To Share or Not To Share? An Activity-centered Approach for Designing Usable Location Sharing Tools

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ABSTRACT

Location sharing has recently become one of the most discussed topics in Ubiquitous Computing. Although it looks very attractive to users, there are still many privacy issues that refrain users from using location sharing tools. Many researchers proposed theoretical solutions for the problem of location privacy, but users still lack usability and control over their location data in tools for location sharing currently available on market.

In this paper, we present the results of a qualitative user study conducted with 14 people. We devised a set of activities around location sharing, and we designed a prototype interface for a new location sharing app in which the sharing behaviour is based on activities rather than on people.

Participants to the study, guided through a semi-structured interview, express the privacy concerns and issues that they feel more compelling while using location sharing tools, and comment on the usefulness of such tools in different cases and situations.

Our concept of activity-based sharing is then evaluated by users. Our findings suggest that ad-hoc tools provide more versatility and are preferred by users, while long-standing location sharing functionalities look more invasive and are considered only for a limited group of trusted contacts.

Categories and Subject Descriptors

K.4.m [**Computers and Society**]: Miscellaneous; H.5.2 [**Information Interfaces and Presentation**]: User interfaces—*User-centered design*

General Terms

Design

Keywords

location privacy, user study, location sharing

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1. INTRODUCTION

The topic of location sharing has recently become one of the most debated ones. The reasons for this popularity are probably manifold, involving the availability of new powerful mobile devices; the use of services custom-built for mobile devices; the privacy concerns raised by the increasing use of these technologies; and the perceived usefulness - or uselessness, depending on the case - for end-users. As a matter of fact, currently available smart-phones are becoming affordable for a large number of people, while at the same time containing increasingly powerful hardware and a multitude of sensors suitable for many different tasks. Taking advantage of the new opportunities offered by technological improvement, users are also going "mobile", using their smart-phones for a number of different tasks that were previously only available on desktop computers. The mobility of users has pushed also the proliferation of deals for 3G data plans which guarantees the ubiquitous data connectivity of people's smart-phones. At the same time, many common applications - and in particular social networking services (SNS) - are getting mobile as well, allowing people to share their photos, videos, comments, places, and much more directly on-the-go. Besides the well known SNS like Facebook[1] and Twitter[2], several new apps are emerging, designed and intended for use in mobility: this is the case especially for location-based SNS, such as Google Latitude[3] or Foursquare[4].

If on one side there is a clear interest and value in location sharing, on the other hand many people keep away from location sharing tools, or just use them in a limited way. Although the scientific literature has dealt with location privacy from a theoretical point of view (see e.g. Krumm's survey on location privacy approaches [4]), there are still a number of privacy issues that have to be solved. Since location is perceived as sensitive information, people need to always feel in control and to have usable tools in order to feel comfortable while sharing location. Popular tools for location sharing which are currently available on market offer too simplistic privacy controls that basically require people to share all or nothing (e.g., Latitude), or offer complex settings that are too cumbersome to set and maintain (e.g. Facebook Places).

Our hypothesis is that by following an activity-centered

[1] `http://www.facebook.com`
[2] `http://twitter.com`
[3] `http://www.google.com/latitude`
[4] `https://foursquare.com`

design that organizes location sharing around activities ("i'm running late to meet Jack and Jill, let them know how far away I am"), rather than people and rules ("share with my boss from 9 to 5"), will greatly simplify the control of sharing and thus minimize unwanted blanket sharing behaviour. For this reason, we synthesized a set of activities around location sharing and we devised an initial mobile interface around these activities. We then arranged a user study in which we investigated the attitudes and leaning of people towards location sharing, as well as their concerns and issues, and evaluated our concept in a set of 14 interviews. Our prototype complements the common long-standing location sharing functionality with ad-hoc tools such as the proximity detection and the rendezvous functionalities, that can be used respectively to limit the location disclosure only to nearby contacts and to share location with a selected group of friends only for the time of a specific meeting.

Our findings highlight that long-standing location sharing tools, such as Google Latitude, provide limited usefulness for people, who end up using them only with restricted groups of trusted people. When presented with activity-based tools (for instance: share my location with these 5 people this evening), people express much more satisfaction and feel these kind of tools fitting more their needs.

2. RELATED WORK

In one of the first experiments on location sharing, Brown et al. [1] conducted a field study with 5 families. In each house was introduced "the whereabouts clock", i.e. a particular clock with four quadrants, displaying in each quadrant a possible location for the household members: home, work, school and elsewhere. A lancet positioned on one of the four quadrants allowed the family members sitting at home to keep in touch with the others, thanks to the coarse-grained location information available. The clock, positioned in a room often frequented by all family members such as the kitchen, stimulated the sense of "connectedness", and increased involvement of each other's activities within household members.

In another study, Danezis, Lewis and Anderson pretended to be selecting possible participants among undergraduate student population for a one month study in which people's location would be constantly monitored [3]. During the (fake) selection phase, candidates were asked to give a price to reward the full disclosure of their location tracks for one month. The average bid proposed by participants for compensation turned out to be quite low, highlighting the difficulty for people to evaluate privacy risks in location sharing.

The difficulty of users to find added value in location sharing technologies was underlined in a paper by Tsai et al. [11], in which researchers also underline the lack of privacy controls felt by users. To overcome the highlighted issues, the same research group introduced Locaccino [10], a location sharing mobile application in which the privacy model is based on rules that users can set to limit their sharing.

A study by Consolvo et al. [2] was conducted explicitly asking people to disclose their location data. It turned out that the most important factors that people take into consideration before disclosing their location data are: *who* is requesting location data, *why* he needs it and at *what level* of detail.

Our approach differs from that of Locaccino in the privacy model: instead of relying on the user to create and manage his custom-built rules for limiting location disclosure towards specific people at certain times, we propose activity-based sharing tool, that users can use to accomplish to specific tasks. In our previous work [6], we expressed the need for different privacy models while using tools which have different goals, and in which the interaction with other subjects (i.e.. for instance, service provider, intended recipients or unintended recipients) varies depending on the specific goal. Here, we propose some activity-based tools and we report how people evaluated them in our user study.

3. THE USER STUDY

The study is composed of two independent parts:

1. a semi-structured interview, which had the goal of eliciting participant's needs, opinions, usefulness and concerns regarding location sharing both in general and on some specific functionalities; and

2. an evaluation session where participants were asked to follow pre-defined scenarios for assessing the paper prototypes of our application.

Participants for this study were recruited both through flyers on campus, to advertise the study among students, and among acquaintances of students, to also involve people outside the university, such as professionals and high school students. Overall, we had 8 participants from USI Informatics faculty, 4 professionals and 2 students from high schools. We had in total 14 participants, among which 8 males and 6 females. Their age is the range of 16-25 for 9 of them; in the range of 26-35 for 3 of them; one in the range of 36-45 and one over 46 years of age.

We had a first run with 7 participants who took part both in the interview and in the prototype evaluation session. Participants to this phase were rewarded with a 20 CHF bonus voucher for shopping in a well known store downtown Lugano. The sessions lasted around 60 to 80 minutes, and most of the time was dedicated to the prototype evaluation part. A second run was performed with other 7 participants, who only took part in the interview. Volunteers among students in the Informatics department of USI took part in this second phase.

The first questions of the interview were conceived to introduce the discussion about location sharing with participants, make them speak their minds about how they fell the utility of location sharing. After filling out a short questionnaire with their basic demographic information and their use of common SNS such as Facebook or Twitter, participants were guided to brainstorm their thoughts, impressions and needs about sharing location. We introduced the topic of location sharing asking them how often they happen to receive phone calls in which they are asked questions like *"Where are you?"*, what's their usual answer, and whether the answer actually depends on the person calling them. The discussion about the recipient of the communication involved also the analysis of their actual use of the SNS and how they are used to share information - and more specifically of their location - with their contacts. After this, many participants started expressing general remarks or concerns on sharing their location with others, clarifying in which conditions they would feel comfortable sharing their location,

with whom they would like it to happen and with whom instead they would not like to. We then asked them to describe how a hypothetical "dream application" for location sharing should be done for them, how would they like it to work, and how would they like location sharing to happen. Some of the participants suggested several practical use cases in which they find location sharing useful. Moreover, we ask them to focus on other sides of the problem, such as at what level of detail they would like to disclose their location, to whom, and what they would like to know about others.

Finally, we described three functionalities that will be present in our prototype application, and we asked participants to comment their utility and to evaluate them. These functionalities were described in the following way:

1. **Long-standing location sharing.** You can continuously share your position with your friends, so that you and your friends can constantly see each other's locations. You can decide to disclose your location at various granularity levels with different people: "Country", "Region", "City" and "Best" levels are available. Furthermore, you can decide to use a dynamic granularity: friends in the same city will see best level location; friends in a different city but in the same region will see only city level location; friends in different region but in the same country will see region level location; and people in different country will see country level location. In this mode, the more detailed granularities can still be made unavailable, limiting the precision of the reported location.

2. **Proximity detection.** You can decide to share your location with some of your friends only when you are "close" to them; you and your friends would then be notified of each other's presence in the neighborhood automatically, but no information would be disclosed to friends which are too far from you.

3. **Rendezvous.** You can decide to share your location with a group of friends with whom you decided to meet. You and your friends will start sharing your location only in occasion of the meeting, so that everybody is informed about who is late, who is arrived first and is waiting for others, etc...

The first 7 participants also took part in a paper prototype evaluation session, in which we proposed them to act following three scenarios, each of them built for one of the functionalities, using a paper prototype of the interface. The participants who didn't take part in the paper prototyping session were asked to comment on each functionality, in which situation they would feel it useful, and with whom they would use it with.

3.1 Results of the interviews: discussion and remarks on location sharing

The very first feedback we received from our participants confirms that people's location plays an important role in social relationships. Almost all the participants agreed that in a phone call often they happen to report their location or to ask someone else's location in order to coordinate with others, to meet, or simply to share it with family members. Moreover, an important role is played by the recipient of their communication, as already underlined in the paper by Consolvo et al. [2]. The participants faced the discussion on location sharing while at the same time often associating the particular recipient involved in the communication, being it a group of friends, household members or strangers, and discussing the role played by these people within their social network, as underlined by participant 12: *"I would like to allow some friends privately to know my location; not for all of them, but only for selected friends"*; and by participant 8: *"I have friends that I can trust"*.

For most of the participants sharing their location with others has a clear value, but they also take into account the opportunity to limit in some occasions the location disclosure towards their friends, and more in general to keep in control of their sharing tools, as summarized by participant 13: *"I would like other people to know where I am, but not all the time; when I want to switch it off, I'd like to have the possibility to do so, or if I want not to disclose to some people where I am, I'd like to have the possibility to do so"*. Most of the participants seem to have this kind of attitude, balancing the benefits of sharing their location with the privacy risks perceived in the contingent situation they are involved with and with the people they are dealing with; we could identify them as *privacy pragmatist* users, as defined in the work by Sever, O'Grady and Westin [8]. We could however identify *privacy fundamentalists* and *privacy unconcerned*; the former for which the privacy risks are systematically predominant (e.g. participant 11: *"I don't want to let other people know where I am". "I don't trust anybody". "We just look at our face, nobody knows what is inside"*), and the latter that always tend to neglect the privacy risks (e.g. participant 2, which would never feel annoyed for sharing his location with any of his contacts at any time).

Spontaneous use case suggestions.

Many of the participants spontaneously explained in which situations they would feel location sharing useful, and several use-case scenarios of practical use were proposed. One of the most common reasons recalled by our participants is sharing location when they are on vacation, to keep in touch with friends: *"Maybe I would like it if I go for vacation, to show where I am"*, *"I like to let other people know where I am, I'm in Venice, and I'm having a beautiful day"*. This scenario, however, does not necessarily involve a live stream of data which is kept updated, but could also be accomplished with less detailed location information, such as a city level location.

Another common situation in which our participants would feel the value of location sharing is that of a meeting: *"if you have an appointment in the city center and one is late, and maybe you can see where he is, whether he's coming or not... It would make things simpler"*; *"I had to go somewhere for a business trip. It happened that we were in a city, and we were in small groups, and it happened to make 10 phone calls to know where the others were... In such a case it would be many phone calls saved and much time saved... in that case it would be very useful"*; *"I would like to know whether friends are in the vicinity to have a meeting or a chat. The most useful feature is to know if we are close to each other, to have a meeting"*; *"For example, I ride the bike, and I have some friends who also ride the bike; sometimes we go for a ride in the same day without knowing about each other, so it would be nice if we can make the trip together"*. We were happily surprise that many participants were actually anticipating one of the functionalities that we were going to

propose them, on which we explicitly wanted to ask their comments.

On the other hand, there are cases in which sharing location may be inconvenient; participant 6 described a real situation in which one of her friends happened to be in an unpleasant situation: *"On one side, you could say, if you're not a close friend, I don't care if the other person knows where I am, but there are those people that like to nose about others, that say "oh, look, she has been there, I wonder what she did there". I would like to know why they want to know, because in the end they could use it against you; anyway, if it works, for me it wouldn't be a problem, but if somebody starts making up stories about me, at that point yes, this could piss me off. In my case it did not happen, but I have a case in mind... For instance, you know that a guy disputed with a girl, and then I see another friend of mine near the girl, and you can start saying "You know? I've seen him near her, he went there for sure for this reason", but instead he was there just by chance, but people start making up stories...".*

Moreover, another participant pointed out that location sharing can even be useless when reporting routine: *"location sharing is maybe even useless during my daily activity, because I'm at work, and everybody knows, it gives little information".*

Privacy concerns.

In general, besides recognizing the value of location sharing, many of the participants introduced right away some privacy concerns as well. The participants to our study clearly underlined the sensitivity of location data, and expressed the need to differentiate among different groups of people: *"I don't really like to share my location with people that are not involved with the situation I'm currently involved with". "Location is a very private thing, maybe someone doesn't want to share his location for some important reason I don't now". "Location is one of the most sensitive things". "I don't want to expose my location to everybody, just to a small group, only to those I care about or I'm in touch with". "To very close friends I'd like to show every time where I am, but maybe with my parents I wouldn't like to share where I am at every specific time. For other friends, not so close to me, it depends on the time; sometimes I'd like to share where I am, and sometimes not".*

Another privacy concern involves the way in which location is shared: if one's location is automatically and continuously updated, people might feel uncomfortable, like participant 12: *"I don't like my position to be automatically tracked".*

Role of the service provider.

As already pointed out in a previous work [6], the service provider has a very sensitive role: while it has to guarantee the routing of location data among users, in principle there is no need to let the service provider know or, worse, collect users' location data. Some of the participants were critical about the role of the service provider: *"First of all, I would like to know that the data are safe, the service provider should not know what I'm doing. The provider should convince me that my location data are treated in a safe manner".*

Need for control.

One of the key points of the interview was clearly the need for control of the sharing tools. Our participants expressed many times the close connection between the utility of location sharing and the control they need to have on the tools for sharing their location: *"I would like to control when to share my location and with whom". "For me, it would be important to know that I can mostly control what I am sharing". "I'd like to have the chance to switch it off". "I would like to control when to share my location and with whom. Default contact groups would make it easier to arrange it".*

4. THE PROTOTYPE OF OUR SYSTEM

In this paper, as introduced in a previous works [7], we complement the concept of long-lasting location sharing, already familiar to many users thanks to the well known Latitude, with other tools that can be used for more specific tasks. While in our previous work we introduced the use case scenarios for these new functionalities, here we present a new interface where such tools are presented to users.

The three main functionalities conceived for this application, introduced to the participants of our study in the way already described in Section 3, are characterized by a growing relaxation of connectivity constraints: starting from the known long-lasting location sharing (in which users can decide to share at varying levels of detail), people can opt for the "proximity detection" functionality, in which location is shared only with people in the neighbourhood and users can be notified about the presence of friends, to finish with the "rendezvous" case, in which sharing is managed completely ad-hoc for a specific meeting.

The main screen of our prototype is shown in Figure 1(a): on top of a map view there are four icons: one for become invisible to others, one for managing proximity notifications, one for creating new meetings and the last one for adding new contacts. Moreover, a side slider on the left allows to show the on-line contacts, and a tab in the bottom side of the screen leads to a monitoring screen for rapidly checking with whom location is being shared.

4.1 Long-lasting location sharing

This first functionality, which is very similar to e.g. Latitude, received quite a lot of criticism: some participants did not like it at all (participant 12: *"I really don't like it."*, participant 9: *"I don't like automated location sharing because I cannot control it."*) because of the perceived intrusiveness of such a tool. Another participant criticized the utility of such a functionality: *"People would need some more added value for sharing location".*

Other participants found this functionality useful, but they would limit its use to a limited number of very people, which typically involves family and very close friends: *"I can share at any time with 3 to 5 people, not more; others should ask"*; *"Household members should know about my location, otherwise they start asking me"; "For contacts other than household members, it depends on the situation"*; *"If I'm at home waiting for my sister so that we have dinner together, I'd watch on the map to see when she leaves work, then I'd use it".*

Usability and simplicity of use, however, must be ensured in order for the tool to be useful: *"I would like to share my location constantly with my family, if it was simple for them to see it"*; *"My mum cannot use personal computer to keep in touch all the time, so maybe if she had that application, she'd have it open the whole day to see where I am and what trips I'm doing... She knows that I'm doing a trip around*

(a) Home screen of the application.

(b) Sharing options available.

(c) Rendezvous: creation of a new meeting.

Figure 1: Interface prototype of our location sharing application that was evaluated in the study.

Switzerland and she would be very interested to know that now I'm in Zurich, now I'm in Basel, now I'm in Bern... she would like it very much, definitely!"

One of the participants questioned the nature itself of this tool: *"If somebody wants to see where you are, it means that he wants to nose about you. If somebody has genuine intentions, he calls you, or asks you "where are you?" If instead he looks for programs for tracking people he does it with a weird intention... Maybe because it's not too used today... Maybe further on, if everybody will start using it, it will look more normal".*

Another user, which is perhaps more used to these kinds of tools, likes the functionality and doesn't feel threatened by it: *"I think that I don't have problems, because I know that the phone will work in this way. We are in a society where I share my location, my friends share too, but I want the possibility to hide something".*

the possibility to share location at different levels of detail (we called them location granularities), as shown in Figure 1(b), slightly improved the satisfaction of participants, perhaps enlarging the choice of potential contacts to use it with: *"I don't like it; I would feel more comfortable with country level location, I'd use it with 99% of the people"*; *"You could play with it a little bit more, but I wouldn't use it"*; *"More granularities would help me add more people in the list"*; *"Probably sometimes more details would not be useful to someone far from me, but if there's more detail, it's not a problem"*; *"it would expand my list of contacts".*

The introduction of the dynamic granularity, i.e. automatically determining the granularity level depending on the reciprocal position with others, was hardly understood by users, and didn't substantially change their opinion on this functionality.

4.2 Proximity detection

Despite researchers have developed algorithms for privacy-aware proximity detection (refer e.g. to the work by Mascetti et al. [5], or to the one by Šikšnys et al. [9]), to our knowledge there are still no field studies in which the use of proximity detection is evaluated with people. We introduced this concept in our prototype, where users can decide when and with whom to use it, as shown in Figure 1(b).

The general feedback we received on proximity detection is positive; only a few people found it useless (*"Useful? Not that much, actually... During the day, either I disclose my location or not"*), while most of the users found it useful: *"Maybe more useful than continuous sharing"*; *"I would keep it always active, so that I can know who's around"*; *"Ok, to notify someone, when I have time".*

Several participants recalled practical cases in which they would be happy to use it, e.g. participant 3: *"Some days ago I was here and I needed to know where a friend of mine was, because I couldn't contact her - she wasn't answering because she forgot to turn off the silent mode - and I needed to know where she was, and even calling her I wouldn't have found out where she was. Knowing that she had to move towards me, it would have been useful, because then I could have looked for her instead of waiting for her to move"*; participant 5: *"This summer, for the Olympic games, it will be interesting knowing whether people from other groups are there; maybe I know they will also go there, but I won't know whether they're in London already, or if they're nearby. It happened at the last world championships that we met with another group by chance at the exit of the gym"*; participant 14: *"That would be very interesting, I would like it definitely! Because all the time I have to inform my friends that I'll be a bit late again, and I have to call them every time... With*

this they would see me. That would be perfect, actually!"

A problem with this functionality can lie in the management of notifications, balancing them appropriately: *"A problem could be [receiving] too many notifications"*; *"But if I walk near some place frequented by friends, I would get "bombed" by too many notifications"*; *"Useful, but notifications can bother me"*.

4.3 Rendezvous

With this functionality, users are offered a tool for completely ad-hoc location sharing. Our rendezvous tool is similar to what's offered in Glympse[5]; however, in our system users are offered a range of choices by which they can decide the tools according to their needs. The interface for the creation of new meetings is shown in Figure 1(c): users can create a meeting in a given place inviting a group of friends to share their position only for a certain time.

Participants agreed on the utility of this tool, and there wasn't much discussion about it: *"This is very useful"*; *"It is very useful, I really liked It"*; *"Very useful. I would be using this one"*; and even the more cautious users (privacy fundamentalists) liked the idea: *"This I find useful. 100 %."*

This tool collected the most consent perhaps because people felt the concept of rendezvous lacking in other approaches, and commented it usually very positively: *"I'm thinking about when a bunch of people want to be together in some place and... a lot of mistakes... people late, you know... this is definitely going to organize things"*.

Several users judged the rendezvous functionality as the most useful among all the available: *"This is much lighter and useful, I mean, this is exactly what I want. I don't want huge lists of contacts, I don't care. I just care of small tasks and light tasks that fit me, and that's it"*; *" This is the most important functionality, because I almost everyday have meetings, and I spend a lot of time arranging them. I want some things to be private, days that I want to be alone, and be alone and no one knows where I am, or only my best friends know where I am. I would like to have the possibility to decide"*.

5. CONCLUSIONS

In this paper we have presented the results of a qualitative study in which three functionalities for location sharing have been evaluated in 14 interviews.

Long-lasting sharing was considered useful when used with a very limited group of trusted people, usually composed of family and very close friends, while most of our participants would decide not to share with contacts outside this small group. In general, criticism was pointed towards this mode of sharing, which could result in excessive exposure to others (people feeling tracked), and in some cases with limited usefulness. Proximity notification was usually appreciated by participants, who gave examples in which such a tool would have been helpful. However, the most successful functionality was the rendezvous, because of its light impact on people's data and ease of use. Our findings highlight that task-based sharing is important to improve the utility and understanding of location sharing to users.

The outlook of this work is to test the concept evaluated in this paper in a month-long study, in which participants can use the system together with other people belonging to their social circles and can evaluate them over a longer period of time, supporting their answers with extensive use of these tools.

[5] `http://glympse.com`

6. ACKNOWLEDGEMENTS

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