Designing for Social Context of Mobility: Mobile Applications for Always-on Users

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ABSTRACT

The informational and instrumental portabilities of mobile devices have made the devices appropriable in various contexts and for various uses. This, then, leads us to ask—how does the always-on usage impact our day-to-day lives? Extensive investigations were carried out to uncover socio-technical configurations, appropriations, and negotiations developed to combat perpetual technological availability. Based on the findings, we developed three prototypes, which utilize context-awareness to promote increased sociability, stress relief, and reduced intrusiveness. In this paper, we report on the user investigations, design conception, prototypes, evaluations, and broader learnings.

Author Keywords

Urban computing, mobile devices, informational boundaries, context-aware, social aspects of mobile phones

ACM Classification Keywords

H5.m. Information interfaces and presentation (*e.g.*,, HCI): Miscellaneous.

INTRODUCTION

Nowhere else is the evidence of computation moving off the desktop as clear as in mobile devices. These tiny, powerful devices have shifted the site of interaction to everyday life and the temporality to anytime. Carrying these technologies almost everywhere one goes has become a common phenomenon in urban environments [11]. These device ensembles, or arrays of portable devices, include mobile phones, gaming devices, music players, and thumb drives [23]. The computation in these devices is not just physically embedded, but also socially and procedurally embedded. So much so, that we continually use these devices without thinking of them as computational [2]. These experiences give rise to new tensions between the novel computational capabilities and the already existing social and cultural norms, leading to negotiation, re-configuration, avoidance, and compliance.

Always-on use is a direct affordance of stable network connectivity and long battery lives of mobile devices. It is characterized by lightness of gadgetry and dependence on the environment for providing data connections [29]. The mobile phone enables locational—geographical movement, operational—flexible co-ordination, and interactional—intense interactions with people and data, mobilities [5]. In addition, these devices provide informational mobility—transferring information across different form factors, through suitable data connections. These capabilities have radically changed our lifestyles by removing geographical, sensorial, and usage demarcations between first, second, and third places, real and virtual worlds, and individual and shared access. This leads us to raise pertinent questions on the nature of interactions shaped and mediated by these portable devices in urban lifestyles. The transformative power of these devices lies not only in participating in different spaces, but also in creating them wherever we go. They aid in temporarily appropriating public spaces for personal use [11] [16] to escape the surrounding physical space.

Whether it is true that the characteristics of mobile devices such as inexpensive prices that are driving the high adoption rates, or the existing mobile practices of people are supported through mobile phones [27], the effects of ubiquity and always-on usage on lifestyles is of utmost importance. Previous research has explored context-aware mobile applications equipped to better deal with the above-mentioned problems, such as SenSay—which eliminates unwanted interruptions by automatically sensing activity and location [24], and Mobilife—applications based on 3G [14]. However, mobile contexts are problematic—they are not simply delineable from location and ambience, because are fundamentally social. They are relational, dynamic, occasioned, and arise from activity [5].

We engaged in studying the complex realities of the social context of mobility—the interplay between the functionings of mobile devices and the construction and re-construction of social meanings and practices. To what extent can the design of mobile applications automatically aid in drawing informational boundaries—considering cultural, geographical, and interactional norms? In other words, how can mobile devices suitably adapt themselves to usage, context, and appropriateness in social circles? In spirit with the approach put forth by Jones and Marsden [12], we undertook a 3-month long investigation to study real-world mobile experiences to design applications. We sought out to uncover cultural practices around the perpetual use of mobile devices, specifically mobile phones. In particular, we studied social signaling, configurations of and negotiations with technology, and work-arounds against intrusiveness. Salient

OZCHI 2009, November 23-27, 2009, Melbourne, Australia.

OZCHI 2009 Proc ISBN: x-xxxxx-xxx-x

findings of the study informed the system design of three context-aware prototypes—TimeOut, TryMyLuck, and ForMyEyesOnly. We then systematically evaluated the proofs-of-concept to garner feedback on social appropriateness, utility, and ease-of-use of these prototypes. In this paper, we report on the user investigations, design conceptions, evaluations, and broader learnings.

RELATED WORK

Current technology has also allowed us to store more private content in our mobile devices. Since the mobile devices have become more all-embracive, privacy issues have also became more relevant. Devices that can store private content are often used in public settings. In prior research, Taransewich [26] has designed privacy blinders for a web browser. There are several hardware-based solutions mainly for laptops to solve the problem of maintaining information privacy, such as privacy covers. For cell phones, such solutions do not yet exist. However, applications utilizing ambient design for mobile phone screens have been suggested, as this kind of approach would enable personal information to be presented *e.g.,* on the idle screen of mobile phone without revealing private information [24].

In addition to emotional needs for using the device, mobile phone, our research touches upon the field of context-aware computing. The term context-awareness has commonly been used for two different kinds of application approaches: to capture context so that it can be later used as a cue for information retrieval, or, more commonly, to user context to adapt device behavior to correspond to the manner of its usage [6]. In addition to these two cases, *i.e.,* tagging context for later use and automatic execution of actions, context-awareness can be used for providing information presentation to the user [4].

Location is probably the most commonly used variable in context recognition, and it brings easily identifiable potential use cases. In addition to information about the physical location itself, the information in the means of distance and presence may provide useful data for time management and social navigation. Presence applications utilizing the information about the spatial nearness of an entity are also important function in the field of mobile context-awareness. Presence is sometimes considered as a subcategory of location-awareness, as reminders or notifications related to a spatially fixed entity, such as a shop or a printer, in the neighborhood of the user are often considered as presence notifications. There exist several mobile applications utilizing presence. For example, BlueReminder is a mobile phone application [19], where a Bluetooth triggered reminder related to another person goes off when it detects the proximity of the corresponding person's Bluetooth phone. Poypurev *et al.*. have prototyped a concept and prototype for spotting the presence of people that are buying and selling items that interest the user [20].

When a context-aware application is being developed, one has to carefully concern with its ultimate value—what is gained by implementing context-awareness to the specific application. The utility value, *i.e.,* what is gained by adding context-awareness to the application, is emphasized, as context-awareness typically employs more risks than having a conventional, non-context-aware solution [8] [9].

UNDERSTANDING EFFECTS OF ALWAYS-ON USAGE

In line with the principles of user-centered design, the potential users of the applications were involved in different phases of the design process [21]. Semi-structured interviews, focus groups, and photo diaries helped in eliciting cultural principles and usage patterns of mobile devices. This was followed by analysis and creation of initial low-fi prototypes of the applications. A user study was arranged to assess the concepts and usability of the early prototypes, and the results were incorporated into the design of detailed, hi-fi prototypes. The final, iterated designs were tested using Wizard-of-oz method [13].

Our field investigations attempted to pursue the following topics: A day in the life of the mobile user, Tasks and contexts of use of mobile devices, Transitions between social and geographic spaces through mobile devices, Intrusiveness and mechanisms to deal with it, Non-use of mobile devices, Play and relaxation, and Spirituality—use of devices for "higher" emotions. In carrying out a complex investigation of lifestyle issues, a mixed method approach is required. Using a three-step process, we conducted user research by employing qualitative techniques.

Set-up of Studies

The study was conducted in Finland. We recruited a total of 15 informants, both students and professionals. The informant pool ranged from 23 to 35 years of age, with a median of 25, comprising 7 females and 8 males. We specifically chose this age group since they form a key demographic of mobile phone users. A compensation of a gift card at the local shopping complex for €15 was provided for every part of the study. The various components of the study were as follows:

3.1 Questionnaires

1) The user studies commenced with a questionnaire structured on features and processes that affect personal relationships with mobile devices, such as memories, personalization, routine, adaptation, and mobility.

3.2 Interviews

Interviews followed the questionnaire session. Interviews were semi-structured, lasting an hour on average. The interview questions explored a typical day with mobile devices, how they transition different spaces, various tasks and contexts of use of devices, and intrusiveness. Interview data was analyzed using an affinity wall, and categories were developed.

3.3 Focus Groups

Following analysis of the interviews (see figure 1), we conducted two focus group discussions with 11 professional and student informants The focus group meetings were arranged in two cities in Finland. The Focus group participant pool ranged from 24 to 27 years of age with average age of 25. The first focus group had 6 participants with 2 females and 4 males, and the second group consisted of 5 participants, which included 2 females and 3 males. Each focus group lasted approximately 60 minutes. Before the actual focus group session the participants was conducted, a pre-assignment task of documenting their use of portable devices during an ordinary day, was provided. The focus group

discussion topics considered behavior with portable technologies, such as relaxation with portable devices, shutting down technologies, dealing with technology in public and private context, signaling with technology (see Figure 2).

3.4 Photo Diaries

Finally, a week of photo diary-keeping was administered to document the following issues: i) Instances of *avoiding* mobile technologies, ii) Instances of *relaxing* through mobile technologies, and iii) Instances of *signaling* through mobile devices. These topics emerged from the focus group discussions. The photo diary exercise was followed by an exit interview. We recruited 2 males and 3 females from the Focus Groups participants to keep the data consistent. Flickr Mobile applications were installed on camera phones, and pictures were uploaded to private, individual accounts. Pictures were uploaded as soon as they were taken, and additional comments, titles, and tags were added at the end of each day. From the photo diary exercise, we collected 39 pictures in total.

KEY FINDINGS

In this section we briefly salient findings from our study.

4.1 24/7 Fluid:

Similar to the Zimbabwe Bush Pump, the mobile phone is adaptable, flexible, and responsive [3]. In our study, mobile devices served different functions—communicational, informational, recreational, and quotidian. Many aspects of human life were either complimented or substituted by mobile devices. From waking up to the mobile phone alarm in the morning, to checking e-mail before falling asleep at night, mobile devices were constantly in use.

P10 explained to us how she spent a day with mobile devices—"*Actually I use my phone as an alarm clock, I check email, and leave to work. When I am at work I usually don't get phone calls, I IM, I use the phone to check traffic reports 'coz sometimes I get stuck in traffic so I see how long it takes to get out, it's easy, I have two computers, but I check email on it. I am always using technology, so for me there is no gap really. I am using a phone all the time. The browser on the phone sort of sucks, hard to type. I use Google reader to check RSS feed but I know some sites will not do well with the phone. I check e-mail on the phone before falling asleep."*

An important phenomenon to note here is that possessing the device was considered valuable. Consider what P24 says—"*You never know what use you will have for a mobile. I feel lost without it.*" To illustrate the addiction to mobile devices, consider the following quote by a Focus Group participant, P31—"*we should try this experiment someday—someone would take away our mobile phones from us. Just to see how we would adjust. I bet I cannot handle that situation."*

Figure 1. Affinity wall analysis, and Focus group discussion in Tampere, Finland

4.2 Situational Impairment:

Mobility allows for the user to exist and encounter places and *non-places.* Augé mentions that a non-place is a transitional space, with no familiar attributes of place [1]. These non-places were places of transit, such as the bus-stop, the drive to work, or the wait at the super-market. Oftentimes, they possessed the properties of regularity and repeatability. Mundaneness hinges upon insignificance, hence boredom. Mobile devices, offering a plethora of applications, filled the gap here. P10---"*One of the important contexts for using portable devices was filling the gaps in life, like walking to the campus or waiting for something. If I am walking I'll take my mp3 player and text msg."*

Depending on the movement (stationary or mobile) and mode of transport, relevant applications of the mobile device were invoked, such as, listening to MP3 or calling friends while walking, playing games while waiting for someone/thing, or calling while driving a car. P11 drives back and forth from home to school every day. She makes phone calls while being stuck in traffic jams—"*When I drive to school, I have my phone next to me or sometimes I make phone calls. I know I shouldn't do that but it's nice to have an hour to make phone calls."*

4.3 Gregarious Hermits:

Isolation from public was achieved by creating a sense of technological engagement. Most nomadic activities involved absent presence—disengagement with the surrounding neighborhood [7] Socialities constituted a large portion of activities, but with remote communicants, through text-messaging or phone calls. Other interactions hinged on the device features, such as listening to music. As noted elsewhere, our research points to mobile devices being appropriated as "masks" to circumvent potential social interactions in the neighborhood [22]. By creating an impression of technological engagement amidst social groups, absent presence was indicated.

4.4 Media and Space Linkages:

Modalities of the mobile phone permit a wide variety of media to be captured and played. Linkages to spaces and people were strengthened through these media forms. The portability of the mobile phone afforded capturing or playing media anytime, anywhere. Finland enjoys high-end phone capabilities and 3.5G networks. Therefore, the incidence of uploading photos and videos to albums online, downloading and listening to music files was high. Not only did device capabilities enable capture of contexts, but the physicality of the space itself was attributed to certain memories, such as—P26:"*Every time I walk down this road, I listen to my favorite track 'Bye bye beautiful' by Nightwish. It is something I associate with this road.*"

4.5 Intrusiveness and Loss of Privacy:

With perpetual possession of technology and co-present perpetual possessors of technology, intrusiveness is not uncommon. Intrusiveness is "characterized by intrusion or intruding where one is not welcome or invited" [28].

Intrusiveness occurs when technology is unnecessary, unwelcome, or forced upon the user. Intrusiveness can result

due to various factors—cultural issues, access models, or context [Ibid: 22]. Device-mediated intrusiveness was reported in public settings in the form of loud ambient conversations and inappropriate timing for phone interactions. We also found instances of loss of privacy in sudden appearances of persons in the physical space while making phone calls. FG5—"*Like, if I am talking something private to my boyfriend, and someone walks into the room to ask me a question, I would not like it!*" Talking on the phone is louder than normal face-to-face conversations. Informants carefully considered privacy while making phone calls. They avoided talking in buses, and rather make the private phone calls at home. C case of a Finn living in Sweden is illustrative: FG4—*"Always when I come here [Finland] I think that, oh crap they can understand what I'm talking now.*"

Consider the following anecdotal photos. From left to right, top to bottom (Fig.3): 1) *Way from work. I often call somebody to spend time.* 2) *Going home by bus after work; bored. Listening to music. 3) Drunken guy is calling to his friend in a music festival and yells his business for all to hear. 4) At work (I) used my mp3 to block friends' telephone conversation just for courtesy.*

Figure 3: Samples from photo diaries

TRANSLATION TO DESIGN

5.1 Designing for engagement:

At non-places, our informants tended to while away time by idling or "fiddling" with the mobile devices, which presents an interesting design opportunity for rich, engaging applications.

5.2 Breaking the routine:

The design motivation here is not to replace a technological interaction (such as creating a spreadsheet) with another (such as playing a game), but to provide a refreshing experience to go back to the original activity.

5.3 Context-awareness:

Since mobility is synonymous with interfacing with various contexts, social settings, and groups, context-awareness is key to creating meaningful applications that will adapt to surroundings.

5.4 Building sociality:

Applications specifically targeted at renewing old social bonds are missing.

5.5 Fun and relaxation:

Since the design space was non-work, interacting with potential applications must be fun.

5.6 Control in the hands of user:

Applications must provide the user control at all points and be minimally intrusive.

5.7 Protect privacy:

The applications should help protect and manage privacy of the individuals.

In the next section, we discuss the prototypes that emerged from these findings.

PROTOTYPES

The above findings inspired the design of three applications—TimeOut, TryMyLuck, and ForMyEyesOnly. For our evaluations, we prototyped applications on the mobile phone platform, which have a rich set of modalities and features. Applications were built using Abode Illustrator for the first round of evaluation and Flash Mobile for the second round of evaluation. These platforms allow for rapid programmability with rich libraries for invoking media and handling key press interactions. We used the Nokia 95 phones to run the prototypes.

Context-awareness:

All three prototypes were designed to be sensitive to informational boundaries. Context-awareness was built into the system design. Social neighborhood was to be determined by Bluetooth detection. As context recognition is seldom 100% correct, the deduced context information is provided data closer to phone applications that serve as ordered lists of recognized contexts. Communication logs (missed calls, text messages, received calls, most frequently dialed numbers, and most frequently ignored calls) from the mobile phone were to be used to determine social recommendations. Indoor location was to be determined by Wi-Fi triangulation and outdoor positioning by Global Positioning System data. System clock, availability (in use or not) of the device, and calendar information were to be used to provide recommendations at appropriate timings. Accelerometer data was to be used to detect movement of the phone. The active context data was automatically linked with personal routines [15] and finally, this data was made available to applications.

User experience:

6.1 TimeOut:

TimeOut was motivated to create persuasive opportunities for de-addiction breaks. It was designed to provide for automatic recommendations at pre-defined or pseudo-random times. TimeOut provided suggestions for social opportunities, taking walks, listening to music, simple physical exercises, and other de-stressing activities defined by user preferences. TimeOut was designed to nurture relationships, promote health, and by detecting neighbors in proximity, TimeOut provided suggestions for meeting the latter. Suggestions for making phone calls worked on multiple counts—1) on detecting many received calls from a particular contact, TimeOut suggests their name 2) on detecting a number that was not contacted over many weeks or months, TimeOut suggests the contact, and on 3) user-defined favorites or to-call contacts. TimeOut's recommendations depend on the context of the user. For example, in the office, TimeOut makes suggestions to get coffee with a colleague, or to try Finger Yoga. At home, while working, TimeOut makes suggestions to take a shower, cook, or to go on a bike ride. Figure 4 shows

screenshots of TimeOut. The first screenshot depicts the start page of TimeOut, second shows a list of options to the user, and the third screen shows Finger Yoga instructions once the user selects "Stretching" as an option in the previous screen.

TimeOut's suggestions could be pre-defined by the user during setup. For example, coffee breaks at work are usually at 10 a.m. and 3 p.m. Otherwise; TimeOut makes pseudo random suggestions when the phone has been idle for a long time. The user can choose to continue the application or ignore it, whereupon it will exit the screen in 5 seconds. Every time the user ignores or uses the application, it learns from the interaction.

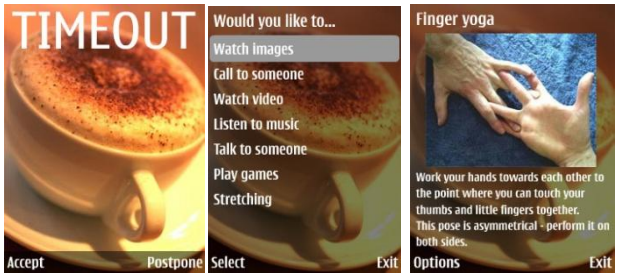

Figure 4: Screenshots of the TimeOut demo

The user was able to define an identity for the phone, by selecting an icon. This icon popped up every time TimeOut was initiated in the device.

6.2 TryMyLuck:

This application was designed to provide a playful, automatically-generated interaction during bouts of waiting or situational impairment [30]. The idea was that the user would run TryMyLuck, and it would generate a suggestion for killing time. The gambling metaphor was used, with several variations, such as—slot machine, pack of cards, wheel of fortune, roulette, and housie. TryMyLuck gives off the impression of being random, but its suggestions are generated from by user interaction.

Figure 5: Screenshots from the TryMyLuck demo

TryMyLuck was also inspired by the memory findings from our data. We learned that the informants had associated songs, places, and photos with memories of events and people. Since TryMyLuck was designed to be context-sensitive, it would pop up suggestions for playing media based on current location. We call this feature *memory recall*, and define it as the function through which media tied to objects, places, and people are recalled through a mobile device. As we can see in figure 5, TryMyLuck employs a slot machine metaphor. The user spins until they get a matching row of options. The maximum number of attempts for achieving this was programmed to be 3.

TryMyLuck has a user-driven component in that it is started by the user. Suggestions included games, phone calls, chat, music, and photo-viewing. In addition, it automatically associated media with tags and location. For example, it made suggestions of songs that were heard the previous time at Helsinki Square, without getting repetitive. It would also suggest that the user may browse a photo album shot in New York City, if the contact just spoken to lives in that city. In addition, the application kept track of the informational history by providing contextual information, such as the time last spoken to the contact, when and where the track was last played, and so on.

6.3 ForMyEyesOnly:

This application was inspired to combat the large amount of intrusiveness that comes with mobile devices. There were two formats—1) alerted the user during private conversations when a friend or stranger was approaching (phone call demo), 2) used ambient alerts to display private alarms (alarm demo). In order to ensure privacy of confidential phone conversations, ForMyEyesOnly could be set to alert when a person in the contact list or a stranger approached the proximate neighborhood. The application beeps during the phone conversation and displays text, to alert the user. Figure 6 shows three screenshots—i) turning on the "Alert on contacts" option, ii) A phone call in progress, and iii) Alert on a contact in close proximity.

Figure 6. Screenshots from the ForMyEyesOnly _PhoneCall application demo

The second format of ForMyEyesOnly was designed to protect the user's privacy in public settings. Many a time, there is a need to setup alarms, but when alarms go off they turn embarrassing. For example, a doctor's appointment could be embarrassing if displayed to co-present others, or confidential information going off in a meeting could lead to undesired consequences in the company. The ambient alarm was set by marking an alarm as private during setup. A corresponding icon was also chosen at the time of setup. The ambient alarm went off at the pre-determined time, and displayed as a growing icon.

EVALUATIONS:

The evaluations were designed to gauge the appropriateness of the applications within the scope of certain cultural and geographical contexts, and user experience.

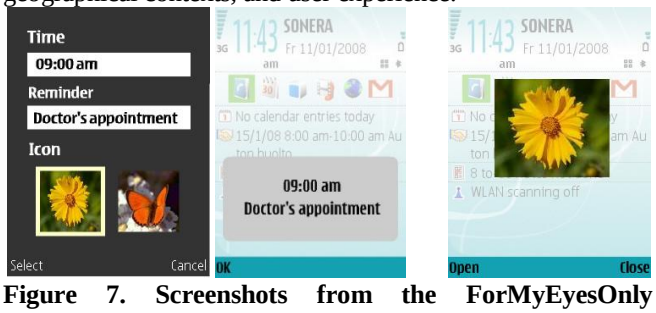

Figure 7. Screenshots from the ForMyEyesOnly Reminder application demo

7.1 Evaluation round 1:

Round one was designed to highlight preliminary usability issues. A formative Thinkaloud study was conducted [17]. The initial designs were evaluated with 10 participants (5 female, 5 male), with a median age of 32 years, who were summer interns and full-time employees of the research lab. PowerPoint was used to create a sense of continuity, with screenshots of each state per slide. Participants were interviewed at the end of each set of application slides. The interviews were conducted to gather feedback on usability and usefulness of the designs. The feedback was incorporated into the prototypes.

7.2 Evaluation round 2:

In round 2, the prototypes were evaluated with 8 participants (4 female, 4 male). Participants were 19 to 29 years of age, with an average age of 23. Their socio-economic and educational backgrounds were similar to those participating in the first round. They were recruited based on heavy mobile usage (average number of calls per week = 10 or more). A think-aloud was orchestrated throughout the evaluation process. A heuristic evaluation was employed at the end of the evaluation study [Ibid: 22]. In both, evaluation round1 and round 2, monetary compensation was provided.

Evaluation contexts were separated into high/low noise, public/semi-public, dynamic/static location and bright/dim illumination of the user (figure 8). These contexts were chosen based on data gathered from the study on locations, ambient conditions, and activities circumscribing a typical day. An example of a high noise environment is a water cooler setting, and a low noise environment could be a cubicle. A public environment could be a café setting, and a semi-public environment could be an elevator's indoors. A dynamic environment could be a car, and static could be a couch. A brightly-illuminated environment could be a park, and dimly-lit could be a cinema hall.

Noise	Visibility	Movement	Illumination
High	Public	Dynamic	Bright
Low	Semi-public/ private	Static	Dim

Figure 8. Evaluation contexts

Participants were handed mobile phones, pre-installed with demos of the three prototypes. The Wizard-of-Oz technique was employed to ensure that sophisticated aspects of interactions worked [Ibid: 17]. Role-playing was used in combination with personas and scenarios. The idea was to enact the role of a regular student and use the demos in situations of a regular student's life. Similar approach has been introduced in [10] where role-playing the use situations has been used as a tool in the application conception phase. In [Ibid: 10], the users and designers together refine design concepts by simulating or acting the usage situations in preferably authentic environment. Oulasvirta *et al.*. [18] report that bodystorming is an effective way of getting familiar with unfamiliar activities, and is more memorable and inspiring than conventional brainstorming sessions.

The evaluations were conducted within the premises of a University campus. The study involved spending time in various locations of the University, and was in the style of a-day-in-the-life-of a student. Each study session lasted approximately one hour. Initially, a short story based on the persona was read by the user. Then, six different tasks were performed in different contexts.

First, in the high-noise, dimly-lit, public, static environment of the University café, the participant was made to wait for a friend, after ordering coffee (see figure 9). The following three tasks were performed in order:

1) Use TryMyLuck, while waiting for the friend.
2) Turn on the ForMyEyesOnly for intimating when contacts are around. Make a phone call to a friend.
3) Set a reminder using ForMyEyesOnly.

When the phone call was made, the researcher at the receiving end played a pre-recorded conversation between two friends. A beep was heard when the friend (researcher actor) walked by.

Next, the participant walked to the library through a corridor. The corridor varied from public to semi-public, noisy to quiet, and was bright throughout. While walking, the participant was asked to:

4) Use TryMyLuck while walking to the library.

At this point, the TryMyLuck prototype played an audio track, heard by the participant through headphones.

Once the participant reached the library, he/she was instructed to:

5) Set the ForMyEyesOnly preference to strangers. Make a phone call to a friend.
6) Read a page of a book. While reading, that the ForMyEyesOnly reminder goes off.
7) While reading, the TimeOut application pops up. Accept and choose Stretching.

Similar to the second task, a pre-recorded conversation was played to the participant during task 5. A researcher actor walked in and a beep was heard on the phone headphones. Automatic delays were introduced between various demos, to accommodate for the time spent in walking and in the case of slower interactions.

After each demo, opinions of participants were solicited. At the end of the evaluation, a short interview was conducted to gather information on regular practices and behavior while waiting, taking breaks, and intrusiveness, and the effect of the prototypes during these phases. Heuristics of each prototype were evaluated on Likert scale.

RESULTS

In this section, we discuss important findings from the evaluations.

TryMyLuck

14 out of 16 users mentioned that they would use TryMyLuck for killing time. The 2 other participants were generally hesitant to use the mobile phone. With TryMyLuck, some differences were found among participants belonging to different user groups—2 participants with full-time jobs mentioned that it would suit teenagers better.

The serendipity of the application was favored by all. The suggestions pre-selected for the sake of user studies were not uniformly liked by all, as they needed to be subjective (which was the goal of the system—the application would learn

based on user interactions). The social feature of recommending contacts to speak to, appealed to all female users (n=4). E1 mentioned—"*It's excellent. You can stay in touch with people. Calling somebody you haven't spoken to in a while won't often come to your mind. You should stay in contact with people more often, so it's nice to get these suggestions."*

The memory recall feature along with timestamps E6 mentioned—"*It is nice, that you see when you had last spoken to somebody. To see when and where you had last listened to a song last is a nice detail."*

Figure 9. User study in the café (left) and library (right)

The interactive, game-like feature was well-appreciated—E4:"*I love this slot machine! I don't have to visit random shops anymore! Plus it's cool how it suggests things to do. That's like twice the fun.* "

Finland has a high number of slot machines in non-traditional places like video parlors and grocery stores. TryMyLuck blends well with the unique geographical characteristic. Some users noted that TryMyLuck could be used on weekends and holidays. E10—"*You could self-define activities like going for a swim on a Saturday morning or cutting the grass. Activities you could imagine to do on a vacation anyway."*

TimeOut

The idea of setting break times manually was highly favored. Needless to say, automatic alarms going off on a busy and intense day was disfavored. Feedback also highlighted that inappropriate timing could lead to annoyance—E11: "*When I'm concentrated on something, something like this could annoy me a lot. However, if the application can learn, then I like the idea. I also like the idea of setting the alarm manually."*

Contrary to the initial design assumptions, a few participants stated that TimeOut could be used for leisure—E6:"*On free days it could be nice. For example it could suggest what to do on a rainy day. But not command me like "clean the bath room" but more like "make yourself a nice cup of coffee."*All participants liked the options of listening to music and stretching—E1:"*I don't usually remember to stretch so it would be great if the phone could remind me to do that. Stretching is a good tip and useful."*

Suggestions for other content to be included were poetry, cartoons, foreign phrases, and origami. Depending on the activity, TimeOut was also considered to be a "feel good application", since it could suggest the user to do something nice and positive.

ForMyEyesOnly

The location detection feature of the ForMyEyesOnly raised suspicions and concerns of privacy among the participants—E14: "*It would be nice to see other people's locations but if someone would see me it would not be that nice.* " E16—"*It would feel like it's an invasion of privacy if someone knew about my presence when I did not want them to."* This led us to improve the design by allowing the user to choose who, when, and where could their availability be shown. Availability could be displayed to three types of social groups—individuals, groups, and broadcast to everyone.

The application was considered most useful among those with jobs, who found use cases for this feature in both business and leisure. The findings emphasize the desire for user control, which is in agreement with earlier research [Ibid: 9]. The pseudo-random presentation of options and ambient alarms employed in the designs seemed to work well—a finding which opens up further possibilities in the future design of UIs for context-aware applications. It also led participants to think of other uses—E12—"*If I had to find a lecturer and he wouldn't be in his office, it would be handy to use this to find him."* E12—"*I could use this [for safety] in a dark alley.*" E14—"*In wilderness (while hiking), I could use this to find other people."*

The ForMyEyesOnly reminder invoked a great deal of interest in the participants. In the corporate setting, ForMyEyesOnly was considered to be helpful to differentiate between personal and professional reminders. Many participants modified or shortened their reminders to keep them private and unintelligible to others. ForMyEyesOnly would solve the issue.

BROADER LEARNINGS

Support incidental and intentional control:

Mobile technologies should allow for a combination of manual and automatic control. Since automated responses depend upon the environment, which is a thorny concept, providing manual control should make up for the discrepancies.

Unanticipated use:

By virtue of physicality of the device and light weight, the mobile phone lends itself to unanticipated use. Earlier cited examples from our study include the use of social neighborhood detection to find other hikers, and using the same feature to figure out if a professor was available. Broader innovations such as use of cell phone backlight as torchlight, and missed calls to notify and communicate with others, also reflect unanticipated use in this space.

Designing for non-use:

Posing questions on non-use helped us understand how *not* to design technologies, in addition to incorporating practices around non-use in our applications. Examples include the ambient notification in ForMyEyesOnly and the automatic turn-off of notifications in TimeOut.

Small is valuable:

Clearly there is a lot of value in developing applications for incremental or little, but perceivable, value through games, health, and skill-building applications. Adding stress-relief

options such as Finger Yoga created a sense of "satisfaction" while using the applications.

CONCLUSION

In this paper, we have presented a human-centered design process of studying mobile practices, design ideation, prototyping, and evaluation of three prototypes for always-on mobile device users. Specifically, our prototypes addressed the problems of addiction to mobile devices, time spent in waiting and transit, and intrusiveness. We tried to address the problem of social mobile contexts, by situating the designs in existing practices. We also explored how to enable context-awareness on mobile devices, in meaningful and intuitive ways. Our research presented in this paper is somewhat limited by the short duration and setting of the study—a highly technology-friendly country with excellent network infrastructure. To investigate the uptake of the applications, a longer-term user study with fully functional applications should be arranged, but the current study vetted out the fit of exploratory designs for social context of mobility.

With the enormous adoption rates and consequently perpetual possession of mobile devices, the interplay of social circles and device-mediated practices remains under-studied. With this research, we seek to have provided a starting point for providing context-aware solutions in drawing social and informational boundaries, considering usage, context, and appropriateness in social circles.

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