# I Don't Mind Being Logged, but Want to Remain in Control: A Field Study of Mobile Activity and Context Logging

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## ABSTRACT

People have a natural tendency to capture and share their experiences via stories, photos and other mementos. As users are increasingly carrying the enabling devices with them, capturing life events is becoming more spontaneous. The automatic and persistent collecting of information about one's life and behavior is called lifelogging. Lifelogging relieves the user from manually capturing events but also poses many challenges from the user's perspective. We conducted a field study to explore the user experience of mobile phone activity and context logging, a technically feasible form of lifelogging. Our results indicate that users quickly stop to pay attention to the logging, but they want to be in control of logging the most private information. Although logging personal content, such as text messages, is experienced as a possible privacy threat, browsing the content and getting insight to the revealed life patterns was considered interesting and fun.

### Author Keywords

Lifelogging, mobile phone activity, context, user experience, field study

### ACM Classification Keywords

H4.m. Information systems applications: Miscellaneous.

### General Terms

Human Factors

## INTRODUCTION

People have a natural tendency to capture and share their experiences via different life mementos. As users are increasingly carrying the enabling devices with them, capturing life events is becoming more and more spontaneous. Still, many precious moments pass without people obtaining any mementos. Lifelogging, i.e., automatic and continuous recording of information of one's life events, would relieve the users from manually capturing important events.

The ultimate vision of lifelogging can be defined as "a form of pervasive computing, consisting of a unified digital record of the totality of an individual's experiences, captured multimodally through digital sensors and stored permanently as a personal multimedia archive" [6]. A lifelog may contain (1) information about the person's activities such as when and where the activity took place, and (2) the content of what was done, and said, etc. [6].

A mobile phone contains information about its owner's social connections in the form of contacts as well as phone calls and message logs. Global Positioning System (GPS) functionality enables the device to determine the location of the user and Bluetooth (BT) scanning allows the phone to detect other nearby devices and people. In addition, the camera enables users to capture memories visually whenever they want to. The use of these mobile phone features is now making lifelogging feasible. However, as lifelogging is based on rapidly developing technologies and inherently touches people's everyday lives, development may face many challenges from the perspective of user experience (UX). UX consists of the pragmatic and hedonic aspects of use [11], and thus is dependent on both functional and emotionally meaningful features of the system.

This paper focuses on the UX of mobile phone activity and context logging. We conducted a field study with 13 participants who used such a logging system. We studied how the awareness of logging affects users' behavior, their sense of privacy and the extent they need to be able to control the logging to feel comfortable with it. Furthermore, we studied what information people find interesting and valuable as well as what information is considered too sensitive to be logged and what information is considered useless. Finally, we wanted to explore the purposes that users have for logging information and what their needs are related to sharing their logs with others.

## BACKGROUND AND RELATED WORK

### *A Short History of Lifelogging*

The idea of lifelogging dates back to the 1940's when Vannevar Bush suggested a private file and library system called "memex" for storing all of an individual's books,


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records, and communications, which could be consulted with speed and flexibility [2]. Since then, many lifelogging experiments have been based on the idea of recording all the things one experiences in life in visual or audible form, for example, on video using a head-mounted camera for recording and broadcasting the user's life [4,13]. In these experiments, the researchers have recorded their own life and introspectively analyzed the experience.

Other "memex"-like approaches have also been presented. MyLifeBits by Microsoft is a research system storing all personal information found on a PC. Its goal is to store everything that can be captured, including Web pages, phone calls, meetings, room conversations and mouse clicks for every active screen or document, as well as all the 1000-2000 photos that SenseCam captures every day [8].

In the 1990's, Donald Norman [15] speculated about a small and portable Personal Life Recorder device named "Teddy" that would be given to children in the early childhood. The device would record all of its owner's life moments, and the collected data would be transferred to devices matching the owner's maturity level.

Modern mobile phones contain various personal life activity logs and are increasingly starting to resemble the idea of "Teddy". Based on that idea, researchers at Samsung Electronics Software Laboratory have developed a mobile life diary that records all of the mobile phone's activities [19]. The life diary ecosystem also has a larger infrastructure including the PC and the Internet to enable keeping track of personal music, photo, video and file collections. A similar commercial system, Nokia Lifeblog, implements the collection of content recorded with a mobile phone as well as software for browsing the content with a phone and a PC [14]. It supports storing photos, videos, text messages (SMS), multimedia messages, notes and blog entries.

Although many different lifelogging implementations have been introduced during the last decades, very few UX studies have been conducted. This is largely due to the controversial ethical and legal issues related to lifelogging. Speculations and predictions made on the implications of lifelogging are described in the next section.

### *Benefits and Risks of Lifelogging*

Lifelogging enables the capturing of precious moments in a person's life, allowing that person to focus on experiencing the moment with little or no interaction with the capturing device. However, further benefits have been predicted: a lifelog would work as a memory aid, it could be used in sharing personal experiences with others, and it would foster personal reflection and analysis [1,5]. Additionally, it could help in time management through the coordination among family, friends, and co-workers, and increase security as the logged information could be used for legal purposes, e.g., as an evidence [5]. Thus, it is easy to see why the automatic and continuous capturing of one's life appeals to people [9].

There are, however, many controversial legal and ethical issues related to lifelogging, No matter how well the recorded memories are secured, the external records are still easier to access by third parties than human memory and thus pose a data security threat. The opinions of people differ when it comes to losing privacy and control over what is recorded. Most people are not willing to relinquish this control [17].

Cheng et al. [3] predicts that systems that record an individual's perspective of the world, using personal sensors such as a microphone and a camera, will emerge and they will radically change our notions of privacy. Like we expect almost everyone to have a mobile phone today, in the future we might expect everyone to record their lifelogs and hence be able to recall things that most people would have normally forgotten.

Access to extensive records of one's life has its downsides. Complete and objective memories of past, traumatic events that one would normally forget over time may have a very negative effect on mental well-being. Moreover, the availability of an extensive lifelog might lead to pathological rumination of one's past and over-valuing the otherwise transient details of one's life [1]. These issues pose a great challenge for lifelogging system design.

Furthermore, recording one's life is restricted not only by an individual's privacy concerns and the community norms, but also by legislation. When recording one person's life, many aspects of the lives of people around him or her are also recorded, and the statutory consent requirements pose great challenges for lifelogging [3]. Olsson et al. [17] suggests that one solution to recording data continuously, but yet more ethically, is to record mere context data excluding audio and visual media.

Allen [1] lists the following ethical limitations for lifelogging: 1) No one should be required to keep a lifelog and no one should be suspected for not keeping one. 2) Personal lifelogs should be deemed the property of the creator and no one should record the activities of others for a lifelog without their consent. 3) The owner/subject should be able to delete and add content at will.

### *Lifelogging and Sharing*

The need to save memories is often interconnected with the idea of also sharing them with others [17]. A lifelog consists of a much wider range of personal media content and other recorded information than just photos. However, as the personal photos represent mementos of past events, the motivations and patterns related to photo sharing may well apply to the sharing of lifelogs.

Van House et al. [21] divide the motivations for sharing camera phone photos into five categories: creating and maintaining social relationships, constructing personal and group memories, self-expression, self-presentation, and

functional purposes. Furthermore, camera phone photos seem to be shared with people who pose in the pictures or those who should have been there [17,21]. Olsson et al. [18] argue that the recipients of this kind of personal content usually do not vary much for an individual user.

*User Experience of Lifelogging*

Hassenzahl and Tractinsky [12] define user experience as "a consequence of a user's internal state, the characteristics of the designed system and the context within which the interaction occurs." According to Hassenzahl [10,11], people perceive interactive products along two different dimensions: pragmatics and hedonics. Pragmatics refers to the product's perceived ability to support the achievement of "do-goals", and hedonics refers to the product's perceived ability to support the achievement of "be-goals". Assessing pragmatics calls for a focus on the product – its utility and usability in relation to potential tasks. Assessing hedonics calls for a focus on the user himself, i.e., the question of why does someone own and use a particular product, and what are the emotional responses that the users have by using the product.

The user experience regarding lifelogging is not only about the logging of life data itself. In addition to recording, the total experience of lifelogging includes the interaction with the recorded material afterwards or simultaneously with recording. Therefore, important issues affecting the lifelogging UX include the experience of controlling the logging, including what is logged and when, as well as any interaction with the logs by browsing, editing, or sharing the logged information with others.

Previous studies have been mostly speculative predictions about the issues that will emerge from lifelogging [1,3,6,16], and only a few studies on real user experience have been reported [4]. The present study's goal is to conduct a field study of 13 participants in order to gain a more thorough understanding of UX issues related to lifelogging. Because such extensive logging has many legal and ethical issues as well as privacy implications yet to be solved, we used a limited set of logged information and let the user have more control of the logged content than in the prevalent scenarios of lifelogging. Furthermore, we aimed at gaining an in-depth understanding of the logging UX by analyzing how the pragmatic and hedonic aspects are emphasized.

## FIELD STUDY

There have been lifelogging studies focusing on the continuous recording with wearable cameras and media content indexing on the personal computer [4,8,13]. Our focus was on the material recordable with a mobile phone, a personal device that people frequently carry with them. The phone logged the content available on the phone, the interaction the user has with the phone and the context data recorded from the environment.

### Study Setup

The field trial with three participant groups of a total of 13 users was conducted in Finland. The study lasted from eight to eleven weeks depending on the participant group. The study started with a six to nine week long logging periods (varying between the user groups because of the recruitment practicalities), and then proceeded to the phase where the users could use a web application to browse and share their logged data. The logging period was intentionally longer than the browsing period so that the users could gain a long-term perspective of their logs.

Users had phones running a logging client application and Flickr (www.flickr.com) accounts for storing and viewing the photos and videos they captured during the trial. In addition, they had approximately 10 days to use the web application for viewing their own and their friends' shared logging information, including the photos stored on Flickr. During this time, users still employed their phones to log their mobile phone activity.

*Logging Setup*

As the recorded information extended to personal data, we met the potential participants face-to-face before the trial to introduce them to the objectives and details of the trial. Users also created accounts for the services used in the trial: Flickr, and ShoZu (www.shozu.com). ShoZu was used for getting GPS coordinates to the photos and videos and for uploading them to Flickr.

In the following meeting, the users were lent Nokia N95 8GB camera phones. The phones contained the ShoZu application for uploading photos and videos, and the Nokia Simple Context Collector for performing the rest of the logging. The following three types of context information were recorded and periodically uploaded to a server:

- Location: The GPS coordinates and GSM cell IDs
- BT devices: For example, the BT names and the Media Access Control (MAC) addresses of the nearby BT devices
- Wireless Local Area Networks (WLAN): For example, the access point names and MAC addresses of the nearby WLAN devices

In addition, the following actions were logged and uploaded:

- Made and received phone calls: For example the timestamp, direction, duration, as well as the phone number and name of the other party.
- The text messages that were sent and received, e.g., the timestamp, direction and contents, as well as the phone number and name of the other party.
- The music tracks to which the participants listened, e.g., the timestamp, title, artist, album and duration.

A written contract between the test users and researchers was made about the extent of logging and the principles of

using and storing the data. This way the data collection was in full accordance with the laws of Finland regarding data security of electronic communication. The information that was logged was stored for the users' own use and viewed strictly by the users themselves. Only the amount of uploaded data was monitored by the researchers to ensure that the logging clients were working correctly.

Users had an option to stop participating in the trial at any time. Furthermore, the logged information from all users was removed immediately after the end of the trial, and only the quantitative information about uploaded data amounts was stored until the end of the next calendar year.

During the study, users were asked to use the mobile phones as they would normally do. Users had their own subscriber connections in use during the trial, but they were compensated for all the data traffic expenses caused by the trial. After six to nine weeks of logging, the web application for browsing the logged information was introduced to them. Next, users had about ten days to use the application, while still having the phones logging their life information.

In this paper, we discuss the UX of the mobile activity and context logging, including the interaction with the logged data using the web application. Because the UI design of the application plays an essential role in the experience of interacting with the log, we shortly describe the UI as well.

*Web Application for Browsing the Logged Information*

During the last ten days of the trial, users were able to browse their own logged information with an Adobe Flash-based web application used via web browser. With this application, they were also able to share information with others and view the shared information of other users. Users had to authenticate themselves to the system by entering a user name and password.

The UI of the application has two main views for browsing the logged information: the timeline and the map. Both of the views present the stored information as content items represented by icons or thumbnails, depending on the media type. The supported media types are photos, videos, listened-to music tracks, text messages, phone calls and location (GPS) tracks, i.e., paths created from the sequences of locations. Metadata about an item will be presented in a tooltip when the user holds the cursor over an item.

In the timeline view, the user and his or her friends each have their own timeline. On these timelines, the user's own items as well as the items shared by their friends are shown in chronological order. In the map view, items are overlaid on top of a map at the position in which they were created (see Figure 1).

In either of the views, timeline or map, the user can open the items in a separate view where the item is presented alongside some information derived from the stored data, like friends who were present at the time of the creation of the logged event.

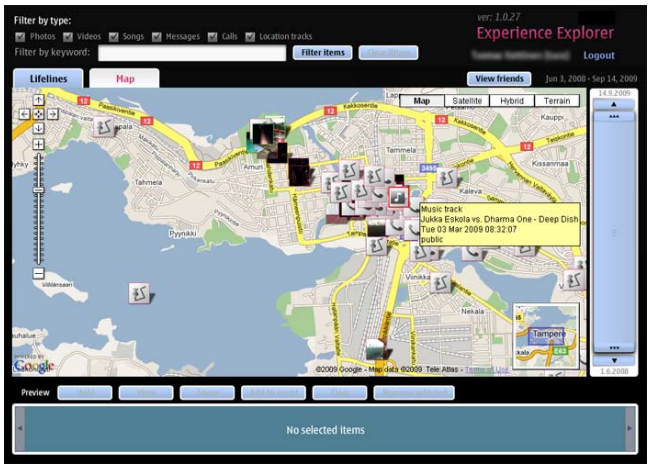


**Figure 1. Map view of the web application with a tooltip of a music track activated.**

The items the user shares with friends in Flickr are automatically shared with the same people in our system. Users can also share photos, videos, location tracks and titles of listened-to music tracks item by item with our web application.

Users can select the individual users with whom the items are shared and the extent of the shared metadata. For photos, videos and music, users can decide if the location of the item is shared. For photos, videos and location tracks, the user can also decide whether the title and the description of the item are shared. As text messages and phone calls are considered to be owned by both participants, both participants would need to agree to share these items. The required functionality would be rather complex so, in order to protect the other party's privacy at this stage, the sharing of text messages and phone call information was disabled.

**Participants**

Three groups of friends were recruited to participate in the trial: two groups of five members and one group of three members. Thus, in total, we had 13 participants (11 males and two females). All the participants were from 19 to 32 years old. Ten of the users were students, and their educational background ranged from attending vocational schools to attending universities. Two participants were working; one was a factory worker and the other person was an IT consultant.

All the participants were daily users of mobile phones. They were also active media consumers, and most of them were familiar with social media Web sites, such as Facebook (www.facebook.com), Flickr and Last.fm (www.last.fm). In addition, 10 participants were listening to music daily, and 12 were taking photos at least monthly.

The participants in group 1 were actively meeting friends (4 males, 1 female), who were living in the same city and sharing common interests. The second group consisted of two brothers who were sharing an apartment and their male friend who lived 200 km away. Group 3 consisted of a

group of acquaintances who were living in the same city (4 males, 1 female), formed around one person who knew the others.

### Methodology

Our main goal in the study was to gain insight into the subjective experiences of users' mobile phone activity and context logging. To achieve these goals, users were interviewed individually twice during the trial: after six to nine weeks of logging, but before using the web application and at the end of the trial. Both semi-structured interviews consisted of two parts: the first part was about logging and privacy-related issues and the second part was about the use of the web application.

The interviews were recorded and transcribed, and the collected data was compiled into tables categorized by the interview questions. Next, the comments were organized by the following repeatedly appearing themes: general experiences on logging, experiences on logged content types, privacy, experiences of logging text messages, sharing of logs, and behavior changes during the trial.

The logging experience was also measured with a quantitative survey at the end of the trial. The questionnaire was created on the basis of two existing UX question sets: the AttracDiff 2 questionnaire by Hassenzahl [10] and the UX elements defined by Roto and Rautava [20]. The AttracDiff 2 questionnaire measures perceived pragmatic quality, hedonic quality–stimulation and hedonic quality-identification. The UX elements that Roto and Rautava have identified are utility, usability, social value and enjoyment [20]. Furthermore, the questionnaire was created to focus especially on the aspects relevant to the UX of mobile activity and context logging. The scale was 1-7 (1 = completely disagree and 7 = completely agree).

## RESULTS

We present the results of our study by the main themes that arose from analyzing the interview data, backed up by the log data and the UX questionnaire results.

During the trial, on average, 6.5 calls, 4.7 text messages (SMSs), 1.0 photos, 15.7 music tracks, 1.3 location (GPS) tracks and 0.02 videos were logged each day for each participant. As can be seen from the Table 1, differences among the participants were large. For example, the average number of logged text messages per day varied from 0.3 to 9.9. This reflects the broad range of phone usage habits of the participants.

The average number of videos per day was very small. The only exception was one user from group 1 who uploaded 13 videos during the study. For automatically logged content, like text messages, the number of logged items remained quite stable over the course of the study (see Figure 2). In contrast, the number of photos that were uploaded manually decreased somewhat towards the end of the study. The peak

| | User | Calls | SMSs | Photos | Music | GPS tracks |
|---|---|---|---|---|---|---|
| Group 1 | M, 32 | 3.6 | 3.5 | 2.0 | 2.8 | 1.2 |
| | M, 21 | 3.2 | 5.8 | 3.3 | 72.1 | 1.0 |
| | M, 22 | 4.3 | 8.2 | 1.2 | 33.5 | 1.5 |
| | F, 21 | 5.6 | 7.1 | 1.1 | 6.2 | 1.4 |
| | M, 24 | 8.7 | 1.8 | 0.5 | 8.9 | 1.8 |
| Group 2 | M, 19 | 1.0 | 1.1 | 0.5 | 1.8 | 0.5 |
| | M, 19 | 1.3 | 1.4 | 0.9 | 10.5 | 1.0 |
| | M, 19 | 2.1 | 0.3 | 1.1 | 4.6 | 1.8 |
| Group 3 | M, 25 | 9.0 | 3.8 | 0.1 | 11.2 | 1.9 |
| | F, 22 | 11.8 | 8.4 | 0.2 | 14.8 | 1.5 |
| | M, 25 | 9.1 | 0.7 | 1.7 | 33.1 | 1.6 |
| | M, 25 | 16.1 | 9.9 | 0.4 | 4.7 | 0.7 |
| | M, 21 | 8.4 | 9.6 | 0.1 | 0.2 | 1.3 |

**Table 1. The average number of items created in a day per participant.**

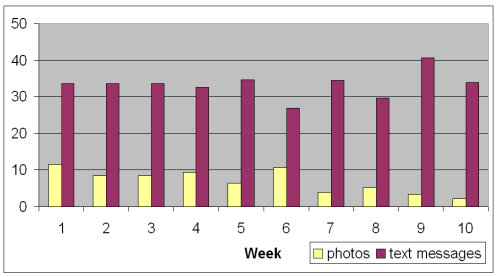


**Figure 2. The weekly average numbers (over participants) of photos and text messages logged during the study.**

at week 6 was due to one user who uploaded 69 photos in one day. Otherwise, the decline in numbers of uploaded photos was quite steady.

### General Experiences on Mobile Phone Activity Logging

Users were only a little disturbed by the logging. After the logging client had been running on the users' phones for a few days, users stopped paying attention to the logging. None of the users experienced the logging as a negative experience in the first interview.

> *"I'm really against supervisory society, so this has been very interesting. What if your every step is recorded? But I haven't noticed anything, I've forgotten [the logging] completely."* (Male, 22)

In the beginning of the study, the participants' predictions about the benefits of lifelogging included the logged information working as a memory backup and helping in getting a picture of one's life and behavior, as also predicted in the literature [1,5] and shown later in our study. Before being allowed to browse the logs, users were

thinking mainly of the personal benefits of lifelogging such as observing where they have been and how they have used their phones, but no social benefits were expected.

Browsing the logs changed the situation so that getting information about one's friends was emphasized. Users were especially interested in whether their friends did something that was out of their normal, daily routines, for example traveling outside their home town or, finding out something that was previously unknown but that was held in common among friends. These created positive experiences for users.

> *"It's the thing that you can see what you've been up to and how you've been using the phone. In a way you can analyze your lifestyle more. And similarly what your friends are doing, you can find common interests that you might not have realized before."* (Male, 21)

The perceived downside of logging included rapid battery consumption and the threat that logging poses to privacy. The latter is discussed in more detail in the following sections. As the literature predicted [1], one of the users was worried that logging might start to control one's life:

> *"It might also be somehow addictive, if the possibility to collect some statistics turns one's life to just collecting the statistics."* (Male, 21)

All in all, users considered the experience to be positive. This can also be seen from the questionnaire results as the median of the answers to the statement *I definitely want to continue data logging* was 5.5 (between slightly agree and mostly agree).

#### Experiences on the Logged Content Types and Actions

The continuous activity and context logging will quickly result in the collection of huge amounts of information. To avoid overwhelming the user, it is important to identify the content and information that is of real value to the user.

We inquired of the participants how interesting they considered the logged information to be. Before seeing their data, users were thinking of the individual data items, not what the logged information could reveal about their lives when the pieces of information have been aggregated. Still, many users considered the location information interesting, both as pure location tracks and related to photos. Despite having little practical use or emotional value to the users, the nearby BT devices and WLAN access points, otherwise invisible to the human eye, were also considered interesting. After having browsed the logs, the most interesting content types included photos, listened-to music, text messages, and location tracks. The photos were clearly the most interesting content in the web application.

This reflected also on their browsing habits. When asked what participants checked first when logging into the system, they said that they checked their own activity, especially music listening from the last few days, and then they checked the activities of their friends, and whether their friends had been nearby or whether they had shared any photos. Furthermore, when compared to the amount of each media type in the system, photos were browsed the most (see Table 2). Activity logs of the web application show that 27.6 % of the times an item was selected by clicking it, the item was an image, although only 3.5% of the items in the system were images (almost 8:1 ratio). A similar 7:1 ratio for images can be seen when analyzing the distribution of opened tooltips. The relative numbers of the browsing actions directed to the other content types were much closer to the relative amounts of those content type items, ratio varying from 0.4 to 2. (There were too few videos uploaded to make conclusions about them.)

| | % of Data (D) | % of Clicks (C) | % of Tooltips (T) | Ratio of C to D | Ratio of T to D |
|---|---|---|---|---|---|
| **Calls** | 21.4 | 26.6 | 21.2 | 1.2 | 1.0 |
| **SMSs** | 16.0 | 15.3 | 14.6 | 1.0 | 0.9 |
| **Photos** | 3.5 | 27.6 | 24.6 | 7.8 | 7.0 |
| **Videos** | 0.1 | 0.3 | 0.3 | 5.3 | 5.2 |
| **Music** | 54.4 | 21.0 | 30.5 | 0.4 | 0.6 |
| **GPS tracks** | 4.6 | 9.1 | 8.8 | 2.0 | 1.9 |

**Table 2. Percentages of logged and browsed content types (by selecting an item by clicking it or by opening an item tooltip).**

Users found the logged information interesting according to the questionnaire as well. The median of the answers to the statement *The logged data makes me curious* was 6 (mostly agree).

We also wanted to know how satisfied users were with the current variety of logged information and what other information they desired to be logged. According to the questionnaire results, users desired more information to be logged. Participants only slightly agreed with the statement *The system logs all the data I want* with a median of 4.5. Before browsing the logs, participants' suggestions, on what should be logged in addition, included status messages, video calls, calendar events, data traffic statistics and statistics of captured photos. After browsing the logs, the list grew with multimedia messages, statistics about the detected Bluetooth devices and listened-to radio stations. However, there was also hesitation regarding whether all the logged information should be retained. The statement *The system logs data that I don't want* in the questionnaire got a median of 4 (neither agree nor disagree).

The content type that the users hesitated to log the most was clearly the text messages, which was mentioned by six participants. Logging the names of the callers or the call recipients, as well as the locations, worried only individual users. In general, users seemed to be more careful with the information about others than about themselves.

The least interesting content type in the web application was the phone call. The limited information logged and displayed in the application about the phone calls were not enough to help users remember the content of the call or the situation. Thus, the individual items logged did not provide users any real value. However, when viewing the items in larger clusters, they became more meaningful because this information began to reveal patterns. One user brought up the issue that the logs may encourage users to analyze their own behavior. Recognizing a habit of making phone calls whenever waiting for a bus, created a stimulating and positive experience for the user.

> *"You've noticed for example a place, where you have to stand still a lot, you can see loads of phone calls there, like a bus stop, where you've changed busses. These are interesting discoveries."* (Female, 22)

In total, there was no clear division that separated interesting and uninteresting content types in the web application, but the valuation of content types varied from user to user. Some users found it difficult to distinguish among the most interesting content, since all of the content was somewhat interesting.

> *"[The most interesting content types are] photos and the locations, and I have to say that the messages and phone calls as well. You get to know where you've called and to whom and those old messages. It's exciting to see where you have sent them and when."* (Female, 22)

In summary, the limited version of lifelogging we have implemented provided value for the users, but participants wanted the addition of more content types.

### Sense of Privacy

Continuous and extensive logging and storing of information on one's life obviously gives rise to concerns over whether one can trust that the information remains safe and private. A related issue is the amount of control required to make the users willing to use the logging. We questioned our participants about possible privacy concerns and how they felt about the control options.

Most of the users felt that their privacy was not threatened, despite using the logging system. There were, however, concerns about the technology failing in general, about passwords getting into the wrong hands and issues related to the logging of text messages.

> *"So much data is transferred from the phone, and it's easy to intercept."* (Male, 25)

One user was worried because his messages were stored in two places, and protecting his privacy was no longer just a matter of holding onto his phone. The password protection and data encryption features on the server were not enough to make him feel that the information is secure.

All in all, the interviews revealed that the concerns users had were not as severe that they would have prevented the users from logging and using the system. This is also supported by the previously stated median of 5.5 (between slightly and mostly agree) of the statement *I definitely want to continue data logging*. However, it must be taken into account that the issues that had helped users feel that their privacy was secured had more to do with the trial arrangements than the features of the system. It was naturally easier for the users to trust the system due to meeting the researchers face-to-face than if they had started using it on their own.

Users had a need to control what was logged and when, especially in relation to text messages and phone calls. In the trial, users were in total control of what events to capture with photos or videos, as well as which photos and videos to keep and which to upload to the system's server. This setup was considered good by the users. Only three of the users would have liked automatic upload if battery consumption would have allowed it.

Users wanted to manually control the uploading for several reasons. Not only did users take several pictures of the same subject and choose only the best ones to keep and upload, but users also wanted to keep the most private photos locally on their own device to have better control over them. It seems that the mindset of most of the users was not to collect as much as they could but also to think about presenting the items to the others.

In addition to being in control of the logging, users should be able to delete content later. Additionally, users should not have to delete items twice. When deleting messages from the mobile phone, users should be able to choose whether they want to delete them from the log or only from the phone's local memory.

Naturally, sharing items highlights privacy considerations as well. One user mentioned that she tried to ask permission from all of her friends who appeared in her photos before she shared them in the web application. The same user mentioned that one photo was shared by her friend that she might not have wanted to be shared because of how she looked in the photo, although this really did not bother her. This indicates that at least some users feel they need to ask permission from others who appear in the log whether information about them can be shared.

### Experiences of Logging Text Messages

As mentioned, users were in total control of what photos and videos they uploaded to the system. In contrast, text messages were automatically logged. It turned out that logging of the contents of sent and received text messages was clearly considered the biggest threat to privacy. There were users who would rather not have logged the messages at all and users who wanted the possibility of manually setting whether a message was logged. Users were worried

about the text messages being secured by only one password in the web application.

> *"On the other hand, it's interesting, but the security risk is so high if there's something personal [in the message]. [...] I think I wouldn't dare to use this. Now I actually got afraid of what if someone would get to know that [thing mentioned in a message]. You can see all the text messages, also the very intimate."* (Female, 22)

Despite the logging of text messages being considered a considerable threat to privacy, text messages were also considered to be among the most interesting content even by some of those who considered this to be a threat.

> *"If you think of your own stuff, then the old text messages [are interesting]. [...] It has been rather fun to read them."* (Female, 21)

To alleviate the fear that others might intercept the content of the text messages, the content should be stored on the phone or on user's own PCs until such messages are shared with others. Sharing and providing views about a friend's activities would be more complex to implement, but it would serve the needs of users who want to be in control of private data.

#### The Extent Users Are Willing to Share Their Logs

Some of the logged information was considered to be very private, some freely shareable. All the users were happy that the sharing of calls and messages was disabled in the web application. The feature was considered to protect users themselves from accidentally sharing private information. On the other hand, six of the participants shared their listening information publicly using a username in Last.fm before the study. Thus, many of the users were willing to share their music listening history automatically in our system also.

In the system, photos and videos were shared with friends automatically based on their visibility in Flickr. Although photos could have been shared in our web application as well, this may have given the impression that the sharing functionality was divided into two places. Furthermore, the fact that users had used Flickr for more than one and a half months before starting to use our web application made them accustomed to setting the visibility of their photos in Flickr.

This, and the short period of use, resulted in users not really taking advantage of the manual sharing functionality of the web application outside the interviews. A couple of the users shared a few items but mainly as an experiment. However, the usage during the interviews and the sharing of photos through the Flickr interface gave everyone enough experience to reflect their expectations on sharing.

Users mostly felt that the location of an item can be shared with the item, and the possibility to share the information was valued.

> *"If I've been sharing photos in IRC Gallery [Finnish photo sharing Web site], the first question has been where it was taken."* (Male, 25)

> *"Yeah, I've been leaving it there, it doesn't bother me if somebody sees where I have listened some music."* (Female, 21)

There were also exceptions. When doing something socially delicate or when sharing the information would reveal the exact location of someone's home, the possibility to control sharing becomes important.

Although only few location tracks that were logged were shared in the trial, motivations sharing them were mentioned. They seem to fall under the known categories of motivations for sharing photos described in the literature. One motivation for sharing past location information was self-presentation by showing special locations visited during a trip. An example of this happened during the trial where one participant shared location tracks from her trip to Stockholm and another user, after finding the tracks, considered this kind of information to be among the most interesting content in the web application. Another motivation was more pragmatic: a need to guide friends to a summer cottage, a place that requires careful navigation.

The possibility to select certain persons to receive the items was valued and considered to be an aspect where our web application excels over Flickr. For example, when users have participated in an event with certain friends, they would like to share the content with exactly those same friends. When capturing something interesting one has come across like street art, users might more readily share their photos with all friends.

#### Changes in User Behavior during the Trial

Logging enables seeing and sharing information about one's life that has not been possible before and the literature has predicted that it will have significant implications for the users' sense of privacy. Therefore, we were also interested in how the impact of logging will change users' normal behavior: whether the logging might either restrict or increase the activity of the users.

According to the questionnaire, logging seemed to increase the participants' activity in content creation. The median of the answers to the statement, *Awareness of the data logging encourages me to actively gain new experiences* was 5, a slight agreement.

Users were lent new phones with features that some of them had not had before. In the first interview, users said that they had done more with their phones than they had normally done before. They had, for example, taken more photos, browsed more Web pages and listened to more music. At this point, using the phones more and creating

more content may have been due to the extensive feature set of the phones, instead of the logging changing users' behavior. However, members of the group 1 said that logging had especially increased communication among them. They made video calls and sent multimedia messages partly because they anticipated that these items would be interesting content for browsing later.

Using the web application did not seem to cause any radical changes in the users' phone use compared with the logging period. However, some new indications regarding logging's ability to alter users' behavior were mentioned. Logging inspired users to take more photos, listen to more music with their mobile phones and play with the GPS positioning to get their location logged. One user would have made more video calls if they had been logged, and another user had been intentionally trying to get his location recorded.

> *"Sometimes you check your phone on purpose so that it would set the GPS positioning on. For example on a bus you go to sit by the window."* (Male, 25)

Only one of the users mentioned refraining from some actions because he did not want those to be logged. Otherwise, the logging did not bother users so much that they would have reported avoiding performing their normal routines because of it. This is also shown in the results of the questionnaire as the median of the answers to the statement, *Awareness of the logging makes me restrict my doings* was 2, showing that participants mostly disagreed.

## DISCUSSION AND CONCLUSIONS

In this paper, we focused on the user experience of mobile phone activity and context logging. We conducted an eleven week-long field study of 13 participants to explore users' experiences of the logging. We found that the perceived value of logging consisted mostly of hedonic aspects of the UX. Only a few pragmatic benefits were experienced by the users in this setup within the short period of time that this logging system was used. Yet, even without considerable pragmatic benefits, the value of logging outweighed the concerns that it presented.

One of the fundamental questions of lifelogging is whether it is better to be able to control the logging and delete content at will or whether it is better to log everything. When having control, the user may miss logging some of the precious moments or may delete some mementos considered valuable at a later date. Without this control, the most private and sensitive pieces of information as well as the memories that should be forgotten are logged.

Users were not disturbed by the logging. Many were a bit uneasy in the beginning, but this feeling was forgotten in a couple of days. None of the concerns kept users from continuing the logging. As the logging extends to cover more of the users' actions and the logged information becomes more meaningful, the concerns may increase.

As predicted in previous literature [1,5], our results indicated that the logs inspire and help people to analyze their life. The information logged and the life patterns that the logs reveal were considered interesting by the users ─ not only by the loggers themselves but also by the friends with whom the contents were shared.

It became apparent in the study that the username-password combination is not considered secure enough to protect such sensitive information that an extensive lifelog would contain. More effective methods of information security must be used because the information collected is considered valuable and worth logging and preserving. In order to make users feel more secure, information that is not shared should be stored locally. In addition, the information shared on a server should be synchronized with the local repository so that users do not have to repeat actions twice.

In this study, the automatic logging of text messages was considered to be the biggest privacy threat. For photos and videos, users were able to decide which items they uploaded to the log and many of these items they chose to keep only on the phone. To feel more secure, users wanted a similar kind of control for messages. As the preferences of what information should be logged automatically and what should be logged only by manual selection vary from user to user, flexible controlling options are needed.

In addition to having the ability to control logging, users want versatile options for sharing the logged information with others. Users prefer sharing some information automatically such as listening history, sharing some information at will and keeping some information private. Furthermore, the more versatile the logged information becomes, the more users want to control with whom the information is shared.

Another challenge of lifelogging is the unavoidable logging of other people's lives around the user. Abuse of this information cannot be totally avoided if someone decides to do harm. However, there were clear indications in our study that users are even more careful and protective with the information about others than about themselves.

Inevitably, in our study, the experience of using a new phone, as well as Flickr and ShoZu was mixed with the logging experience. Participants did, however, own quite advanced phones (e.g., many had other S60 smart phones or an iPhone), and many of them were active users of similar Web sites before they participated in our study, so the change was not that significant.

Considering everything, the results of the study suggest that using the mobile phone and its sensor-enabled context recording capabilities as the basis of lifelogging is a promising approach worth developing further. The variety of content logged in the study was limited, but the system already provided value for the users. In further studies, we aim to extend the variety of logged information to the types suggested by our users and to information available from

other services on the Internet. Furthermore, longer field studies are needed to examine how the value and use of the logged information changes over time and what kind of changes logging will cause to users' behavior and phone usage.

UX is naturally culture-dependent, and this applies also to the highly pervasive lifelogging. The prevailing social norms and the conception of privacy vary between cultures, and the implications of these differences should be taken into consideration in the design of lifelogging systems.

As lifelogging is developed further, it is important to carefully consider the ethical and cultural issues and involve users in all stages of the development process. We argue that most users would prefer limited lifelogging that they can control over the full-fledged storing of everything a person sees, hears and does.

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**REFERENCES**

1. Allen, A. Dredging-up the Past: Lifelogging, Memory and Surveillance. *University of Chicago Law Review*, 75, 1 (2008), 47 – 74.
2. Bush, V. As we may think. *Atlantic Monthly 176*, 1 (1945), 101-108.
3. Cheng, W.C., Glubchik, L., Kay, D.G. Total Recall: Are Privacy Changes Inevitable? In *Proc. CARPE'04*, ACM Press (2004), 86 – 92.
4. Clarkson, B. Life Patterns: structure from wearable sensors. PhD thesis, MIT, 2002.
5. Czerwinski, M., Gage, D., Gemmell, J., Marshall, C., Pérez-Quiñones, M., Skeels, M. and Catarci, T. Digital memories in an era of ubiquitous computing and abundant storage. *Communications of the ACM 49*, 1 (2006), 45-50.
6. Dodge, M., Kitchin, R. 'Outlines of a world coming into existence': pervasive computing and the ethics of forgetting. *Environment and Planning B: Planning and Design*, 34 (2007), 431 – 445.
7. Dumais, S., Cutrell, E., Cadiz, J., Jancke, G., Sarin, R., and Robbins, D. Stuff I've seen: a system for personal information retrieval and re-use. In *Proc. SIGIR 2003*, ACM Press (2003), 72-79.
8. Gemmell, J., Bell, G. and Lueder, R. MyLifeBits: a personal database for everything. *Communications of the ACM 49*, 1 (2006), 88-95.
9. Gemmell, J., Williams, L., Wood, K., Lueder, R., Bell, G. Passive Capture and Ensuing Issues for a Personal Lifetime Store. In *Proc. CARPE '04*, ACM Press (2004), 48 – 55.
10. Hassenzahl, M. The Interplay of Beauty, Goodness, and Usability in Interactive Products. *Human-Computer Interaction*, 19 (2004), 319–349.
11. Hassenzahl, M. The hedonic/pragmatic model of user experience. In *Proc. workshop Towards a UX Manifesto* (2007). http://141.115.28.2/cost294/upload/506.pdf.
12. Hassenzahl, M., Tractinsky, N. User experience – a research agenda. *Behaviour & Information Technology*, 25, 2 (2006), 91 – 97.
13. Millican, T. iam: Experiences with Persistent Video Recording. In *Proc. CARPE'05*, ACM Press (2005).
14. Myka, A. Nokia Lifeblog - towards a truly personal multimedia information system. In *Proc. MDBIS 2005*, Gesellschaft für Informatik (2005), 21-30.
15. Norman, D. *Turn Signals Are the Facial Expressions of Automobiles*. Addison Wesley (1992).
16. O'Hara, K., Tuffield, M., Shadbolt, N. Lifelogging: Issues of Identity and Privacy with Memories for Life. In *Proc. Identity and the Information Society* (2008).
17. Olsson, T., Lehtonen, M., Pavel, D., Väänänen-Vainio-Mattila, K. User-Centered Design of a Mobile Application for Sharing Life Memories. In *Proc. MC'07 (Mobility'07),* ACM Press (2007), 524 – 531.
18. Olsson, T., Toivola, H., Väänänen-Vainio-Mattila, K. Exploring Characteristics of Collective Content – a Field Study with Four User Communities. In *Proc. CHI 2008*, ACM Press (2008).
19. Rhee, Y., Kim, J. and Chung, A. Your phone automatically caches your life. *Interactions 13,* 4 (2006), 42-44.
20. Roto, V., Rautava, M. User Experience Elements and Brand Promise. *The fourth International Engagability & Design Conference (Idec4)*. (2008). http://research.nokia.com/files/ UXelements-v2.pdf.
21. Van House, N. et al. The Uses of Personal Networked Digital Imaging: An Empirical Study of Camera phone Photos and Sharing, In *Proc. CHI 2005*. ACM Press (2005), 1853-1856.