Understanding Mobile Social Behaviour Using Smartphones

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ABSTRACT

Understanding the behaviour of users as they share information with mobile social applications is important for enhancing their experiences and improving the services provided. In this paper, we present an approach to studying users' behaviour with the Experience Sampling Method, using a single mobile device to ask questions of users and simultaneously monitor their activities and contexts. While our approach presents benefits compared to traditional questionnaires, we also present the challenges faced, and the problems still to be explored.

1. INTRODUCTION

More and more mobile social applications have become available to smartphone users, allowing them to share personal information with their social networks anywhere at any time. Designing such applications must not only provide users with the ability to share information, but also take into account their concerns regarding disturbance, intrusiveness, and social implications of sharing personal information in their everyday lives. Failure to do so may lead to public outcry or expensive redesigns of services after they have been launched, as has occurred recently with Facebook's privacy controls[1], or Google Buzz.[2]

Studying users' behaviour is paramount for understanding these concerns. Formal interviews and questionnaires allow us to collect self-reported information about users' behaviours when using mobile social applications, but users may forget some details about their experiences or report inaccurate information when answering questionnaires. The behaviour of mobile social application users can also be studied by analysing the information shared on social network sites (SNSes), but this only allows the examination of those information that have been shared, rather than the information that have not been shared, or the contexts in which users do not wish to share. A third way to study users' behaviour, that addresses some of these drawbacks, is the Experience Sampling Method (ESM) [6]. ESM is a diary method that consists of asking participants to stop at certain times, either on a pre-determined basis (signal-contingent) or when a particular event happens (event-contingent), and report about their experiences in real time.

In this position paper, we advocate the use of ESM, possibly in addition to questionnaires and analyses of SNS accounts, for capturing information about mobile users' behaviour *in situ*, when the mobile social application is actually used. We share our experiences in using a mobile phone for asking questions of participants about their self-reported experiences, and for collecting data about their actual, rather than self-reported, behaviour.

The remainder of this paper is organised as follows. In the next section we describe our testbed using ESM with smartphones to study the behaviour of mobile social application users. We then share our experiences in deploying and using such testbeds by presenting their benefits compared to surveys and SNS anaysis in Section 3 and the challenges raised in Section 4. We finally conclude the paper in Section 5.

2. EXPERIENCE SAMPLING WITH SMARTPHONES

ESM has already been widely used to study users' behaviour by polling participants in real-time during their everyday lives, particularly studying how they share their location. Consolvo et al. [4] use PDAs to ask signal-contingent questions to participants at random times about location disclosure to their social relations. Disclosure to their social network was hypothetical and questions were both asked and answered through the same device. Anthony et al. [1] study how privacy preferences vary with place and social context by sending basic signals to participants using pagers, for them to fill in questionnaires in a notebook. Disclosure was also hypothetical, and since questions were too numerous to be easily answered on an electronic device, they were both asked and answered through the notebook.

Our research is interested in how, when, where and to whom people share their locations with their social network, to better understand their privacy concerns. We go a step further than previous experiments by actually disclosing location to the participants' social network. Moreover, we use a single device to detect location, ask ESM questions, and then collect both ESM answers and detected locations. We believe that carrying only one device is much less intrusive than carrying a notebook to answer the questions, a pager for the signals that an ESM question must be answered, and a sensing device to collect automatic data such as location.

Our first experiment [2] involved 40 participants sharing their location to their social network with a smartphone over the course of one week. Each participant was given a Nokia N95 8GB smartphone, constantly running a custom application that detects their location using GPS and Wi-Fi scanning. Locations were regularly uploaded to our server through the cellular network, and published on their Facebook SNS account according to their disclosure choices. To this end, participants were asked during a pre-briefing session to set up friend groups on Facebook if these did not already

[1] http://mashable.com/2010/05/23/facebook-ceo-mistakes/
[2] http://news.bbc.co.uk/1/hi/technology/8517613.stm

Figure 1: Using a smartphone to ask a participant whether he/she would share a photograph with his/her social network friends.

exist (e.g., family, classmates) and default disclosure choices.

Six types of signal- or event-contingent ESM questions were sent to the participants through an SMS handled and displayed by the application:

- **Signal-contingent.** Ten signal-contingent questions were sent each day, at random times of the day.
  1. *"We might publish your current location to Facebook just now. How do you feel about this?"*
     We asked the participant about his/her actual feeling by reminding that his/her location can be published without any consent. The participant could answer this question on a Likert scale from 1 to 5.
  2. *"Take a picture of your current location or activity!"*
     The participant could accept or decline to answer this question. If the participant answered positively, the phone's camera was activated and the participant was asked to take a photograph. .
- **Event-contingent.** Up to 10 questions per day were sent whenever the system detected that the participant had stopped at particular locations.
  1. *"Would you disclose your current location to:* [friends list]*?"*
     We asked the participant for the friends lists to whom he/she wanted to share his/her location. We first asked if the location could be shared with 'everyone'. If the participant answered 'Yes', then the question was over and the participant's location was shared to everyone on Facebook. Otherwise, if the participant answered 'No', the phone asked if the participant's location could be shared with 'all friends'. If so then the question was over, and the location was shared with all of the participant's Facebook friends. Otherwise we iterated through all of the friend lists that had been set up by the participant. Finally, sharing with 'nobody' implied answering 'No' to all the questions.
  2. *"You are around* [location]. *Would you disclose this to:* [friends list]*?"*
     This question mentions the detected place. This is to determine whether feedback from the system makes a participant share more.
  3. *"Are you around* [location]*? Would you disclose this to:* [friends list]*?"*
     This is the same question as above, but we asked the participant to confirm the location. If the participant confirmed the location, then we asked the second part of the question. Otherwise, we asked the participant to define his/her location by typing a short description before asking the second part of the question. This was to determine the accuracy of our location/place-detection.
  4. *"You are around* [location]. *We might publish this to Facebook just now. How do you feel about this?"*
     This question was intended to examine preferences towards automated location-sharing services, e.g., Google Latitude [5]. Locations were explicitly mentioned to determine whether the participants felt happier when the location being disclosed was mentioned. Note that this question does not ask to whom the participant wants the location to be shared: default settings given in the pre-briefing were used instead.

Figure 1 shows how we ask participants for their sharing preferences when they take a picture of their location or activity.

3. BENEFITS

Analysing the data available on users' SNS accounts is an attractive method for collecting large quantities of data. Paterson and Siek [10] studied information disclosure and awareness of disclosure implications on Couchsurfing.com, an online social networking site where users connect with others interested in traveling and staying at each other's homes. Nosko et al. [8] examined disclosure in online social networking profiles of Facebook users. Patchin and Hinduja [9] determined the extent to which adolescent information disclosure on MySpace.com has changed between 2006 and 2009 by analysing their personal content made publicly available. Lewis et al. collected and studied Facebook profiles and friendship networks of 1,710 college students from 2007 to 2009. But such studies can only focus on the information shared by participants. Nevertheless, the information that is *not* shared is also important, especially if we are to understand the concerns that lead to information not being shared. In our ESM studies, we encourage participants to share their location when a new location is detected and to share pictures of their activity. When the participants decide to keep their location or picture private by not sharing it with anyone, we know that this information does not appear in the user SNS account. Hence, our method also allows us to study what information is not shared by participants. To illustrate that private locations (i.e., not shared to anybody) can be detected, Figure 2 shows the proportion of private locations for each location type. Participants of our experiment kept their location private when at the Library, much often than when they were at a Leisure or Academic place. When participants are at the Library, only 64.7% of locations appear on their

Table 1: Location-sharing choices of participants.

Group	*Number of participants*	*Responses to location-sharing requests*	*Locations that were shared*
Never share location on Facebook	31	431	77.5%
Share location on Facebook	9	95	78.9%

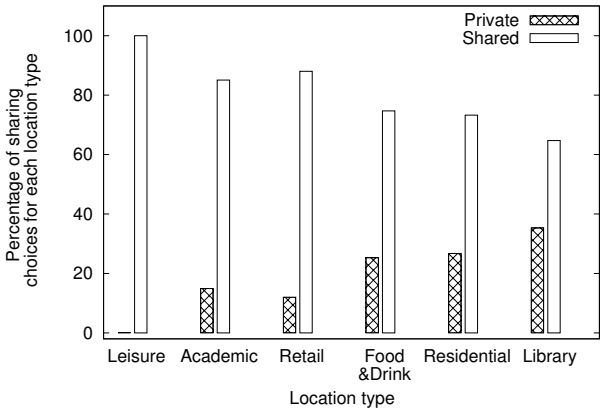

Figure 2: Proportion of sharing choices at different types of locations. Leisure locations were always shared with someone.

SNS accounts, and analysing only this shared information would disregard the important fact that the participants decided to keep their location private when at the Library 35.3% of the time.

Compared to surveys, our method collects answers with the device when participants are actually using the mobile social application, during their everyday lives. This provides us with more accurate answers than when they are asked through a survey where they may forget about the context and their actual behaviour. Moreover, asking the participant several times during the one whole week at random times and locations provides richer data for analysis: we received 2,054 *in situ* answers to the ESM questions and our system detected 2,011 locations. Participants expressed their sharing preferences for 988 of these locations, and took 730 photos, always with sharing preferences. Another benefit of our method is that collected data can be compared to self-reported information provided by questionnaires. Before our experiment, we asked participants to fill in a questionnaire where they were asked whether they shared (at least once) their location on Facebook (e.g., by mentioning their location in their status updates). Out of 40 participants, 31 of them reported that they never share their location on their Facebook accounts. During our experiment (cf. Table 1), those participants who self-reported to never share their location on Facebook actually shared 77.5% of their locations, while participants who self-reported to share their locations on Facebook shared 78.9% of their locations. In other words, while their self-reported behaviours were very different, the actual behaviour of these two groups was very similar, and this behaviour would have been missed by a questionnaire alone.

4. CHALLENGES

Compared to SNS analysis or traditional surveys, implementing the Experience Sampling Method to study the behaviour of mobile social application users is more complicated and time consuming. Our method requires designing, implementing and deploying an appropriate testbed composed of smartphones to collect data and a server to monitor and store these data. But while it would be difficult for our method to be as simple as a traditional survey or an analysis of participants' SNS accounts, there are a few main challenges we can address to improve the method and avoid its potential shortcomings.

A first challenge is to reduce the energy consumed by the smartphones. Using a single device to collect data, ask questions and collect answers necessitates the use of more energy than the normal use of such a device to answer calls. In particular, monitoring users' behaviour continuously may involve multiple sensors to be triggered frequently, which may quickly deplete the battery. Hence, managing efficiently the sensors to save energy is an important challenge to collect data on participants' behaviour in their everyday lives. For instance, in our system, we use the accelerometer embedded in most smartphones to detect motion, and switch off the GPS when the participant is not moving to save energy [3].

Another challenge is to avoid the experiment being too intrusive. Polling participants in their everyday lives may disturb them and answering ESM questions may be sometimes inappropriate. A partial solution is to ask participants for the times they do not want to receive ESM questions. Answering the questions may also take time, especially when they are received frequently. Instead of a notebook, using an electronic device may be easier to use when replying questions, if they are appropriately designed to be quickly replied, by pressing a few keys. But avoiding to ask some questions is even better: detecting an activity or a context instead of asking the participant not only provide other data than self-reported information, but also helps understanding the ESM answers given by the participants. For instance, the location can be detected instead of asking the participant.

Remotely managing the devices while they are used by the participants is also challenging. Participants can move anywhere during the experiment and so monitoring malfunction and and misusage of the device is difficult to achieve. Using smartphones is helpful here, as commercial cellular networks can be used to communicate with the device, rebooting it or for downloading an updated version of the experimental mobile social application.

As for every experiment involving human beings as participants, ethical considerations must be carefully taken into account, especially when the experiment is running during their everyday lives, as personal information may be collected. In particular, privacy issues may be experienced by the participants, and, although unlikely, potential psychological harm, discomfort, or stress. For the latter, the risk is difficult to quantify or anticipate in full prior to the start of the experiment, but the participants always have the option to withdraw from the experiment at any time, without any justification. As for privacy issues, what, how, and when data is collected must be made clear to the participant before they provide any consent to participate, as well as where information is stored and who has access to it. Anonymisation of personal data allowing participants' identification must be guaranteed.

5. CONCLUSION

In this position paper, we advocate using ESM to get better data on the behaviour of users sharing information with mobile social application. ESM allows collecting experiences *in situ*, which we believe is more accurate than when collected later through a survey.

To implement ESM, we suggest using a single device to ask questions and collect the answers, but also to monitor data that is not self-reported to better understand the user's behaviour.

Our use of the ESM methodology has multiple benefits compared to questionnaires, and can provide additional data in the information that is not shared by the user. Nevertheless, there are a number of challenges that we addressed, and solutions that still need further exploration. To this end, we are in the process of designing and running further studies.

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