommodation	Nil	Informational
3 (4%)	Afternoon	Sightseeing	Activity	Informational

4. IMPLICATIONS AND FUTURE WORK

In this paper, we presented the results of a diary user study, aiming at understanding users’ contextual information needs when they were in leisure traveling. The study’s results indicate the roles of different context factors (e.g., location, time, activity) in influencing and prompting travelers’ information needs. In particular, we have found that the majority of needs in the traveling life were with the goal of obtaining geographical information, which phenomenon was interestingly found to be different from the normal daily life’s observations reported in [4]. The results also suggest that the location-sensitive mobile services can be particularly useful when users are in sightseeing, transportation or accommodation (i.e., three location contexts where the needs were frequently prompted). In addition, this paper discovered frequencies of question types (i.e., where, yes/no, what, how-to, etc.) that were expressed by users in their

information needs. These results can be hence suggestive to the design of intelligent mobile interfaces to facilitate query inputs of users. As additionally implied by the association rules between contextual factors and users’ information intents, the findings will be further applicable to the development of dynamic mechanism to recommend users’ needed answers at the spot.

Motivated by this diary study, we will be engaged in extending our previous work on travel maps [3] to accommodate the above suggested implications. Our context-sensitive mobile interfaces will be targeted to take full advantages of location, time, activity and preference-based contents, to meet users’ actual information needs. In our future work, we will also continue the association analysis through the collection of travelers’ information needs in order to identify more prominent rules.

5. REFERENCES

- [1] Agrawal, R., Imielinski, T. and Swami, A. 1993. Mining association rules between sets of items in large databases. In *Proc. ACM SIGMOD*, 207–216.
- [2] Axup, J. and Viller, S. 2006. Sampling Mobile Opinion: A Contextual Postcard Questionnaire Study, Technical Report. University of Queensland.
- [3] Chen, L. and Pu, P. 2009. Critiquing-based map information seeking. In *Proc. IHCI’09*, 218-222.
- [4] Church, K. and Smyth, B. 2009. Understanding the intent behind mobile information needs. In *Proc. IUI ’09*. ACM, 247-256.
- [5] Dearman, D., Kellar, M., and Truong, K. N. 2008. An examination of daily information needs and sharing opportunities. In *Proc. CSCW ’08*, ACM, 679-688.
- [6] Hinze, A and Buchanan, G. 2005. Context-awareness in mobile tourist information systems: challenges for user interaction, In *Workshop on Context in Mobile HCI’05*, Salzburg, Austria.
- [7] Kamvar, M. and Baluja, S. 2006. A large scale study of wireless search behavior: Google mobile search. In *Proc. CHI ’06*, ACM, 701-709.
- [8] Laporte, L., Eyckerman, P., and Zaman, B. 2009. Designing a mobile task based UI for tourists. In *Proc. MobileHCI ’09*, 1-2.
- [9] Nguyen, Q. N. and Ricci, F. 2008. Long-term and session-specific user preferences in a mobile recommender system. In *Proc. IUI ’08*, ACM, 381-384.
- [10] Nylander, S., Lundquist, T., and Brännström, A. 2009. At home and with computer access: why and where people use cell phones to access the internet. In *Proc. CHI ’09*, ACM, 1639-1642.
- [11] Schering, A., Dueffer, M., Finger, A., and Bruder, I. 2009. A mobile tourist assistance and recommendation system based on complex networks. In *Proceeding of the 1st ACM international Workshop on Complex Networks Meet information & Knowledge Management*, ACM, 81-84.
- [12] Sohn, T., Li, K. A., Griswold, W. G., and Hollan, J. D. 2008. A diary study of mobile information needs. In *Proc. CHI ’08*, ACM, 433-442.

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Motivation

Recently, many researches have been done on intelligent information seeking aids in order to be sensitive to users' contextual environments, especially in the tourism domain. However, most of related analyses were purely based on users' action logs when they interacted with a specific system, without capturing their actual information needs. Thus, we conducted a qualitative method of diary study that aimed to learn persons' mobile information needs during their leisure traveling.

Dairy Study Design

We have recruited 14 persons who were prepared to have a leisure travel to some places for at least four days at the time of our experiment. They are all Chinese aged from 20 to 50 and from different professions. We have prepared a paper notebook for each participant to note down any information needs and contextual factors that were related to each need:

"When did you have this information need?"
"Where were you?"
"What were you doing when the need arose?"
"Why did you have this information need?"

Results Analysis

This study finally collected 204 valid diary entries with average 14.57 entries per user. The study length varies from 5 days to 17 days among the participants. For each recorded entry, we mainly analyzed its need content and contextual factors.

Information Need Content

Classification of diary entries by question types



Overall, eight types were observed from our users' diary entries: yes/no, where, how-is, how-to, what, why, when, and choice question.

Classification of diary entries by intents

Intent	Traveling life	Daily life (*)
Informational	34.8%	58.3%
Geographical	60.5%	31.1%
Local explicit	32.5%	12.8%
Local implicit	15.9%	14.8%
Directions	12.1%	3.5%
PIM	4.7%	10.6%

(*) Church, K. and Smyth, B. 2009. Understanding the intent behind mobile information needs.

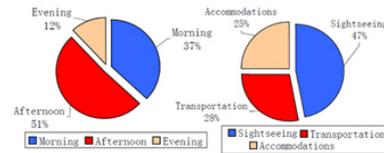
There are three groups of intents: informational intents; geographical intents; personal information management (PIM). The geographical intent occupies most of entries in traveling life which is different from that in normal life.

Classification of diary entries by topics

Topic	Number of entries (% of all entries)	Number of users who reported (% of all users)
General info	47 (23.04%)	14 (100%)
Restaurant	33 (16.18%)	14 (100%)
Sight	24 (11.76%)	14 (100%)
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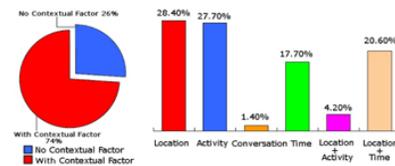
Contextual Factors

Classification of information needs by objective context factors: time and location



Time indicates morning, afternoon and evening. Location indicates users' positions: sightseeing, transportation and accommodations.

Percentage of diary entries that were influenced by contextual factors and these factors' respective impact powers



74% entries are affected by contextual factors. These influential contextual factors can be divided into six categories: location, time, activity, conversation, location+time, and location+activity.

Conclusion

The study results show the roles of different contextual factors in influencing and prompting travelers' information needs. We also find the goal of obtaining geographical information occupies the majority of these needs. Motivated by this diary study, we will extend our previous work on travel maps and design new context-sensitive mobile interfaces.