

# “Need to Know”: Examining Information Need in Location Discourse

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**Abstract.** Location discourse involves the active or passive sharing of location information between individuals. Related applications include mobile friend locators, and location-dependent messaging. Privacy issues pertaining to location disclosure have been considered in research and relevant design guidelines are emerging, however what location information a user actually “needs to know” has received little systematic analysis to date. In this paper we present results from a questionnaire study and a diary study considering location information need. We provide a classification of location discourse and the factors which impact location need, showing that seemingly small changes in a scenario can yield drastically different location information needs. Finally, we summarize trends that are of interest to designers of location discourse applications.

## 1 Introduction

Location discourse, or sharing location-related information, is part of our daily lives. We often need to know where others are or will be in order to coordinate our own activities. People commonly establish one another’s location during mobile phone conversations [19], in human centric terms [20]. Sharing location information often leads to an action (e.g. meeting up) or decision making (e.g. asking a favor), but can also simply provide contextual information that helps to frame a conversation. Increasingly, applications to support location discourse of one type or another are being designed and evaluated in research labs and in industry.

In this paper we define a *location discourse application* to be any application in which location plays a direct communicative role, whether it is purposeful or incidental in nature. This communication may be synchronous (live), or asynchronous (messaging), or even indirect (via an established protocol to automatically disclose location information). Such an application might facilitate organizing groups of people without requiring individual phone calls, give an indication of a contact’s availability before one decides to call, or simply augment a phone conversation with

photo sharing. There exists a significant body of work examining various styles of location discourse application, including [6, 8, 10, 17]. Privacy issues, in particular, have been a central concern for location-awareness applications, examining issues such as what a person is willing to disclose about their location [8].

Despite the large amount of research on location discourse applications, there has not been a systematic analysis of *information need* (i.e. “what a person actually needs to know about another’s location”). Information need (or desire) is an obvious counterpart to information disclosure. As shown in previous work, a person’s perception of another’s information need is an important determinant of what they will disclose [2]. This phenomenon—assessing what information the receiver in a conversation needs—is known in conversation analytic terms as “recipient design” of an utterance [2]. Establishing information need can assist individuals when making decisions about disclosure, and can assist designers when developing applications that involve sharing of location information. If we understand location discourse from the perspectives of both the requester and discloser, we will be in a better position to develop applications that provide real value without imposing undesirable demands on either user. Consider the following mismatched example:

*Eve’s husband only needs to determine whether she has left work to pick him up. Providing him with a detailed map of her office building showing the exact room she is in is irrelevant and will make it difficult for him to quickly answer his question. In addition, if Eve’s husband sees that she is no longer in her office building (when she is actually at a meeting elsewhere), he may assume that she has left to pick him up. In this instance, the system led to misinterpretation and a very frustrated spouse.*

As with other applications that provide location information (such as navigation systems and tour guides), information need in location discourse is influenced by such factors as someone’s prior knowledge of an area, and their activity. The social element of location discourse adds further complexity, introducing expectations and interactions that can greatly influence need. For example, when checking on Alice’s availability to discuss some current work, does Frank really care to know where she is precisely located in the city, or that she is grocery shopping? If Bob is upset because Alice is late for a dinner he prepared, does he want the same or a different kind of location detail than when he’s lost during a family canoe trip?

Users may be willing to accept location information that is not explicitly tailored to their current situation, if that information is *appropriate* to the task they are trying to accomplish. One motivation for the work presented here is to understand when too little, too much, or inappropriate location information impedes our ability to accomplish tasks and support our relationships. In the study presented in this paper, we examine information need in location discourse using a questionnaire that presents contextual *moments* of location exchange. By varying aspects of context concerning *activity, location, relationship, and emotional state*, we begin to identify how various facets of these broad contextual dimensions can impact location information need.

## 1.1 Contribution

This paper presents a systematic, in-depth examination of what location information is needed (and preferred) by a requestor, depending on the context of the request. Context is examined in terms of *activity*, *location*, *relationship*, and *emotional state*.

The results of this study clearly demonstrate that these dimensions, while interrelated, can be used to help focus an analysis of location information need. Further, our results have yielded several key observations that can help reduce the complexity of this problem space and that are relevant to designers of location discourse applications. The results also show that the design issues presented by location information need are not always the same as those presented by location information disclosure.

## 2 Background

A variety of location-based services have been considered by the pervasive computing research community. These have been designed to support a range of needs, including facilitating interaction within our environment [1], our social communications [3, 8, 10], and our community [6], or benefiting people with disabilities [12]. These services provide contextual information that *context consumers* (i.e. friends, tourists, workers) use to assist decision making. Typically, the focus of context-aware computing has been on location because of its usefulness in a social context [6, 8]. Beyond physical location, activity at a location (e.g. in a meeting) has been shown to be useful for determining availability and providing awareness [8]. However, location is sensitive information [11]. Previous research [2, 7] has shown that there are numerous considerations that influence location disclosure, the most significant being the relationship [2, 11, 15] between the sender and receiver. Consolvo et al. [2] have shown that beyond relationship, location disclosure is additionally dependent on what information the user perceives as useful to the location requestor. Our research reveals a similar concern for the information discloser on the part of the location requestor.

The dominant methodological approach for examining social location discourse applications has been the user study [8, 9, 12, 14-17]. The majority of location applications are designed to fulfill a presumed location need given a specific context such as rendezvousing, or benefiting social interactions. Location applications such as WatchMe [14], often run pilot studies to explore the design features that should be incorporated within their system. Additionally, projects like Guide Me [12] use experience prototypes to refine the information presentation to their users. There have been a number of niche popular commercial location applications [4, 13] used to facilitate social interaction. Applications like Dodgeball [4] provide a tailored service benefiting a specific task, but are limited as a robust general purpose social location system. Information discourse between users is limited not only by the system itself, but by their prevalent medium, mobile phones.

It is important in the design of location discourse applications to consider information need not only from the perspective of the location discloser [2] but also that of the location requestor. Designers explore the usability of their systems [8, 9, 12, 14-17], but often make assumptions concerning information importance [14], which should be a significant part of the system design itself [12].

### 3 Classifying *Information Need* in Location Discourse

We can characterize all location discourse simply as finding out something about a person’s location, and then possibly acting on that information. Interest in another’s location can vary from incidental (e.g. “just curious”) to purposeful (e.g. “do I have time to grab a bite to eat before they arrive?”). The term *location discourse* is used loosely here to describe an exchange of location information, involving synchronous, asynchronous, one-way, two-way, or n-way communication.

Location discourse can involve discussion about a specific location (e.g. “where is the mall?”), about someone’s location (e.g. “is Sue still at the mall?”), and about someone’s relationship to a location (e.g. “what is Sue doing at the mall?”). In everyday life, location discourse can contain combinations of these elements, such as wanting to know if Bob is still at the bowling alley (person), and if so, are there lanes open (location), and if not, is he available for a friendly match in an hour (relationship).

Because information need in location discourse is fluid and varied, we cannot easily discuss “social location discourse” as a distinct genre of location application. We therefore include in our definition applications that are directly social (e.g. rendezvous, dating), indirectly social (e.g. community annotation, mob-logging), and even applications where the social component is unknown (e.g. a taxi locator). While we are most interested in direct social location discourse, we consider the broader definition—encompassing all three elements above—to better understand the parameters influencing location information need in general.

#### 3.1 Categories of Location Discourse Needs

Based on a review of related literature, we tentatively defined several broad categories of information need in location discourse. Throughout our work, we continued to refine our categories, and ultimately settled on the following set:

***Inquiry.*** Determining the whereabouts or status<sup>1</sup> of others. Examples are checking availability (is now a good time to call?), and estimated time of arrival (ETA).

***Coordination.*** Coordinating location with others. Examples are rendezvous (e.g. meeting up after work for a drink) and dispatching (e.g. hailing the nearest taxi).

***Sharing.*** Sharing in the environment or experiences of others. Examples are sharing experiences (a rock concert) or places (a new house), or incidental social exchange (sharing contextual information to augment conversation).

***Assistance.*** Receiving or providing assistance relevant to one’s own or someone else’s location. Examples are roadside assistance (e.g. OnStar), location memos (e.g. DeDe [10]), and location-based messaging (e.g. Place-Its [18]).

While these categories have provided a useful means of organizing *moments* of location discourse need, needs can be fluid during location discourse. For example, Bob might want to know where Alice is (Inquiry), and finding that she’s at a festival downtown want to know what it’s like (Sharing), and then decide to meet (Coordination).

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<sup>1</sup> As explored in other research [e.g. 8], whereabouts, status and activity are highly interrelated aspects of location discourse. Therefore we consider all such inquiry under a large category.

### 3.2 Dimensions Impacting Location Need

In addition to categorizing information need in location discourse, we outlined general dimensions of context that could influence need. We first identified specific aspects of context that might impact need, by examining applications explored in previous work and implemented in industry. We accomplished this by asking ourselves “What would change a person’s relationship to this application? When would this application cease to be useful? When is it useful?” The set of ‘facets’ we derived is necessarily incomplete, but can be classified under four broader, interrelated dimensions:

**Activity.** The activities being performed by all parties. Facets include how easy it is to describe an activity, and the cognitive and physical demands of an activity.

**Location.** The location pertaining to which information is exchanged. Facets include spatial knowledge/awareness, associations and impressions, relation to the requestor’s location, and mobility.

**Relationship.** The relationship between parties. We can consider relationship from a functional perspective (by applying Fiske’s framework of social relations [5]), or consider archetypal relationships (immediate family, close friend, colleague).

**Emotional State.** The emotional state of the parties. Emotional state is often influenced by the other dimensions. Facets include the emotion and its cause.

In real life, facets influencing information need in location discourse are tightly interwoven in ways that can span more than one dimension. For example, a university student may be angry at their roommate for not being at the grocery store buying food for the party they are having. This involves facets of emotional state, location, relationship and activity in ways that are not easily distinguished. It is therefore neither straightforward nor always desirable to vary ‘facets’ in isolation to understand their impact on location discourse. The facets must be reasonable to vary under a given context, and any impact of varying a facet must be considered in the context under which it was varied. This was an important consideration when designing the questionnaire study presented in section 5.

## 4 Diary Study

We conducted a diary study to collect concrete location discourse scenarios for a subsequent questionnaire study, and to explore how needs are impacted by context.

Ten diarists participated in this week-long study, all researchers affiliated with the EDGE Lab at Dalhousie University. After an open discussion of what constitutes location discourse, diarists were asked to record any opportunities for location discourse that arose naturally throughout the week. To tease out the impact of context, the diary entry format included sections for general description, the current location and activity of themselves and others involved, and their relationship with others involved in the scenario. Diarists were also given an opportunity to describe an application that they felt would appropriately address their need.

## 4.1 Results

Over the course of the week, respondents logged a total of 52 diary entries (max 10, min 3, median 4). Some of the scenarios captured were quite straightforward, such as “is my colleague at the lab?”. Others were more complex, as shown in Figure 1.

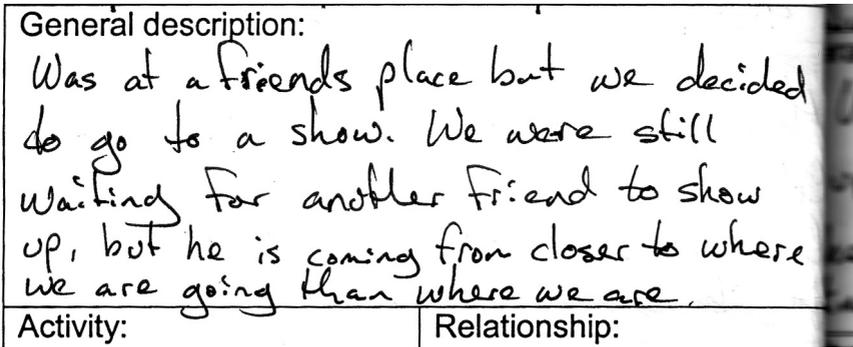


Fig. 1. Portion of a diary entry from Diarist #1 concerning a complex rendezvous need

We grouped diary entries according to the categories of need presented in section 3.1. Complex diary entries such as the one presented above were more difficult to categorize under a single location discourse need, and were sometimes placed under more than one category. After applying a weight according to the number of entries a respondent provided, 8% of responses were classified as *Assistance*, 15% as *Sharing*, and 20% as *Coordination*. As expected, *Inquiry* was the largest category, with 58% of diary entries. Within this category the specific need expressed was split between wanting to know *where* someone was, *what* someone was doing, *when* someone would arrive (ETA), and someone’s *availability* (usually for a conversation). The reasons for the need varied from “just wanting to know” to specific planning purposes.

The scenarios collected in the diary study varied widely across each of the contextual dimensions identified in section 3.2. The information needs and envisioned technological support were correspondingly varied, but differences in information need arose even with subtle differences in context. For example, diarist #10 described eight “inquiry” scenarios. In each scenario, she was at home, and interested in knowing either someone’s progress on a task or errand, or an estimated time of arrival. Despite this superficial similarity, the type of information desired differed with the specific errand, or the person they were inquiring about. The diarist alternately wanted to interpret a location on a map, get an ETA, place a call, or view status info. The variety of contexts described by the diarists and the variety of needs expressed influenced the design of the questionnaire study, described below.

## 5 Questionnaire Study

In order to begin examining location information need, we designed a questionnaire study encompassing a wide variety of possible scenarios. The goal of this study was

to investigate how the context dimensions of activity, location, relationship, and emotional state impact information need, and whether commonalities exist within these dimensions to help design effective location discourse systems.

## 5.1 Design

**Methodology.** Respondents first completed a demographic and personalization questionnaire, followed by a location discourse needs analysis questionnaire. This questionnaire presented fifteen scenarios, each describing a potential need for location information, and several options to address that need. Respondents rated each option according to its usefulness for the scenario, provided a freeform explanation for their rating, and selected one option as their favorite.

Using questionnaires and surveys for assessing need in mobile or ubiquitous applications is problematic in part because such methods rely on the imagination of the respondents; however this can be mitigated by taking their experiences into consideration when designing questions. A full discussion of the challenges and benefits of the questionnaire format as a means of evaluation in pervasive computing is beyond the scope of this paper; however the measures we have taken to ensure an effective questionnaire are detailed in the following sections.

**Population Sample.** Fifty respondents were recruited through a variety of channels, including university and industry notice boards, special interest listservs, company email, and flyers in public locations. Our sample was correspondingly varied, with 25 male and 25 female, of which 23 were students, 26 employed, and one retired. Respondents were predominantly in the 20-34 (29) age range, with two 13-19, twelve 35-49, six 50-65 and one over 65.

A technology expertise score was assigned according to respondents' frequency of use of various technologies such as cell phones, SMS messaging, mobile internet, and GPS devices. Respondents were then sorted into three groups: limited technological experience (16 respondents), moderate (26 respondents), and expert (8 respondents).

Our sample was drawn from residents of Halifax, Canada. A city with less than 500,000 inhabitants, it is broadly representative of North American life. Obviously, this is not a universally representative sample; for example, residents of Tokyo deal with entirely different population densities, transit patterns, technology adoption rates, street numbering schemes, and cultural norms. This is important when interpreting the results of this and other studies examining mobile technology use.

**Scenarios.** Based on an analysis of previous work and the results from our diary study, we collected over forty concrete scenarios to consider in the questionnaire. From these we selected and revised fifteen, according to the following criteria:

- The scenarios permitted exploration of several facets across the context dimensions (*activity, location, relationship, emotional state*).
- The categories of location discourse (*inquiry, coordination, sharing, assistance*) were represented in the same proportions as in the diary study and related work<sup>2</sup>.
- The scenarios were applicable to our population sample.
- The scenarios include a mix of “standard” (similar to scenarios in previous literature), and non-standard or creative scenarios.

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<sup>2</sup> We selected five “coordination” questions due to our own interest in this domain.

Each scenario constituted a single ‘question’. For each scenario, respondents were presented with four to six technology options. Options were briefly described in terms of how they would be used in the scenario, and most had accompanying images (see Figure 1). Respondents were told that the images presented were just approximations, and that they were to assign ratings based primarily on the textual description.

The technology options provided for each scenario were determined by interpreting interface descriptions provided by our diary study participants, based on implementations in research and industry, and by explicitly designing solutions in response to a particular scenario. Generally each option was within current or emerging technological capability, however technical details (such as update frequencies and location precision) were not normally specified. At least one “current standard” option was provided to counter new technology (e.g. check the Departures screen at the airport).

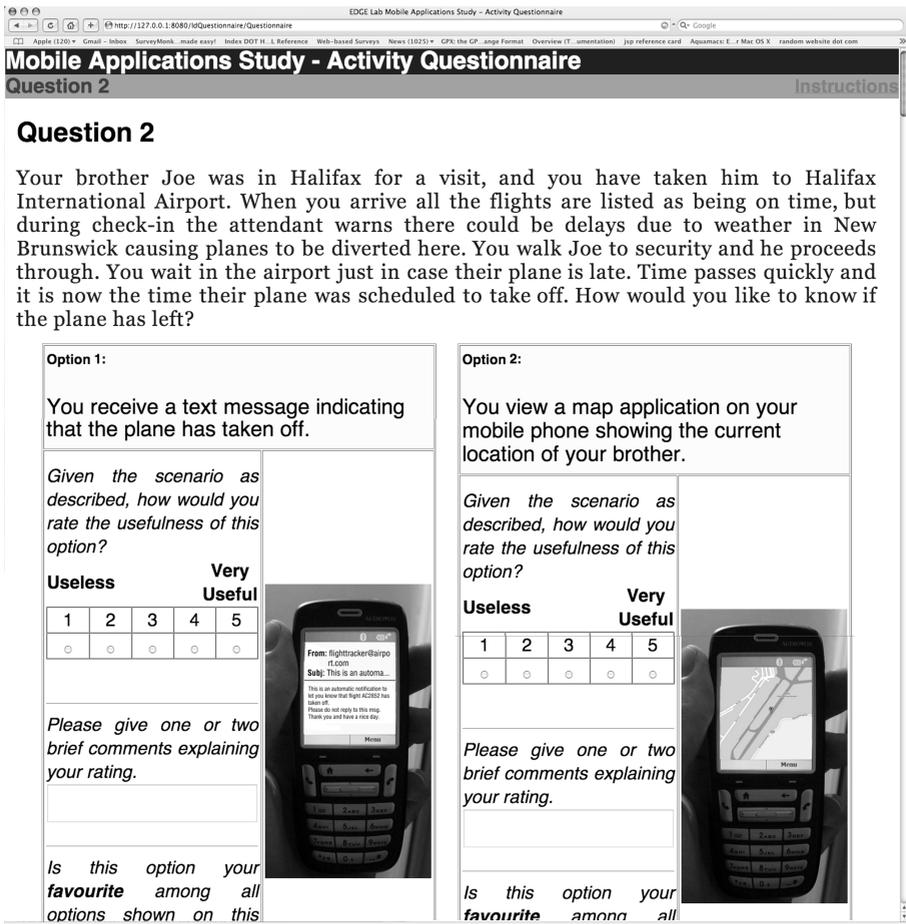


Fig. 2. Questionnaire page displaying a sample question and two technology options (other technology options are not shown here). Text is personalized using details about a family member. Variants of this question had the respondent driving home from the airport, or at home.

**Question Variants.** In order to more closely examine the dimensions of *activity*, *location*, *relationship*, and *emotional state*, between two and four versions of each question were created. For example, for the scenario presented in Figure 1, we varied the respondent’s location (at the airport, driving home, at home). Although the impact of the facet is very much tied to the scenario in the specific question, we also varied certain facets (such as familiarity with a location) in several different scenarios to get a better sense of overall impact. Options were consistent across scenario variants, except where a specific variant warranted a modified or different option (e.g. checking the Departures screen was only possible if the respondent was at the airport. While driving a community service radio station listing delayed departures was provided as an option, and when home, the airport’s website on a home computer). Respondents were assigned question variants so that the “limited”, “moderate” and “expert” levels of technology expertise were balanced across variants.

**Personalization.** A key challenge was to provide questions that had a high degree of realism for our respondents. Using data from the background questionnaire, we personalized scenarios where feasible and appropriate. For example, instead of “your friend calls to see if you want to go out later”, we personalize the scenario so that for example “Steve calls to see if you are available for a game of racquetball”.

In order to accomplish this, we had to ask respondents to answer a set of personalization questions as part of the preliminary questionnaire. This included some quite specific questions such as “name a leisure activity you are likely to enjoy with a friend”. The effect is an increase in realism for the respondent: by incorporating their experience we provide real examples, and they are more able to envision how they would likely respond to the situation given the options provided. They are less apt to answer questions indifferently or to consider the question in abstract terms. Personalization was instrumental to the success of our questionnaire, as made evident by the evocative, engaged nature of the comments entered by many respondents.

**Implementation and Procedure.** As outlined previously, respondents began by completing an online background and personalization questionnaire. This included basic demographic data, questions measuring experience with a suite of relevant technologies, and questions collecting data to enable scenarios to be personalized. Respondents were given the option of leaving questions blank if they were uncomfortable answering, or if they felt the question did not apply to them. Virtually all respondents answered all questions. Respondents were then assigned scenario variants, maintaining roughly even numbers<sup>3</sup> for each variant and balancing technology expertise.

Personalized questionnaires were dynamically generated for each respondent. XSL Stylesheets were used to personalize the scenario description, the description of each option, and to select appropriate images to illustrate the options. Thorough piloting and exhaustive validation was performed prior to running respondents.

Once a personalized questionnaire was created, the respondent was notified to complete the second part of the questionnaire. An instruction page described the procedure, the intent of the questionnaire scenarios, and the question format. For each question, respondents rated the usefulness of options on a five-point scale, and provided a freeform explanation for their rating. In addition, respondents were required

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<sup>3</sup> Some variants required that certain choices be made in the personalization questionnaire, so it was not possible to always get the same number of respondents in each question variant.

to select one option as their favorite among those presented. Question ordering was randomized across respondents, as was the ordering of options on each question page.

The questionnaires took 50-90 minutes to complete. Respondents received \$10.

## 5.2 Results

In this section we present results for thirteen questions<sup>4</sup>, organized by the categories of information need described in section 3.1. For each question we focus on the technology options that were chosen by many respondents as highly appropriate and/or a favourite option for the scenario. We compare results across similar questions in each category, and within variants of the same question, to illustrate the impact of context on technology option choices.

**Table 1.** Sharing questions

Question	Contextual dimensions varied
<i>Holiday.</i> Friends are at a holiday destination that interests you.	Location (landmark or visual event), during or after visit.
<i>Showing off.</i> A friend calls from a place they are excited about.	Relationship and location (friend at new cottage or colleague at new workplace).
<i>Touching base.</i> A colleague/friend calls you at work.	Activity (busy or free), relationship (manager or friend).

**Sharing.** *Sharing* applications emphasize the exchange of location-related information because of its intrinsic value, or incidentally in a spirit of openness. The *Holiday* and *Showing off* questions share location information that is intrinsically interesting. *Touching base* considers sharing location information incidentally.

In *Holiday* and *Showing off*, video was chosen as a favourite option by 18/50 and 24/50 respondents, respectively, and photo slideshows by 20/50 and 23/50 respondents, respectively. Video was the favourite option only when there was some possibility of sharing the visit in real time in *Holiday* ( $U=193$ ,  $p=.003$ ). This was particularly true when the holiday's intent was to visit landmarks (ancient Rome, immigration history in NYC). For other holidays (safari or rodeo), some felt that video distracted from conversation. Receptivity to video was mixed in the workplace variant of *Showing off*. 3/25 respondents expressed that video might be inappropriate in the new workplace, and 9/25 expressed that video provides the wrong kind of information:

“... *I am more interested in their experience than the exact details of what their new workplace looks like.*” - Respondent #54.

In both questions, slideshows were appreciated for the ability to editorialize and share asynchronously. Slideshows fared well across all question variants. Augmenting slideshows with a map was not seen as useful, however some weren't sure how the map would relate to the slideshow. Those who were positive toward the map imagined some direct utility (e.g. to get to their friend's cottage, or to track friends on their trip).

<sup>4</sup> The remaining two questions involved personal location information only. They are not presented in this section but are considered alongside the other questions in the discussion.

For the *Touching base* question, no respondent expressed that it was just “nice to know” where their friend or manager was. Instead, many respondents envisioned using location information in ways not mentioned in the question description. Some felt knowing where their manager was would let them decide how to respond to a call when still working on a project. Others said that knowing where their friend was would help in planning for the night’s activities, especially when they were too busy to take the call. However, the mean usefulness rating for options providing location (3.2/5) in *Touching Base* is lower than similar options in questions where there was a more explicit need for location information (grand mean 3.7). 34/50 respondents cited some kind of location indicator as their favourite option. Of these, 14 preferred textual descriptions, due to their simplicity and because they felt familiar with the routines of their friend or their manager. The remaining 20 preferred maps, as they provided a more detailed, visual reference. Four respondents expressed concern about the privacy of location information. In each case this was in relation to a friend, and when the variant suggested they could take the call anyway. Basic contact info (without location data) was preferred by a majority of respondents only in the variant where the manager calls to ask about a project they have just finished. At that point they have no immediate use for location information.

**Table 2.** Assistance questions

Question	Contextual dimensions varied
<i>Remote guide.</i> Friends in another city need help navigating.	Location/activity (navigating a city or an attraction), familiarity with the city or attraction.

**Assistance.** *Assistance* applications emphasize the exchange of location information to help the requestor or discloser. In *Remote guide*, location and activity are tightly intertwined – either friends are trying to find a hotel (and driving) in a city, or they are trying to find an exhibit (and walking) at an attraction. Guiding remotely without a map was not perceived as useful in the attraction setting, even when familiar with the attraction – most respondents did not think they would be able to recall detail useful for navigation. By contrast, while nobody’s favourite option in the city setting, many respondents felt it a reasonable approach if the city was familiar. Guiding remotely using a map tracking their friends’ location was evaluated positively by 23/25 respondents regardless of their familiarity with the city, but was a favourite of just 7/25. The same option was seen as problematic in the attraction setting, however, with 9/25 respondents positive or luke-warm toward the option, and a favourite of 1/25. A number of respondents cited issues with using a stylized attraction map as a navigation tool, others difficulty communicating, and others issues of time and convenience:

“This is ok, but then they have to go right there. I also have to tell them how to get there.” – Respondent #27.

When unfamiliar with the attraction, many respondents felt it reasonable to have their friends ask for help from staff; in the city setting, third party directions were said to be unreliable. Respondents were happy to identify the destination on a map application used by their friends, allowing them to navigate on their own. This was true regardless of the respondent’s own knowledge of the city or attraction. Despite concern

**Table 3.** Inquiry questions

Question	Contextual dimensions varied
<i>Airport arrival.</i> A family member is arriving.	Activity (preparing a surprise reception or a casual dinner).
<i>Plane left.</i> Know that a family member has made their flight.	Location (at airport, driving home, at home).
<i>Carpool.</i> Determine the ETA of your ride to work.	Relationship (carpool or public transit).
<i>Meeting.</i> Determine whether someone will make a meeting.	Activity (formal pitch or casual meeting), relationship (business partner or potential investor).

that their friends be comfortable navigating, this was the favourite option of 36/50 respondents.

**Inquiry.** *Inquiry* applications emphasize an exchange of location information to determine whereabouts or status.

*Airport arrival* and *Carpool* are ETA-type questions. In *Airport arrival*, a simple phone call to see if their relative had arrived was the favourite option of more respondents (12/23) than any other option when there was no need for secrecy. Many respondents felt the phone call was the richest information source, while others worried about getting accurate ETA information and engaging in a possibly lengthy conversation:

*“Not bad, but the ... alerts are less time consuming, I wouldn't have to talk to me [sic] sister. She can be chatty...”* – Respondent #94.

When preparing a surprise reception, 18/27 respondents preferred an alarm notification when their relative has left the airport, and again when they are within a specified distance from the house. Some respondents were skeptical that the family member driving to the airport would remember to set the notifications, however. A similar preference is seen in *Carpool*, where an ETA display was the favourite option of 24/50. Respondents who didn't rate the ETA display highly were skeptical of its accuracy. Were traffic conditions taken into account? What if the carpool route changes or they stop for coffee? Is it as unreliable as the existing bus schedule? In both questions, many respondents cited that these options were simple but effective, and that they could get on with their activities without needing to monitor the screen.

Tracking location using a map was an option in both *Airport arrival* and *Carpool*. In *Airport arrival*, the option was the favourite of 9/50 respondents, who liked its unobtrusiveness and precision. Other respondents felt that it required too much monitoring, and provided no clear indication of the situation (e.g. did your brother-in-law actually arrive, or is your spouse driving home because the flight was cancelled?). In *Carpool*, the option was the favourite of 20/50 respondents, citing that it was an accurate visual representation, allowing them to calculate their own ETA. Several respondents wanted additional information, such as an ETA, who was driving, or the route, while others felt the map gave too much information and required frequent views.

*Meeting* and *Plane left* involve checking whereabouts or status. In the *Meeting* question, option evaluations varied with meeting formality, and the person being inquired about. In most variants calling was seen as reasonable and direct, and was the favourite option of 19/48 respondents. However many saw a phone call as pushy

when checking the status of a potential investor for a formal ‘pitch’. Others worried that the person might not respond, or that it may disrupt the meeting. Phone calls were not provided as an option in *Plane left*.

Tracking location with a map was again an option in both *Meeting* and *Plane left*. This was the favourite option of 21/48 respondents in the *Meeting* question, and had the highest mean usefulness rating (3.4/5) in the formal pitch/investor variant. Five respondents explicitly mention privacy concerns when tracking a potential investor, while no respondents mention this in relation to a business partner. In the formal meeting variants, many felt that this was a discreet, unobtrusive solution and were comfortable actively interpreting the position data, while others were concerned that it did not conclusively mean the person was on their way. For an informal meeting many respondents felt this technology was overkill. A similar option was the favourite of 16/50 respondents in the *Plane left* question. Most respondents preferred to track the individual rather than the plane, to be certain that the person made the flight. When at the airport, several respondents cited that they could actively track and even contact the person if it looks like they might miss their boarding call, whereas while driving or at home several respondents indicated that they were not familiar enough with the airport to make such interpretations. An alarm-based notification of departure was preferred by 21/50 respondents, regardless of their location. The remaining 13/50 preferred to access departure information on public screens or via mobile phone.

**Table 4.** Coordination questions

Question	Contextual dimensions varied
<i>Project</i> . Meet a colleague when they are at a particular location.	Location (communal space on campus or office in same building), urgency.
<i>Interception</i> . Meet a friend mid-activity.	Activity (walking, jogging, or cycling).
<i>Shopping</i> . Arrange to meet after splitting up to shop.	Location (mall or shopping district), relationship (family or tour group).
<i>Returning item</i> . Return an item you have borrowed.	Location/activity (conference or resort), urgency/familiarity (first day, last day).
<i>Get a lift</i> . Arrange transportation.	Location (home or unfamiliar city), relationship (friends or taxi company).

**Coordination.** *Coordination* applications emphasize actively using location information to arrange meetings. *Project* and *Returning item* involve meeting up with others without their prior knowledge. When the need was urgent, a majority (15/24) of respondents preferred calling to arrange a meeting in the *Project* question. Otherwise opinion was mixed, with some respondents concerned about interrupting the person to just check their location. When the need was not urgent, a triggered notification when the individual is in the particular location was a popular option for the office, but not on campus. Respondents doubted that the person would visit the specified campus building at a good time, while the office worker could be expected to return to their office. A proximity trigger was also an option in the *Returning Item* question; it received reasonably positive reviews when in the structured (and physically enclosed) conference, but not in the open resort setting. A phone call was the favourite option

for 24/51 respondents in *Returning item*, again as a direct way to arrange and guarantee a meeting. However, it was preferred in the resort setting (18/28) more than in the conference (6/22), where many respondents were concerned about causing an interruption. A map-based tracking application was the favourite of 7/48 respondents in *Project*. Many respondents felt that location tracking gave either too much or the wrong kind of information for the scenario:

*“Can I get in touch with them there? How long will they be there? I would want these questions answered”* – Respondent #41.

In *Returning item*, a similar application was the favourite of 16/50 respondents. It was selected as a favourite option more often in the conference setting, with 11/22 votes, than in the resort setting (5/28).

The *Interception* and *Shopping* questions involve planned meetings, similar to *Meeting* except that steps are taken to ensure that the meeting takes place. Additionally, some options permitted dynamically establishing a meeting point, while some rely on a predetermined place and possibly time. In *Interception*, arranging a time and place beforehand was the favourite of 6/16 walkers, but was more problematic for runners and cyclers, who preferred setting a meeting place dynamically (the scenario involved meeting mid-activity). Arranging by phone was the favourite of 5/17 cyclers and was evaluated positively by most walkers, but phones were too cumbersome when running, and no runners favoured this option; instead 13/16 runners favoured map-based tracking applications, as did 10/17 cyclers and 8/16 walkers. Despite the strong numbers for tracking applications, most evaluations also expressed concerns about map legibility, having to refer frequently to it, and safety issues especially if cycling. The *Shopping* question involved rounding up a group of people. In the results we found that a city shopping district was considered in much the same way as a mall. We also found relatively little impact of relationship, except for a common concern about being respectful and democratic with family, versus a general awareness of the responsibilities of a tour group chaperone. 27/49 respondents preferred arranging a meeting place and time beforehand, tracking locations with a map application, and calling stragglers individually. The same setup minus the tracking application was also highly rated, however, and was the favourite of 8/49 respondents. Setting a meeting place dynamically using a tracking application had high ratings for usefulness and was the favourite of 12/49 respondents, however many were critical of the unilateral nature of the option described, especially in the family variants.

*Get a lift* is a question that includes aspects of Assistance or Inquiry, but ultimately involves Coordination. Variants involved one of two diverse settings (at home, or in a possibly dangerous part of an unfamiliar city). This impacted the priorities expressed by respondents, however the usefulness ratings of the options were similar between settings. An option to broadcast your location to one or more cab companies was the favourite option for 8/12 respondents in the unfamiliar city, and given 5/5 as a usefulness rating by all eight. However this option was also the favourite of 6/12 respondents calling cabs from home, albeit with a lower mean usefulness rating. When arranging a ride with friends, 4/25 respondents preferred to just call, while 12/25 preferred viewing the locations and availability of their friends on a map prior to calling. When at home, some commented that this was more applicable to emergency situations, while in the city some felt this would be useful only if you were familiar

with the city. Another 8/25 respondents preferred the broadcast option here, because it lets their friends decide whether to respond or not; however others felt that it was not guaranteed to work in the city setting, or an awkward approach when at home:

“...*too impersonal a way to ask someone to do you a favour*” – Respondent #1.

## 6 Discussion

In this section we characterize the broad trends observed in our questionnaire results that have direct implications for application designers.

**Incorporate the requestor’s concern for others.** Throughout the responses respondents were very aware of the social ramifications of using technology in discourse. While many respondents were concerned for the privacy of the location information discloser, this was usually part of a larger concern for *what is appropriate*. Some expressed discomfort with tracking someone else’s movements, while others felt it would be ok if the discloser gave permission. Many options were only considered useful if there was a good chance the other person would have their mobile phone, knew how to use the application correctly, and when it was safe for them to use it. Many respondents were excited by the prospect of using live video or pictures to get a sense of immersion in another’s experience, however there was concern that this might be disruptive or disallowed in a colleague’s new workplace, for example. Being able to unilaterally set a meeting time and place was only useful if the respondent had been given clear authority to do so. Even with immediate family this was usually not the case. More generally, respondents were uneasy with interfaces that managed requests (for meeting up, etc.) that might be more gracefully handled by a voice conversation.

**Verbal communication is often best.** Verbal communication was often cited as the most preferred means of obtaining both location and status information. Many respondents felt that they could negotiate their needs more effectively with a phone call than by checking status messages or tracking locations on a map. This was especially true when they had a pressing need or knew someone was available to talk. Often, talking was considered best when augmented with contextual cues like maps or pictures. In cases where a phone call might be intrusive, more surreptitious methods including tracking were considered, as were less intrusive messaging options. When the focus of their need was precise location or ETA, many respondents did not trust the ability of the information discloser to be accurate. In such cases more automated tracking was considered useful. Finally, while voice was favoured less when the *Shopping* scenario required communicating with several people at once, it was considered effective in rounding up a few lost or late individuals.

**Interaction should be minimized.** Respondents often made it clear that they do not want to be fiddling with technology in their daily lives. The most common complaint about tracking applications (far more common than concerns about privacy) was the need to monitor. Small maps and images, grainy video, slow text entry and needing to carry a mobile phone around were cited as weaknesses of the technologies provided in

the questionnaire. Alarm-based notification was embraced by many respondents because it was unobtrusive and to the point; sending out an automatic dispatch for a cab in a strange city was viewed as a comfort and a time saver.

**Location requestors want targeted information.** The perceived usefulness of a location discourse technology often hinges on the possibility of inaccuracy and misinterpretation. This includes status messages that could be left unchanged, or that are too vague to be useful in the context (e.g. “in transit” is not enough information if you need to be sure someone is on their way to meet *you*).

Too much detail (e.g. the tracked locations of all nearby available taxis) can overwhelm. The suitability of information presentation is highly context-dependent: an address list of people’s current locations is useful as a directory or to provide passive status information, but useless when trying to determine where they are unless already familiar with the region. Maps assist in navigation and planning but are less useful as generic context.

## 7 Conclusion

We have presented results from a structured analysis of information need in location discourse. Our results illustrate that an analysis of need based on contextual dimensions can shed light on key design concerns. At the same time, the results support the idea that information need is rarely determinable by location, activity, relationship or emotional state in isolation. Instead a change in need is most often brought about by a combination of factors (e.g. my friend calls me at work *and* I am busy *and* we are planning to go out after work). When context clearly influenced technology choices in the questionnaire, it was often because a question variant emphasized a concern for propriety (e.g. capturing video in an office building vs. a cottage), or changed what was known and unknown (e.g. routes are more volatile for a carpool than for public transit). A need for convenience or safety can also impact choices (e.g. an alarm notification is appropriate while driving), however as can be expected many respondents chose the most convenient or unobtrusive option regardless of the situation.

Our analysis highlights the importance of considering information need in location discourse. First, relationship alone was not a strong determinant of need. This contrasts with findings pertaining to information disclosure [2, 11, 15]. Second, the requestor’s and the location discloser’s activity were equally important when determining how needs will be negotiated, again stressing the importance of considering the perspective of the information requestor. Third, precise visual location was often considered to be more trustworthy and useful than text descriptions of activity or location, although providing both might help prevent misinterpretation. Again, this may be at odds with design advice derived solely from an analysis of location disclosure.

The questionnaire study, despite considerable efforts to achieve realism, relies on self-reported evaluation of technology options described by a short paragraph and an image. In future work we will further explore and validate the findings presented in this paper in realistic contexts, and with interactive technology.

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