Hide And Seek: Location Sharing Practices With Social Media

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ABSTRACT
This paper presents a multi-pronged study of users' location-sharing practices in the context of online social networks. The contribution of this study is two-fold: first it presents a series of insights relating to location-sharing practices, and second it highlights the use of third-person scenarios as a useful method for eliciting privacy concerns and potentially educating users.

Categories and Subject Descriptors
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General Terms Experimentation, Human Factors.

Keywords Privacy, location sharing, social networks.

1. INTRODUCTION
Online social networking services are increasingly accessed through mobile devices equipped with location sensing technology. This has enabled users to dynamically integrate their location within their social network profiles to produce live "friend finder" applications. However, location is qualitatively different to other elements of an online profile such as name, age, and gender. Specifically, location is highly dynamic as opposed to other static aspects of users' social networking profiles. Despite prior work on privacy aspects of location and context aware services [e.g. 1,3,4], users' perception and practices of location privacy in the context of a social network service is relatively unexplored. Nevertheless, the sharing of real-time location information raises important privacy concerns since it gives rise to a large number of potential privacy vulnerabilities [8]. This paper argues that in the context of mobile social networks location sharing is qualitatively different from traditional dedicated or rather independent applications.

This study investigates user preferences and attitudes towards location sharing in the context of mobile social media. It considers the mobile application *Locaccino* (a previous version of which is reported in [10]), which enables rule-based location sharing within Facebook. This paper extends previous work by presenting a multi-pronged study consisting of questionnaires, in-depth interviews, and scenario-driven discussion. It elicits the factors users consider when sharing their location in a social network, and compares users' perception of their own privacy against their perception of others' privacy.

The contribution of this study is two-fold. First, it offers a number of insights regarding users' location sharing practices in the context of online social media. Second, it highlights the use of third-person scenarios as a useful method for eliciting privacy concerns and potentially training users. Specifically, the study shows that in the context of online social networks participants were much more diligent and careful about sharing other people's location compared to when sharing their own.

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2. BACKGROUND
There is an increasing amount of work on understanding users' location-privacy needs in ubiquitous and location-aware systems including diary studies [1], interviews [4,5], surveys [7] and lab and field observations [3,6,9,10]. This research suggests that users initially have a poor understanding of the implications of location sharing; novice users can be privacy insensitive due to failing to comprehend how the information is revealed [1,6]. However, subsequently they recognize the importance of controlling the availability of the data through mechanisms such as disabling the service [1] or obtaining feedback about which users can see or have seen their information [4]. Users are also skeptical about the usefulness of location sharing in day-to-day activities, suggesting that current practices (such as calling somebody up) are sufficient [1]. However, the usefulness of such services was acknowledged in more stressful situations involving unfamiliar environments or in crisis and safety scenarios in general [4]. In such situations, information usefulness outweighs privacy concerns.

Research investigating sophisticated privacy mechanisms, such as customizable privacy policies, has indicated they present significant challenges for users. One recent study reports its participants failed to implement their desired policies with a high degree of accuracy [10]. Furthermore, it also noted that although participants varied considerably in the time they spent defining their policies (between 5 and 8 minutes), the duration of this period was not strongly correlated to final policy accuracy.

It has also been observed that the recipients of the location data are typically more significant to users than the locations being shared. Perhaps unsurprisingly, users are more willing to share information with friends than acquaintances or strangers [12]. Furthermore, users tend to produce privacy policies based on recipient identity rather than location or context [3, 9]. Research has also shown that users are sensitive to the reactions of recipients if location information is denied or not made available [4,10]. This suggests that systems need to incorporate an element of plausible deniability. However, users do make distinctions in sharing particular locations: additional privacy is required at home when compared to work. Also, users appear reluctant to deploy strategies to obfuscate their location data by reducing its accuracy. Previous studies reported users either disclose nothing, or the most useful location data [3, 9]. This may be a mechanism for reinforcing or communicating social boundaries [3].

Previous work has extensively studied location-sharing practices amongst friends, however most studies were conducted within the confines of closely-knit communities. The study reported here explicitly frames location sharing in the context of online social networks that in addition to family, friends and colleagues also include friends of friends and strangers. In doing so, this study elicits the factors under users' consideration when sharing their location in such loose communities and for a variety of purposes that include general awareness, work, entertainment and socialization.

3. METHOD
The study was conducted in a lab and consisted of training, the collection of attitude data via a questionnaire and a sorting activity, a semi-structured discussion about location sharing driven by two sets of

scenarios (one predefined, one constructed on-the-fly), and a semi-structured discussion about third party location sharing driven by a set of predefined scenarios. Each participant completed the study individually, and all discussions were between individual participants and 2 interviewers.

3.1. Participants

This study was conducted with 15 participants (10 male, 5 female), aged between 20 and 30 years, and all were either students or employees at our University. We believe that this selection is representative of an important group of Facebook users, but want to remind the reader that some of our results from this population may not generalize to all of the many diverse groups of Facebook users. Participants were recruited via email and online advertisements, and they were not financially rewarded. All participants had computer experience, email accounts, all had experience with at least one social network (e.g. Facebook, Hi5, MySpace). Only one participant had experience with location-sharing applications.

3.2. Procedure

Each participant completed training on the Locaccino application, and three data collecting sessions, lasting a total of approximately 30 to 45 minutes depending on the nature of the open-ended discussion. During training, participants received a demonstration of the Locaccino application and became familiar with its functionality both on mobile phones and inside Facebook. This was intended to contextualize our study and to familiarize participants with fundamental concepts of location-sharing applications.

The data collection sessions described now were conducted with pen and paper, away from a computer to avoid boxing in users within the confines of any specific software products. Participants either wrote themselves (session 1) or voiced their thoughts verbally. During all sessions, there would be two experimenters present, one of which would transcribe what the participant said (sessions 2 and 3). The sessions were also audio-recorded with the permission of the participants.

In session 1 participants were asked to list people they relate to, grouping them if and as they wished (for example, family, colleagues, etc.). Then, participants were asked to formulate a list of places they had visited in the last year. The list was first created at the granularity of country-level and iteratively refined to street level. This data was used in session 2 to construct realistic and relevant questions and scenarios, as described next.

In session 2 participants were first issued a pre-defined set of questions/scenarios, and were asked to decide whether or not they would share their own location in each situation. Then, participants were issued a second set of scenarios, constructed on-the-fly using permutations of people and places identified in session 1 as well as random times of day. An example scenario is: *You are having dinner with your partner, and your boss requests your location*. These scenarios also included broad categories for people, such as "friends of friends" or "strangers", to elicit responses regarding people other than those the participant had identified earlier. In addition to their direct answers, participants were probed further depending on their verbal and non-verbal cues.

In session 3 participants were issued a predefined set of scenarios with fictional characters. For each scenario, participants had to decide if the location of the main character should be disclosed. They further elaborated their answers by identifying slight modifications to the scenario that would change their decision. An example third person scenario is: *Alex is out with his friends to a bar, the night before a big project is due. A coworker of his wants to know his location. Will you disclose Alex's location, and if so, what information would you give?* These scenarios were selected from those that received interesting results during pilots.

	At home				At work				Other place			
	Exact	Fuzzy	No	Lie	Exact	Fuzzy	No	Lie	Exact	Fuzzy	No	Lie
Boss	36	18	36	9	100	-	-	-	18	36	36	10
Subord.	-	40	60	-	80	20	-	-	20	20	60	-
Colleag.	100	-	-	-	100	-	-	-	92	8	-	-
Friends	92	8	-	-	92	8	-	-	75	25	-	-
Family	100	-	-	-	83	17	-	-	58	25	8	8
Partner	100	-	-	-	100	-	-	-	78	11	-	11
Stranger	25	-	75	-	25	-	75	-	-	25	75	-
Acquaint.	25	-	75	-	25	-	75	-	25	75	-	-

Table 1. Responses (%) from session 2, showing participants' attitudes toward sharing their own location. Responses are grouped by who is asking, the current location, and the granularity of participants' answers.

	At home				Other place			
	Exact	Fuzzy	No	Lie	Exact	Fuzzy	No	Lie
Boss	13	25	63	-	43	26	30	-
Colleague	38	38	25	-	75	13	13	-
Friends	-	-	-	-	52	24	19	5
Family	-	-	-	-	33	29	37	2

Table 2. Responses (%) from session 3, showing participants' attitudes toward sharing the location of fictional characters. Responses grouped by who is asking, the current location, and the granularity of participants' answers.

3.3. Results

Participants' groupings of friends and locations were sorted into major categories by refining the recorded tree structure and ultimately arriving at the list of friend categories, location categories, and granularity categories shown in Tables 1 and 2. Furthermore, participants' responses to the questionnaires and scenarios regarding the disclosure of their own location or the location of others' is shown in Tables 1 and 2 respectively. Each participant contributed potentially multiple data points for each cell in Tables 1 and 2. Finally, participants' statements, non-verbal cues and any relevant information noted by the interviewers were recorded, analyzed and the insights from the combination of qualitative and quantitative data are summarized next.

4. DISCUSSION

The first important point to address is that of validity of the collected data. While it is true that in this study participants were asked hypothetical, scenario-driven questions about revealing their location or the location of others, this process strongly resembles the configuration setup of Locaccino. This software requires users to define *a priori* access rules about sets of friends and locations. As such, users are not asked on the fly whether they wish to disclose their location, but rather this decision is made based on users' prior explicit rules.

The results of this study suggest a strong hierarchical distinction in how participants chose to disclose their location when they are at home. Three distinct groups emerged in the responses: most participants were happy to reveal to peers (i.e. co-workers, friends, family, …) that they are home; they explicitly chose to decline the request from strangers; and participants' responses were rather diverse in relation to superiors/subordinates.

The results also show that participants enforced these hierarchical structures much less at the workplace. In this context, superiors and subordinates are treated much like peers, and all but strangers' requests are granted.

It is also interesting to note that participants' responses in the case of the home scenario were rather different when disclosing the location of the fictional characters, and specifically more cautious. For example, while all participants chose to let their colleagues know that they themselves are at home, only 38% of corresponding responses were positive in the case of third-person scenarios.

Similarly, participants were rather protective of the fictional characters in the scenarios. For instance, most participants chose to deny requests from the boss when the fictional character was at home, while participants were more inclined to grant such requests themselves. This suggests that participants felt that while they themselves may not strongly distinguish between work and home, this is probably what others want. The results also show that participants were much less likely to lie on behalf of fictional characters than themselves.

In addition to the quantitive data discussed so far, the study collected a series of qualitative data. Next, the analysis of the qualitative data is presented, which, in conjunction with the quantitative findings, has resulted in the identification of a set of insights on location-sharing practices in the context of social networks. These insights were derived from quantifying participants' answers and analyzing their hesitations or statements during the study.

Location information is preferably shared on a need to know basis, not broadcast. Participants were biased against sharing their location constantly, without explicit consent each time their location is requested. This suggests that people are cautious about sharing their location and need to be reassured that their private information is only being disclosed when necessary and is not readily available to everybody. For example in Table 1, 100% of the participants would disclose their exact location at work to their boss and colleagues but only 80% and 83% to their family and subordinates respectively. This occurs in great measure because there is less perceived need to disclose a specific location to the last two groups.

"If they ask me specifically I don't have a problem, but having the information available, no."

This sense of propriety about location sharing is tightly coupled with the fact that most people believe in only sharing a location when there is a perceived, clear and definite objective to sharing, as confirmed by the work of Consolvo et al. [3] and Lederer et al. [9].

Highly granular location information is shared when a perceived need exists. In sharing their location, most participants considered an address as adequate information. When probed whether they would be comfortable with sharing more precise information, such as the specific floor or room number, most participants agreed this would be the case if disclosing that information would be of value to the person asking.

"There is no need to tell people where exactly I am when they don't know the place!". "In the evening I would disclose the location more specifically. People worry and they would like to know."

Work by Consolvo et al. [3] confirm this insight, also stating that information that is considered useful to the requester is disclosed.

Our analysis also suggests that highly detailed location information is likely to be shared between people that have established common ground, e.g. by visiting a bar or cafe together, or people who frequent the location. For instance, disclosing an office number at university would likely happen between colleagues or professors.

Locations are associated with actions. During the open ended discussion of this study, participants appeared to interchange locations and actions, for example being at the office was associated with working. Previous work [11] suggests that requesters combine the disclosed location information with prior knowledge of the sharer's activity. This was confirmed here, as participants frequently chose to explain what they were doing rather than simply label locations. They also claimed they would only be comfortable sharing their location if they could provide an explanation, specifically to avoid requesters inferring wrong information from the shared location.

"[I would disclose] if I could explain I'm working at home."

This finding suggests a perceived need for annotating locations with more than a street address or a title (like "home", "work"). Work by Barkhuus et al. [2] suggest that people choose location labels that describe activities rather than a particular place. The findings of the study reported here, however, further highlight the dual use of many locations, such as the businessman working from home in the above example. A single label for a location, regardless of it describing the place or activity, was considered insufficient by many participants.

Disclosing location at the granularity of city is perceived as disclosing nothing. In the scenarios, participants were given the option to disclose only city level or country level location information, as well as lie. While there was variety in how participants handled scenarios where they did not want to disclose their location (from lying to giving very little information to bluntly refusing to share), the majority of participants felt that, when in their home city, city level detail and above gives nothing away.

"Saying that I am in [the city] is good for nothing."

The study's population consists of students and employees of a university, and therefore this specific result may be influenced by the group's idiosyncratic behavior and values. A different population may possibly travel more, hence staying in their home town can have a stronger significance and users might not so easily disclose this information.

Previous work suggests that users prefer to hide their location if there is plausible deniability [4], while another study showed that even with plausible deniability only 23% of requests were denied and mostly without relying on plausible deniability [3]. In fact, 24% of reported disclosures in that study were of city-level granularity. In the study reported here, some participants appeared comfortable with disclosing city level information when they did not want their location to be disclosed. However, others perceived sharing only city level in their home town as an evident deception mechanism that would only raise alerts and require explanations. Certain participants even weighed the cons of lying versus the suspicion it would create to only state the city they were in. As can be seen in Tables 1 and 2, fuzzy location and lying were the least popular choices.

"I'd rather lie and tell him that I am at home than [just] saying 'in [the city]'." . "City level would be suspicious when others are used to getting more information." . "Being general might reveal that I am hiding something. But on the other hand, if I am lying it might be easy to verify if I was there."

Being found is associated with being available. Participants felt that by disclosing their location they become reachable, and therefore interruptible. They sensed that if they can be found they can be asked to take action. This finding agrees with the finding reported previously: participants would only share their location if they sensed there was a need, therefore being found implies that something is needed of them.

"If Prof. X was looking for me I would like to appear 'unavailable', even though I might have free time." . "I should be able to go offline."

Interestingly, some participants associated sharing their location with being online in the social network and then they proceeded to request the ability to disconnect or go offline, inline with the findings in [4].

Users are more cautious when sharing others' location. Participants thought longer and considered rather intensely the ramifications of disclosing another person's location. When faced with a moral dilemma (e.g. potentially disclosing that a husband is having an affair), most participants chose what they perceived to be the best answer for the person whose location they were sharing. For example when sharing in the first person scenario, the portion of participants willing to share their home location with their boss, colleagues or sharing other locations with their family and friends were higher than in the third person scenario.

"I don't think a system should make a decision like this that could deteriorate his marriage."

This finding has interesting implications regarding educating users about the implications of location sharing. Since the participants became increasingly aware when confronted with a third person scenario, such scenarios could be used to train users and help them understand and anticipate their own use of location-sharing systems.

5. TOWARDS INTEGRATING LOCATION SHARING IN SOCIAL NETWORKS

The findings of this study suggest that location is an idiosyncratic property of people's social networking profiles, and sharing it does not conform to existing social network practices and norms, particularly when the sharing is done in real-time and through mobile devices that the user permanently carries around. The dynamic and contextual nature of a user's location in conjunction with the increased immediacy of requests are likely causes for this interesting result that also has implications for ambient media.

In contrast to other information that is readily shared on social networks, participants indicated hesitation toward broadcasting their location and preferred sharing it on a need to know basis. This request-reply approach is inconsistent with existing practices in online social networks where profile information is shared on a "broadcast" basis, and careful design is required to integrate such diverse practices. It can be argued that location information requires separate, and possibly more expressive control mechanisms in the context of online social networks.

Furthermore, the study identified the need for annotating both requests and responses relating to location. Requests need annotation so that the response's level of detail can be ascertained. In turn, responses require annotation to fully convey the activities and context of users. Once again this annotation approach is rather distinct from existing practices in online social networks, and possibly cumbersome. A useful approach, especially for mobile systems, may be to allow users to pick from a pre-determined set of "justifications" for requesting someone's location, thus minimizing explicit input while at the same time annotating their request.

Interestingly, participants felt that revealing their location was equivalent to being "online" or "available" in the social network, which is not the case when sharing other type of information in social networks. Hence there is a need for revealing location information in a manner that does not convey availability. Possibly introducing a short delay, say 10 minutes, may alleviate the concerns that participants expressed. Another approach is to display location information in the form of text matching as closely as possible other elements of users' profiles, so that conventional expectations regarding users' availability stemming from static profile elements are transferred to real-time location. In other words, making real-time location information look like the rest of the users' profile may reduce the expectation that participant's are available whenever their real-time location is available.

In addition, the study highlighted the potential of revealing city-level location information as a candidate for plausible deniability, at least when users are in their home town. Participants felt that this information was equivalent to revealing no information at all.

Finally, the third-person scenario technique used in this study highlighted important differences in how participants consider location privacy when compared to first-person scenarios. The findings suggest that participants where more careful, more diligent, and thought harder when deciding whether and how to share other people's location. Hence, the help of third parties, whether friends or strangers, may be an alternative when the system cannot decide with confidence whether to reveal a user's location and with what granularity. The results also suggest that third person scenarios can be practical tools for training and educating users, as well as a valuable method for eliciting information and requirements in a study.

This paper has presented a multi-pronged study aimed at eliciting users' location-sharing practices in the context of online social networks. The results include a number of findings relating to location-sharing practices, and highlight third-person scenarios as an interesting methodology for data collection and potentially user training. The ongoing work stemming from these findings has focused on identifying appropriate mechanisms for sharing location such that the bias of assuming users are "online" or "available" when disclosing their location is minimized.

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