Fear and the City – Role of Mobile Services in Harnessing Safety and Security in Urban Use Contexts

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ABSTRACT
This paper describes investigation of a mobile communication system that helps alleviate fear experienced in the urban context. In order to obtain empirically grounded insights for the concept design, urban females in their twenties and thirties and living in Bangalore, New Delhi and San Francisco, were studied. More than 200 females filled in an online survey. Extensive qualitative data for 13 participants were collected through week long diaries, semi-structured interviews, and situated participative enactment of scenarios [1]. Fear-related concerns were voiced both in India and the U.S., suggesting that reducing fear, particularly in a pedestrian context after the onset of darkness, could be a globally applicable need. User research findings into subjective experiences of fear, contexts in which they occur, and behavioral strategies were used to design a mobile service titled ComfortZones. This concept was developed to the level of a high fidelity prototype and tested in a field trial in India. The investigation highlights further opportunities for design, particularly the notion of emphasizing positive and socially successful qualities of cities to communities concerned with their safety and security.

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Urban fear, mobile communication and personal safety & security.

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Design, Human Factors, Security

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INTRODUCTION

Urbanization is one of the megatrends of the 21st Century. Asian cities in particular will see rapid growth rates in the next decades [2]. As urbanization challenges the social, economic and political structures of the cities in several ways, the experience of fear in urban populations can often be a negative side effect and a factor reducing quality of life.

Studies point to an inconsistency between fear of crime and objective crime levels. In Canada [3] and the U.S.A [4], fear of crime has increased despite simultaneous decline of national crime rates. Irrespective of what is causing its rise, fear of crime has nevertheless become a fact of life for many urban individuals and communities.

Fear casts a shadow on the urban life; some studies suggest that improving the social aspects of the communities, such as social capital [5], might alleviate the situation. In addition to social interventions, we believe that Information and Communication Technology (ICT) can also play a role. Surprisingly few studies have addressed fear and anxiety from a socio-technical view point. Blythe et al. [6] investigate the use of wearable computing technologies to reduce fear of crime among elderly. Williams et al. [7], on the other hand, study the role of wearable technologies in bridging the gap between a child and the urban environment. The study highlights safety concerns, in particular, as an obstacle to children's ability to form a positive orientation toward the environment and proposes 'hazard tagging' as a potential outlet of geographically related safety concerns.

While the acceptability of technologies tackling feelings of safety and security is reflected in [6] and while [7] focuses on facilitating a child's orientation toward the urban environment in general, our research aimed to generate insights to support the open-ended goal of designing mobile communication features for urban individuals and communities concerned with their safety. The present paper describes the findings of cross-cultural user research on a relatively focused user segment, namely young middle class females, in their twenties and thirties. It was hypothesized that this user group is becoming an increasingly important population in urban centers, and that it constitutes a potential user segment for mobile services related to

personal security that has yet to be explicitly examined by this community.

Two disparate countries, India and the U.S., were selected for the study. These countries were expected to differ in terms of the daily commuting options, the quality of public infrastructure, and spatio-temporal patterns of work and free time. One open question was whether commonalities between these two cultures would emerge.

Our primary interests were the nature and range of fears, as well as the contexts in which these concerns typically occur. Further, we examined coping mechanisms and actions taken in situations of fear. Finally, we investigated how ICT, particularly the mobile phone, may be used to alleviate such concerns. Overall, these questions were thought to be integral for successful design of mobile communication features tapping to the area of personal safety and security, a domain that is currently by and large lacking from the mainstream, consumer driven mobile services space.

In the latter part of the research, the user research findings were carried to the design stage. A security driven mobile service was designed and prototyped. We will describe a mobile field study that was done to yield understanding of utility of the service designed specifically for this purpose. Design implications of the trial will also be highlighted.

CROSS-CULTURAL STUDY OF FEAR AMONG URBAN FEMALES

Study Method

The initial cross-cultural study started with an online questionnaire, and was followed by in-depth qualitative methods: a diary study, semi-structured interviews, and Situated Participative Enactment of Scenarios (SPES) [1]. The first phase took place in Bangalore and Delhi, resulting in emergence of initial findings. The study was then replicated in the San Francisco Bay area resulting in consolidation of the themes. The 12 participants that took part in the diary study and subsequent interviews were recruited both from India and the U.S.

Online questionnaire

An online questionnaire prompting for open-ended answers was used to extract the primary causes of insecurity of women as well as to assess the validity of the research topic in general. It was also used to screen and recruit participants for the subsequent stages. In India the questionnaire was emailed to 100 female urban dwellers, with 43 responses. In the U.S. the questionnaire was placed online and data was collected from over 200 respondents. Respondents were asked to describe situations from their daily life in which they felt most vulnerable with regard to their safety and security. They were also asked what they would typically do in such situations to increase their feeling of security. In the end, 13 women were recruited from the pool of questionnaire respondents, selected for diversity of both lifestyle (e.g., occupation, local neighborhood) and responses to the above questions. The women in the resulting sample ranged in age from 22 to 39.

Diary study and interview

To gain insight into feelings of safety and security in the context of their daily routines and environment, the researchers employed a diary study [9] that included media capture by the participants. Each woman was asked to keep a "diary" for 7-10 days in order to record any instances and thoughts related to her sense of security. Instructions were to document moments when they felt unsecure, as well as anything that increased their feelings of security. Participants were encouraged to describe the objects, people, spaces, situations or contexts, as well as their feelings and thoughts related to the situation. They were encouraged to use whichever method (for example, in situ or at the end of the day) and recording tools (photographs, video, text message, or notebook) that were most appropriate for them or the given context. Given the nature of the study, care was taken to explicitly instruct participants to avoid taking any action that might jeopardize their safety. Follow-up interviews were loosely structured around the diaries as elicitation material, but also included general inquiries into the participant's daily activities, lifestyle, and social circle.

Situated and participative enactment of scenarios

SPES has been used as a participatory design technique for engaging individuals to imagine potential products or services for a specific context [1]. In SPES, a participant enacts a scenario using a mockup of some generic form factor. The scenario may be grounded in their actual experience and it takes place in as close to the original context as possible.

Since fear and darkness emerged early as a strong theme in this study, the interviews and SPES activities were conducted close to dusk. Researchers and participant visited the original or an approximate location of a scenario identified from the diary or interview. There, they imagined the circumstance that she had described. For example, one SPES involved visiting a park at night and imagining a situation where the participant was jogging alone. Participants were then handed a rectangular form and told it was a "magic device" that could do anything they liked, and asked to elaborate on how they would use it. The main reason for using the SPES method was to provide the participants with a way of elaborating on the potential role of ICT in alleviating fear relating concerns. Additionally, data emerging from SPES was also used to support themes arising from the media capture, diaries and interviews, which acted as the primary source of data in the affinity analysis.

All data from media capture, diary, interviews and SPES instances were initially coded according to the categories of research interest – the situations of comfort and discomfort that were reported, and the contexts (physical, temporal,

social, etc.) in which they occur. Further coding and theme development proceeded by affinity analysis.

Findings

Online questionnaire

Questionnaire responses demonstrated how fear represents a concrete type of psychological distress among urban Indian and American women. The descriptions also provided understanding of the frequency of perceptions of fear across different contexts. Although the sample may be biased toward individuals for whom fear was a clear concern, it is nevertheless interesting to compare various contexts: (a) indoors, (b) in transit as pedestrian, (c) in transit, public transport; (d) in transit, private transport. Table 1 shows the frequency of the responses across these contexts in both countries.

	Indoors	Pedestrian	Public Transport	Private Transport	# examples given
India	3.7 %	43.3 %	32 %	20.7%	53
U.S.A.	3.4 %	85.3 %	6.8 %	4.3%	205

Table 1. Four contexts of fear emerged from the online survey. Total number of respondents in India and the U.S. was 43 and 198, respectively.

For both India and the U.S., the pedestrian context was by far the most commonly mentioned category: Walking in an unfamiliar area after dark was a typical response. In the U.S., walking to one's car also emerged as a specific concern. Curiously, Indian respondents reported more concerns within public and private transport than their U.S. counterparts. Auto-rickshaws were a particular context of concern for Indian women:

> *"I feel most vulnerable with regard to my safety and security every time I travel by Auto [rickshaw]. ...[I] have heard horror stories of auto drivers being in cahoots with robbers and looting people mid way to their destination and of rape and harassment that has happened to some women traveling by auto."*- Online respondent, India

The reason for Indian respondents being more concerned about their safety while in transit could be due to preferential differences in the mode of transport between these countries. It is possible that in the U.S., use of personal car is more frequent than public transport or taxi travel. In India, in contrast, car ownership is low and females would be more inclined to travel by bus or auto-rickshaw, consequently leading to differences in contexts of perceptions of fear reported by Indian and American respondents.

The diaries, interviews and SPES provided a deeper understanding of fear-related psychological dynamics, as compared to the questionnaire. The next sections describe five following themes, as derived with the help of the qualitative methods: (1) contexts of fear, (2) factors inducing fear, (3) factors reducing fear, (4) behavioural responses to fear; (5) role of ICT in reducing fear. While some findings lend themselves directly to subsequent design principles, others are included here for the sake of sharing a more comprehensive description of the phenomenon studied, i.e., fear in urban context.

Contexts of fear

Building on the questionnaire findings, the SPES sessions revealed further aspects about the contexts of fear. Most of the enactments took place in open environments – car parks, main roads, highways, parks, commercial spaces etc. There were two instances of participants encountering a sense of threat to personal security - one of them was in the stairwell of a building and another inside the participant's house, when she was alone. But there was a clear prevalence of the public sphere as the context of fear.

Further, almost all of the selected contexts were spaces familiar to the participant, on a daily or routine basis. This indicates that even familiar public spaces, mostly when there were uninhabited or inhabited by unfamiliar strangers, turned into uncomfortable, almost alien environments. Factors that were responsible for the conversion of a previously safe zone into one where they felt a sense of threat were level of illumination, the ratio of unfamiliar men to woman present (more no of men indicated a higher degree of fear) and distance from the epicenter of a safe zone, e.g. parking a car further away in the periphery of a parking lot as opposed to closer to the supermarket or coffee shop.

Figure 1 includes three pictures captured in the mobile context by the participants for their diaries. Image (a) is not accompanied by comments whereas (b) and (c) also include a comment of the context written by the participant on her diary.

(a)

(b) *"This is an auto driver who I caught staring at me at a stop-light in town."* – Female II, Bangalore

(c) *"A lane between work and home at 9 pm. A car slowed down beside me and then sped past. Slight, only momentary sense of threat when this happens. It's a small lane, so sometimes it feels like they're sidling up to you even if its not always their intention."* – Female I, New Delhi

Figure 1. Examples of contexts of fear recorded by participants in their diaries: (a) location of a bail bonds venue, U.S (b) staring autorickshaw driver, India (c) dark lane, India.

Factors inducing fear

Darkness. Dark urban spaces, such as parking lots, alleys, parks, etc., were commonly reported as uncomfortable and fear-inducing. When it comes to temporal variation, the onset of night, in particular, marked a qualitative shift in the psychological orientation toward a space:

> *"I was walking out at night, it's the time when it's not bright, it's not dark, but this is when you start feeling a bit uncomfortable."* – Female I, Bangalore

The finding that darkness induces fear is not surprising per se. However, the fact that one's orientation toward the surrounding space changes at the onset of darkness is worth noting as it suggests that security related services and interfaces should be able to distinguish between light and dark spaces as well as day and night.

Contexts of potential accident or theft. Several participants were concerned about the prospect of accidents while in transit, sometimes based on a prior experience. Fear of theft was also common. One respondent reported avoiding her normal route after her purse was snatched. American participants voiced concerns of being robbed at an ATM or parking lot.

Unfamiliar male presence. The presence of unfamiliar men was a strong driver of fear in both populations. A man was considered particularly threatening when he was intoxicated, exhibited unstable behavior, appeared to be of a significantly lower income group, or looked like he "could do harm." Gazes of unfamiliar men were considered invasive:

> *"I went to the gym a little later than usual, 7am. I saw this guy working out next to me. He just kept on staring at me. Made me feel really uncomfortable"* – Female II, Bay Area

American descriptions especially evoked a kind of stereotype with respect to typical dress code, race and even vehicle type associated with fear-inducing personae:

> *"This guy was wearing all black and in a black car with both front and back windows tinted black, and you can't see inside. These are the types of people that make me feel nervous."* - Female II, Bay Area

Factors reducing fear

Personal indoor environment. Familiar indoor environments, especially one's home or personal car, were perceived as safe environments keeping strangers at bay.

My local. Being in a familiar outdoor environment was also seen as a driver of comfort. The physical and social elements within one's local environment were "anchors" of safety.

> *"The small shop owners, security guards and drivers give a sense of safety since they have been in the neighborhood a long time and they all know my family too."* – Female IV, Bangalore

The notion of 'my local' points to relativity in the perception of safety and security. A dark alley may not pose a threat to an individual whose home is around the corner, yet feel uncomfortable to a passer-by.

Access to responsive authority. Signs of access to authority, such as an office alarm, brought about a sense of security. Knowing that help could be found close by was also important. However, there was a cross-cultural difference in this factor. In India, certain police stations were perceived as unresponsive or unsupportive.

> *"Church street is full of people but its crowded streets that are often most overwhelming because men can get away with a lot that is unacceptable when in a crowd. Cops give you a sense that you can turn to them for help although the reality may be quite different."* – Female II, Bangalore

Presence of friends/ co-workers/ family. Knowing that someone from one's social network is present or is in the vicinity inhibited fear, particularly after the onset of darkness. A familiar male presence provided an especially strong sense of comfort.

> *"I walked through this neighborhood the night before with a male friend. I would have felt very nervous without him at night even thought the neighborhood is well lit."* – Female II, Bangalore

Personal device engagement. A mobile device sometimes provided a comforting diversion from the immediate physical environment or the possibility to call for help if required. The role of ICT is elaborated further in later sections.

> *"The phone, so far I've used it as a prop. When I'm in weird or uncomfortable situations I pretend to SMS or talk on the phone. As though -You can't do anything to me, because I'll tell!"* – Female III, Bangalore

Behavioural responses to fear

Three types of behavioural responses to fear emerged. First, in the absence of an explicit or concrete threat (e.g., walking through a dark alley) a general feeling of anxiety was perceived and the need to reduce this feeling state resulted in comforting actions, such as initiating a phone call to a close friend. Second, anticipated threats led

individuals to take preventive actions, such as choosing a well lit route over a poorly lit one or paying close attention to what one is wearing. For instance, the diary study revealed that one of the Indian participants preferred to wear trousers and a jumper when riding on a motorbike, so as to appear as male to people around her and to consequently avoid attracting the attention of unfamiliar men in her proximity. Third, in the case of explicit threats such as the gaze of an unknown male, reactive actions were taken. Examples of such reactive actions include shooting a picture with the camera or walking away to diffuse a situation. The SPES method led to further examples of reactive actions. Most participants referred to a 'one click' response to their interaction with the magic thing while in a state of fear. A one click action was desirable to reach out to a possible nearby friend or when aiming to notify the authorities of a violation and report the exact location of the situation. This sense of urgency of response was translated into simple actions that could be performed even if the user was not in direct contact with the device.

Role of ICT in reducing fear

This section describes actual and hypothetical ICT use cases as envisioned by the participants in terms of reducing fear.

Actual ICT use cases: Mobile phones already appear to play important roles in fearful situations. Two are worth noting: First, phone calls and text messages signaled safe arrival at one's destination to another party. This alleviated fear of the participant as well as the concerned party. Second, participants reported making calls to their close friends or family when experiencing fear. The calls had a comforting effect and they were made e.g., when travelling in an auto rickshaw or walking through a dark area:

> *"In case I am walking alone then I'm most definitely on the phone with a friend having an entire conversation till I reach all the way home. Most definitely at these times I talk to very close people who I trust will watch out for me i.e. in case something happens…."* - Female VII, Bangalore

Imagined ICT use cases: The SPES method required participants to imagine what a 'magic device' could do for them in an unsafe situation, and to enact its use in a scenario. Cross-culturally, participant had very similar responses, many echoing earlier findings of comfort drivers and behaviours. The most common idea was some form of alarm that could scare off a potential attacker. Many imagined ways in which the individual could get in touch with members of her social network situated in the proximity. Also, sending out a silent signal to the nearest point of authority, like a police station or security guard, to alert them of the exact location of the incident was suggested.

Citing some of the specific examples from the SPES study, we can see how participants from different contexts react to similar situations. One of the participants from Bangalore took us to a main road where she was once followed on foot by a stranger.

> *I'd want to tell someone where I was - to register exactly where I was, because if you call someone, in the time it takes you to explain where you are, what's going on and all of that it would be too late…So this would be a device with an emergency red button that allows me to tell someone, like my mom at home, exactly where I am. Or some way in which to send the attacker's cell phone co-ordinates to the nearest cop station, so that hopefully they can be tracked and caught.* – Female II, Bangalore

Another participant from the Bay Area talked about a situation where she was walking back to her car in the parking lot very early morning, and was nervous about being attacked during that time.

> *I'd keep the device inside my sweatshirt on my way back from the gym, and my hand would be holding it, just like I do with my pepper spray now – something I can take out immediately and use with one button. Also, then automatically the cops would get here, without me having to call them or dial or anything.* – Female II, Bay Area

A participant who took us to a dark lane which led to her house walked us through the lane showing us dark corners that she avoided and areas lit by street lights and houses where she preferred to walk. She described an incident that occurred a while back where two men on a scooter tried to offer her a lift while she was walking home.

One of the interesting differences in how females from different cultures respond to situations of violation or insecurity is reflected in the fact that most participants in India felt that they would rather call a friend or someone close to them in proximity in help, rather than relying on the police to come and handle the situation. In some cases this was because they felt that the police would not have the same sense of urgency, while in some cases it was just a distrust of authority figures who in many cases have not responded effectively in similar situations. This does not mean that they did not want to involve the authorities in the reporting of such incidents. Most participants felt that all these violations, however small needed to be recognized by the authorities as being important, and they felt that the violators needed to be caught, but they felt that there was an inefficiency in the way the authorities dealt with situations like these.

In the Bay Area, this immediate response was quite different. All the responses indicated that the participants would first call the police as they were considered to respond well to an emergency situation and take control of it. One participant from the Bay Area talked about a previous incident:

> *In a previous incident when we had a burglary, the cops came around just having their presence around the house or knowing that they were keeping an eye on the neighborhood gave me a sense of security. And maybe that the burglar wouldn't return if he knew the cops were around close by.* – Female II, Bay Area

CONCEPTUALISING MOBILE SECURITY SERVICE

This section is divided to two parts. It highlights empirically grounded design principles. It then goes on to describe the concept that was designed based on these principles and the subsequent prototype implementation.

Design Principles for Security Services

Based on the insights accumulated during the user research phase, we identified the following principles to guide the design of mobile communication features supporting the feeling of safety and security.

1) Enable Social and Communal Involvement: All of the methods used, i.e., diaries, interviews and SPES, underlined that women are not always alone in their fear. Knowing where your friends, family and colleagues are at any given point was found to have a fear reducing impact, both in India as well as in the U.S. Fear can also fuel communication and bind people together. In the communication ecosystem of fear, a person in a vulnerable state often may have another who is able and willing to give support, even from distance. The study showed that the caregiver can come from the intimate social circle. However, would it also be possible to involve an entire community when fostering a sense of safety among users of security related mobile services?

Based on the above, a design principle emerges, namely that of enabling social and communal activities in a security service. Our study highlights many examples that fall in this domain. Knowing that someone from one's social network is close by can bring about a sense of security. Communication activities between members of a social network could also be important, as indicated by the popularity of making phone calls when in fearful situations.

2) Capture and convey location based safety attributes: Several individual variables were identified that affected an individual's perception of the space as safe versus not safe. The study indicated that the following factors can influence such subjective evaluation: distance to nearest authority, proximity of members of one's social network, illumination level, presence of familiar landmarks, and crime rates. Urban areas are expected to vary widely along these variables. Could mobile technology be used to capture the values associated with various fear related factors and communicate the extent to which these values differ between locations?

There are three possibilities for capturing such location specific information. First, automatic sensing allows some of the above variables to be tracked without human intervention. For instance, photo sensors could be used to map how streets vary in terms of their illumination levels. Second, it is possible to collect historical information (such as crime rates) and convey this to the service users. Third, information may also be collected through crowdsourcing techniques. Ushahidi.com [8] is an example of a service relying on the willingness of the general public to use the mobile phone in order to report cases of political unrest as observed in various locations in the developing regions of the world.

3) Support comforting, preventive, or reactive use of the service: The study indicated that individuals are disposed to three types of behaviours in order to reduce the feeling of fear: comforting, preventive and reactive. Acknowledging these modalities can be useful when crafting mobile solutions for safety and security. For instance, providing information on a mobile phone concerning crime levels associated with different parts of the city can support preventive use of the phone. Such information might be useful when planning the route, so as to be able to avoid areas associated with a high risk of becoming victim of crime. Comforting use of the service could take place when the user feels threatened despite of absence of an acute threat. A phone call made to a caregiver when walking through a park could be considered as an example of comforting use of the mobile phone. Features allowing authority to be alerted or sounding a siren in response to an attacker are examples of reactive responses. A commonality between all three behavioural modalities is that, if properly designed, mobile communication features have the possibility of providing an outlet to these motivations.

ComfortZones Security Service

The research team used the three principles described above to design a service falling in the domain of urban safety and security. A mobile service concept titled ComfortZones was generated. See Figure 2 for a screenshot of ComfortZones.

Design Features for Social and Communal Involvement: To support locally based communication among community members, interaction with other service users as well as general service features were designed to be map based. The default view of the application is a map based on the realtime position of the user. The user is situated in the centre of the map, as shown in Figure 2. The main view also indicates the position of other service users who are located within the visible area of the map. Their respective locations are indicated relative to the user (see two rectangles to right of the center in Figure 2 as an example). Profiles of the service users can be personalized by e.g. choosing a thumbnail image visible to other service members or creating a username. The profiles are associated with two types of micro-blogging functionality, passive and active. The former allows one to view status messages displayed by other service users. The latter enables the user to configure one's own status message as well as post responses to respective messages of other users.

Design Features for Capturing and conveying location based safety attributes: The service includes tagging functionality for perceptions of comfort. Users can generate a green or red tag to indicate locations where they feel comfortable or uncomfortable. For the sake of ease, tags were designed to be generated in one click by pressing the

send and end keys of the mobile phone to indicate places of comfort and discomfort, respectively. Tags are uploaded to the server, aggregated on the server side, and visualized on a map according to the location in which each of them has been originally created.

Design Features for Supporting comforting, preventive or reactive use of the service: ComfortZones was intended to support two types of user motivations, comforting and preventive. Conveying social presence, i.e., service users located nearby, was assumed to have a comforting effect. The crowdsourced information (comfortable versus uncomfortable tags) were hypothesized to be associated with a preventive value.

Figure 2. Screenshot of ComfortZones. User is positioned in the centre. Rectangles indicate other service users' positions. Green circles and red triangles are indicative of places where users have felt comfortable or uncomfortable. Micro-blogging feature becomes activated through 'Options' (bottom left).

Prototype Implementation: ComfortZones prototype consisted of a scalable server backend and an advanced client on the mobile phone. The backend was architected in J2EE using Spring and Hibernate frameworks. The MySQL database was capable of supporting up to a few hundred users. A proprietary communication protocol compatible with HTTP 1.0/1.1 was designed for client-server communication, adhering to REST principles and REST architecture. The protocol abstracted the complex mechanism of data transfer between the client and the server and was optimized for real-time efficiency, low battery consumption, and low power consumption. ComfortZones client was developed in Symbian, and consisted of advanced real-time rendering of map content from Navteq repository. The current location of the user and other service members was constantly captured via GPS positioning or cell id and cell tower data triangulation or a combination of both with priority being given to GPS for its preciseness. The present location of the user was constantly displayed on the rendered maps to provide a real-time user experience as the user moved around the physical locations.

COMFORTZONES FIELD STUDY

A field study investigating ComfortZones in a realistic context of use was run, with following research questions:

1. Can a mobile service, such as ComfortZones, bring about a feeling of security among its users?
2. Would community activities emerge that were centred on security?
3. Would the users be motivated to create and share content regarding their place related perceptions?
4. Would such shared content be useful to community members?

Field Study Method

In the field evaluation of the ComfortZones 19 college students from Bangalore, aged 18-19, were recruited for a trial that lasted for 22 days. Fourteen females and five males took part in the study. The participants knew each other at the onset of the trial since they were from the same year course. Studying the use of the service among such a cohesive group was thought to be of importance in facilitating community related activities. Since the duration of the trial was relatively short and the sample size small, it was assumed that a sense of community would not be formed among strangers.

The application was run on a Nokia E71 handset. To remove some of the barriers to adoption of the service, we recruited participants with prior mobile phone experience. Ten participants had used a mobile phone up to a period of two years, while nine participants had more than two years of mobile phone use experience. In order to achieve an ecological validity in the study, the participants were asked to carry the experimental phones with them at all times and to use the handsets for all voice calls and messaging. The voice and data expenses were covered by the research team.

An introduction session was organized at the beginning of the study in order to teach participants about the basics of the E71 functionality, as well as to get them familiar with ComfortZones. Participants were shown a short introduction video about the service and given instructions on how to use specific features. The participants were instructed to use ComfortZones as they see appropriate during the three week period. During this period server logs were collected to assess frequency of use of various features of the service. At the end of the trial, the participants attended a session in which they filled out a questionnaire and participated in a focus group discussion and a group task. The questionnaire assessed participants' individual views about the service and the mobile phone in general. The focus group and the group task were aimed at eliciting ideas for further development of the service.

Field Study Findings

Use of ComfortZones service

Figure 3 depicts frequency of use of various features of the service, across each of the trial days. The values are shown as cumulative numbers across all participants. They include

creation of uncomfortable and comfortable tags, passive micro-blogging (viewing other service users' status messages), active micro-blogging (changing one's status message and posting comments to others' profiles) as well as general application use. The latter is a composite measure of frequency of starting the application and shifting it to the foreground from the background.

There was a peak in use of ComfortZones in the first days, after which use dropped to a significantly lower level. Both passive and active micro-blogging features were popular during the initial peak period. These features did not retain a noteworthy daily use level after the initial period.

General application use remained popular throughout the trial, indicating that it was common to switch on the application and view the map, without necessarily engaging in further interaction with the client. Also generation of comfortable tags remained at a relatively high level even after the initial peak. The daily variations in the use of ComfortZones are especially noticeable in higher use on weekends (Days 1, 8, 15, and 22 represent Saturdays).

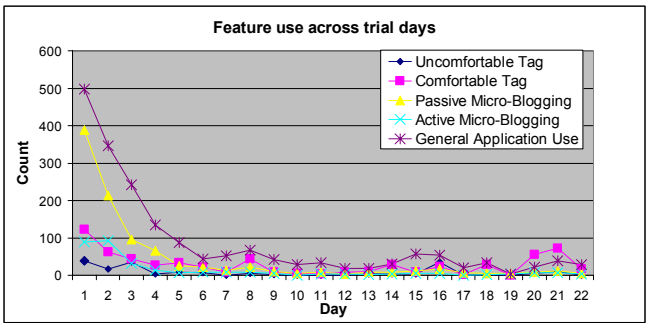

Figure 3. Use of ComfortZones features across the trial, across participants.

While the above diagram represents the overall use pattern across the trial, an examination of the daily average use of various features of ComfortZones provides a way to examine the differences in a more detailed manner.

	Average (per day per user)	Min ind. total use	Max ind. total use
General use	4.5	23	342
Comfortable tagging	1.5	1	155
Uncomfortable tagging	0.4	0	34
Passive micro-blogging	2.3	8	167
Active micro-blogging	0.7	7	40

Table 2. Column 2 indicates average daily use of various features of ComfortZones for each person. Columns 3 and 4 indicate the min and max individual total use of the features.

Although Figure 3 shows that the initial peak was followed by a drop in use, the average daily use for the system was nevertheless relatively high, at 4.5 daily instance of use per user. Generation of uncomfortable tags as well as active micro-blogging, took place on average less than once a day. Passive micro-blogging as well as generation of comfortable tags were more frequently used, on average more than once per trial day by each participant. The min and max figures indicate that there was large variation in terms of use activity. The most passive user engaged in general use of the application approximately once a day (23 times across the trial), while the most active one accessed the application more than fifteen times per day (342 times during the trial).

The following figure examines use of ComfortZones across hours of the day. The lunch hour is associated with a clear activity peak, with the activity being nearly five times higher than at any other point of the day. There is also some increased activity during the evening hours (spanning to as late as 12PM), although this is not comparable to the peak associated with the lunch time use.

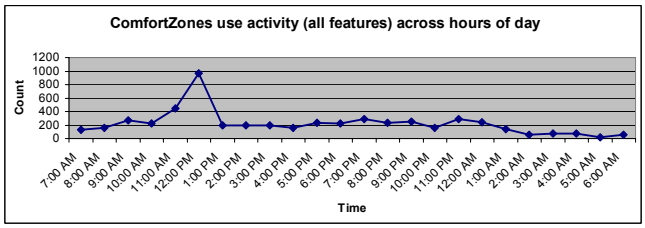

Figure 4. Use of ComfortZones during each of the hours of the day, across the days of trial.

In summary, the service introduction led to a peak in use of all of the features, with particularly general use as well as passive micro-blogging standing out from the rest of the features. However, once the novelty dissipated, two features retained a daily use level worth noting, namely general application use and tagging of the environment with comfortable label. Plotting application use over hours of day shows that lunch hour was a popular time for using the application. However, the application was not so readily used during the evening hours, indicating that its fear reducing potential during this time was not realized.

Utility of ComfortZones

The analysis of the answers to our questionnaire indicates that participants regarded the mobile phone as well as its software easy or fairly easy to use. Hence, it does not seem that any difficulties in use of the phone had hindered the uptake of the service. The participants found the overall concept of ComfortZones interesting, particularly with respect to the location based qualities of the service. The general impression of the concept was that of a social networking service. For instance, one of the participants referred to ComfortZones as a "walking Facebook".

The ability to access other users' location on the map was a widely accepted feature. The questionnaire indicated that 14 out of total of 19 participants regarded this feature in favorable terms and used words such as 'entertaining' and

'cool' to refer to the social location aspects of the service. However, contrary to the original design goal, social location did not facilitate the formation of a sense of security in a mobile context. Rather, this functionality had an entertaining role. The micro-blogging functionality embedded in the user profiles was also used to e.g. coordinate meetings in the town.

While the social location feature was associated with positive perceptions, 12 of total of 19 participants used negative terms to describe the tagging functionality. When asked in the focus group to explain the reasons for the negative perceptions, several individuals stated that the tags contained too little information to be useful. In particular, the participants expressed desire to know more about the background of the tags. For instance, the information about the creator, the time of creation, as well as reason for creating the tag, were all considered as important factors in forming an opinion about the ratings.

We hypothesize that trust plays a strong role in this aspect. An individual's disposition to utilize crowdsourced information, particularly in the domain of safety and security, may be affected by the amount of information embedded in such content. Do I know enough about the circumstances under which this rating was generated? Who was it that formed this opinion in the first place? Without such vital information, it is possible that trust cannot be placed on such content, consequently decreasing its value to the user.

Desires to improve ComfortZones

As discussed in the previous section, several suggestions were recorded in regard to improving the information value associated with the tags. Some of the participants thought that the tags were not informative enough since they lacked information about the creation context (e.g. author and motivation). Categorizing the tags to make them more indicative of the type of location they were referring to was also taken up by the participants. For instance, could the tag somehow include semantics of the location (e.g. bar versus park versus block)? Further, should the choice of labeling the spatial denotation be given to the user?

The above issues have to do with information value of individual tags and with the relationship between any given tag and its creator. However, a suggestion that becomes relevant, when there is a large number of tags associated with a certain area, is related to system side analysis of the data and identification of patterns. Some of the individuals participating in the ideation session noted that it is difficult to draw generalization of a given area when the individual tags are shown on the map. Would it be possible for the system to derive composite measures for areas populated with a critical mass of tags? Consequently, variations in the composite measures between geographies could then be represented with e.g. colour coding.

Field study discussion and future design directions

ComfortZones was used on daily basis, throughout the trial. However, there is no evidence for the service contributing to an increased level of safety and security among the participants. Despite the fact that the name of the service had safety and security related connotations, the perception of the concept was that of a social networking service. Further, the social networking features were not used for safety related discourse, but rather, social curiosity and micro coordination acted as motivators for this aspect of service uptake. The peak hour for using the application was during the day time; for a service to have a comforting impact on its users, one would expect it be used readily used also after the onset of dark.

What factors could have hindered the uptake of the service for safety related motivations? One challenge may be the supposedly high disposition of interacting with the service in fearful contexts. Displaying the phone and interacting with an application when experiencing fear may not be viable. Consequently, can alternative UI be used when experiencing fear? For instance, can the device sound an alarm when approaching an area associated with negative ratings? Alternatively, can communication be practiced with other community members through discreet means, such as by pressing a certain key while the phone is in the pocket?

The findings of the trial also suggest that the term community needs to be precisely defined. By community, do we refer to a closed network of people who are already familiar with each other? Or do we assume that people living in the same area, exhibiting safety and security related concerns, form an online community? Depending on which of these two models is adopted to the service, different kinds of communication mechanisms might be relevant. For instance, a group of close friends may be interested in knowing more about the meaning of individual tags as this would help them form a level of trust in regard to the information value of the individual tag. Enriching the informational value of the tags could be done simply by including an open comment field as part of the tag creation process. In the case of open communities, by contrast, the community members may be interested in accessing certain high level attributes of the crowdsourced content, such as composite indices to differentiate between comfortable and uncomfortable areas of the city. In conclusion, nature of tags (information rich individual tags versus composite indices concerning a large number of tags created in an anonymous fashion) and type of community in question (close versus open) may interact with each other. Studying this interaction presents future research opportunities.

Finally, findings of the study highlight a 'positive' approach to designing security services. Creation of tags indicating a feeling of comfort turned out to be more than three times more popular than expression of uncomfortable place related perceptions. Further, the social and communal involvement aspects of ComfortZones, mostly micro-

blogging and access to friends' location, were considered as entertaining and amusing. Hence, would it be possible to design a safety inducing service that highlights the positive aspects of the urban spaces while ignoring the dark side? Every city is likely to be associated with both negative as well positive areas. Maybe a service that only highlights the successful and positive aspects can have an integrative impact in terms of an individual's positioning to urban spaces.

CONCLUSIONS

We are all occasionally motivated by a need to cope with fear. Our study suggests that for urban women, fear occurs most often in pedestrian and transit contexts. Further, psychological space associated with fear is relatively complex: Variables affecting fear related perceptions among the sample included prior experience as well as the current physical and social context of the individual. Mobile phones are already playing a coping role through allowing voice calls to be made during uncomfortable situations. However, if a communications service was designed specifically to address the fears of this population, what could it be?

One of the key implications of the cross-cultural study is that the mobile phone has the potential to provide a number of different types of outlets to the need to reduce fear. At the moment, a voice call to a close friend can have a comforting effect on the user. However, the study highlighted that individuals are disposed to three types of behaviours in order to reduce fear: comforting, preventive and reactive ones. Acknowledging these behavioural modalities can be useful when crafting safety and security enhancing mobile solutions and when identifying features that enrich and diversify the currently existing ICT-related means of reducing fear. For instance, providing information on a mobile phone concerning crime levels associated with different parts of the city could be thought to support preventive behaviour motivated by concerns of security. Features alerting an authority or sounding a siren in response to an attacker are examples of supporting reactive behavioural responses. The design of a service also poses some unusual challenges, since the experience of fear is based on individual interpretation of circumstances. What would be the limitations of a service based on a sensed environment? Or one that identifies areas in the city as comfortable? Should the goal be, rather, to create channels for users that allow freedom of expression, negotiation, and interpretation of their feelings of security and insecurity, as they unfold in the social and physical texture of the city?

Our exploration of these issues have influenced design of the ComfortZones concept. This concept was prototyped and evaluated in a realistic scenario with 22 users, giving us grounded data about reactions to it and eventual adoption. The analysis of these trial results point to the specific aspects of the service that could be improved and to the overall opportunities for design in this space. Despite the cross-cultural nature of the study, it is still evident that more research is needed in this area. Theories concerning psychology of fear as well as social and communal aspects of fear should be addressed to build a stronger theoretical foundation for the research. Extrapolation of the findings across other age groups and cultures should be assessed with future studies.

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