Women's Safety in Public Spaces: Examining the Efficacy of Panic Buttons in New Delhi

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ABSTRACT

We present a qualitative inquiry through the lens of feminist Human-Computer Interaction (HCI) into women's perceptions of personal safety in New Delhi, India. Since a brutal gang-rape incident took place in Delhi in December 2012 and received global attention, women's safety has been the focus of much attention India-wide. In April 2016, the Indian government issued a mandate that all mobile phones sold in India 2017 onwards must include a panic button for women's safety. We draw on interview and survey data to examine women's responses to the mandate, also investigating what factors influence their perceptions of safety, positively and negatively. Our findings indicate that women's sense of safety may be deconstructed into a multitude of factors–personal, public, social, technological–that must align for this sense of safety to be preserved. We then discuss the implications these factors have for the success and (re-)design of the panic button and similar interventions.

Author Keywords

Safety; Gender; India; HCI4D; Feminist HCI

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION

Concerns regarding violations of women's safety have been foregrounded in India ever since the December 2012 brutal gang rape of a 23-year-old woman in the capital city of New Delhi. There was widespread public outcry of unprecedented magnitude, with protests occurring not only in the capital, but also in other cities and nations [20]. Media attention spread globally "within a matter of days" [27] and media reports on rape increased overall [12]. The event also resulted in a reassessment of criminal law regarding sexual assault and women's safety, though not all recommendations have been implemented [32]. In 2014, 2,069 rape cases were reported in New Delhi, compared to 1,571 cases in 2013 [26]. The number of reported cases of molestation rose by nearly 25% to 4,179 in the same period [26].

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In an effort to improve women's safety, the central government of India issued a mandate in April 2016. Phone manufacturers nationwide are now required to implement a panic button for women's safety on every new mobile phone [38]. In order to make the panic button effective, India's various contact numbers for emergency services have been consolidated into one, which is currently functioning and accepting calls [38]. To learn more about the public response to this mandate, we conducted an interpretive study of women's safety in New Delhi, drawing on interview and survey data. We began the conversation with participants' views regarding the new panic button, before engaging in a focused discussion of women's experiences and conceptualizations regarding personal safety in public spaces. Our research assesses the appropriateness of this panic button as a technology intervention for women's safety, as seen through the eyes of women in New Delhi.

Questions around gender and technology design are not new to the field of human computer interaction (HCI). Gender-focused HCI work in the past has included meta-analyses of how gender is represented in technologies [13, 14, 7], the role of gender in online communities [28, 37, 23, 15], and designing technology for women [34, 4, 19]. In recent years, the scope of HCI research has expanded to explore the design of technology for women's personal safety in public spaces in both developed and developing countries [30, 1].

Our study looks at a large-scale intervention of safety technology in India. We use the lens of feminist HCI in the process of analyzing and discussing our findings. The feminist HCI framework as described by Bardzell suggests a commitment to feminist as well as scientific objectives [5], providing room to reflect on how exactly our findings are situated among the power imbalances perpetuated by the patriarchal value system. To pursue such an analysis, we begin with providing a definition of safety based on our empirical findings. We view personal safety as a state in which one is protected from or need not feel compelled to think of ways in which to protect oneself from immediate threats to the individual person, such as people who seem to or actually have the intent to harm one's physical or mental well-being. We also recognize that terms referring to women's safety issues, such as street harassment, sexual assault, and sexual violence, overlap with each other. We study all forms of violence women face in public spaces, but focus on real or anticipated situations that might bring to test the efficacy of the panic button.

In the next section, we present works related to technology and women's safety that we have considered in our effort to determine the successes and pitfalls of prior interventions. We then describe our methodological approach, before presenting our findings and their implications for the success of the panic button in New Delhi. There are two key takeaways that we discuss. First, we use our findings to explain what India's current implementation of the panic button likely could and could not accomplish with regards to improving women's safety. Second, we use a feminist HCI framework to make recommendations for designing a system in which the panic button might play a successful role in addressing women's safety concerns.

RELATED WORK

The basis of our study is the literature on women's safety practices in public spaces and safety technology. Our research extends prior work by offering a more nuanced assessment of women's safety in New Delhi as it focuses on an ongoing large scale implementation of interventionist safety technology using the lens of feminist HCI.

Existing research has shown that there are common situations in which people tend to feel unsafe, such as places that are unfamiliar, not well-lit, far from a safe or familiar place, or notorious for being unsafe [6]. People tend to feel safe in places that are more familiar, where their social network is present, or when the perception of having their social network present is apparent [6, 10, 30]. Women, in particular, tend to be concerned when walking alone in unsafe areas, using public transit, in the presence of unfamiliar men, or in very crowded places such as concerts or markets [1, 6]. Especially in India, women are concerned when using public transit (possibly as a result of public transit being more widely used) [6]. A study of public spaces in New Delhi found male-dominated areas like cigarette shops, car parks, dilapidated buildings, and parks without good lighting to be most unsafe, while residential areas, crowded night markets and parks, and patrolled areas were safest [36]. We extend these findings by examining how public spaces, along with other autonomous actors, contribute to women's sense of safety in New Delhi.

In light of gender differences in navigation of public spaces, research has highlighted the impact of constantly dealing with threats to personal safety. Women may feel helpless, faced with the lack of public discourse on women's safety and the limits on their mobility [1]. Simultaneously, bringing attention to street harassment can itself be a source of shame and embarrassment [1]. Women also tend to avoid reporting to the police, as police may be viewed as unhelpful or partake in harassment themselves [17]. Reporting sexual crimes can result in the woman being shamed, being blamed for supposedly provocative behavior, or being made light of [17]. We examine the diverse actors and norms that contribute to these situations, through the case of India's panic button.

Drawing on the above understanding of women's safety practices, multiple studies have taken place with the purpose of seeing if information and communication technology (ICT) might play a role towards women's safety. In studying the safety practices of people navigating an urban setting at night, Satchell and Foth [30] found that women, men, and sex workers acted very differently. Women pretended to talk or text on their phones in order to give the perception that they are close to a social network that can aid them in case of an emergency [30]. Men tended to see their phone as a tool to call for help after an incident started to occur [30]. Meanwhile, sex workers would talk on the phone with their managers or coworkers, constantly updating them regarding their location so that in case of an emergency, the police could be sent to their exact location [30]. Blom et al. showed that women also called to notify loved ones on arrival to their destination [6]. Dimond et al. addressed ICT use in the more private context of domestic violence, recommending a redesign of ICTs to respect women's need for privacy and control over communication when escaping the abuser [11].

To expand the function of ICTs in women's safety in public spaces, multiple projects such as Protibadi [1], Safestreet [2], Harassmap [39], ComfortZones [6], CityWatch [18], and Hollaback! [10] have designed similar features: alarms to draw attention of passers-by, quick and silent methods of contacting friends or police, maps displaying locations of frequent harassment (often created with crowd-sourced data), and methods of describing and sharing experiences of street harassment with others. There were multiple social and technical issues that came up with these designs. Alarms, though effective in scenarios where there are many bystanders, could also be a source of embarrassment and unwanted attention [1]. The desire to contact police also differed by culture. In one study, women in the U.S. preferred contacting the police, while women in India preferred contacting their social circle [6]. Maps such as Harassmap and ComfortZones, which indicated locations with a high frequency of sexual harassment incidents, sometimes allowed women to avoid those areas and broke through literacy barriers using visuals [39, 6]. However, these types of maps are also perceived as another form of unfair adjustment that women have to make to be safe [39]. ComfortZones, which used a tagging feature to label a location as comfortable or uncomfortable, was also deemed to provide too little information to be useful for navigation decisions [6]. Finally, sharing experiences of sexual harassment, either immediately with the touch of a button or more descriptively in a website posting, gave women space to relate to or become more aware of street harassment, while also challenging misconceptions and normalization of street harassment [9, 10]. Variations on these core features were special assurances of anonymity of information to reduce social stigma and real time notifications of entering high risk areas as women traveled [2]. We extend this work by viewing a current large scale implementation of interventionist safety technology through the lens of feminist HCI and analyzing its efficacy in correcting power imbalances.

To evaluate the panic button with feminist HCI principles, we draw on Bardzell's framework [5], focusing on the values of **participation**, **pluralism**, **ecology**, and **advocacy**. Pluralism is the idea that a universal design does not exist [5]. Pluralism and participation work together to inform a design process that purposefully asks for and recognizes differing needs within a user base [5]. The quality of ecology encourages us

to think about how a technology reflexively designs the environment in which it is being used [5]. Advocacy focuses on ensuring technology is progressive and attempts to bring about political emancipation [5]. To apply these concepts to our study, we think about the "who questions" as suggested by Muller [25]. We ask *who* speaks for women regarding their safety and *who* is allowed to design how women ensure safety. In doing so, we also draw inspiration from Dimond's application of feminist HCI to Hollaback!, a social movement organization and forum to discuss street harassment [9, 10].

METHODOLOGY

We conducted our study (post institutional review board approval) in New Delhi from June to August 2016. The methods we used included 17 semi-structured interviews and an in-depth survey with 30 responses (through viral distribution). Both instruments asked the same questions with the goal of understanding women's opinions on the panic button mandate and experiences with personal safety in public spaces. The questions covered participants' demographics, commute practices, views on the panic button, conceptualizations of and experiences with safety, and technology use for personal safety. Examples included "Are you aware of the new nationwide mandate on having a panic button on every phone? How do you feel about it?", "What are your thoughts on personal safety? Is it a concern?", "Is it more of a concern here in Delhi than in, say, other parts of the country or the world?", and "Have you ever been in a situation wherein you or anybody you know felt that your personal safety was threatened?"

Our survey targeted men and women at or above the age of 18 living in New Delhi currently or up until recently. The authors, other researchers in New Delhi, and study participants shared the survey link on various social media channels. We note that because the survey was distributed so widely, people who did not live in New Delhi also responded to it. Rather than discounting these responses, we used them to compare ideas of safety between New Delhi and other Indian cities. Although we did not initially plan to include men in our sample, some did respond to our survey, and we analyzed this data as well to see how it compared against women's responses. Overall, the interviews allowed us to delve deeper into participants' thoughts and experiences, while the survey provided a bird's eye view of trends across different demographics.

We conducted our interviews in English with women between the ages of 21 and 33, all residing (and working/studying) in New Delhi. We began by recruiting five women in their late 20s and asked them to refer any women in New Delhi between the ages of 18 and 40 who would be interested in participating in a study regarding women's safety. As a result of utilizing snowball sampling, we were generally referred to participants who were in a similar age range and comparable socioeconomic status [16].

Responses to closed-ended questions in the interview and survey were analyzed by calculating percentages and cross-tabulated (as fitting) to view percentages for a certain gender or income bracket. Responses to open-ended questions in the interview and survey were coded using interpretive qualitative analysis [24]. We conducted "open coding" by going through each response to questions and selecting concepts. Examples included "I talk to my parents while riding in autos" and "I avoid walking alone in dark places". Further iterations of coding resulted in the formation of categories such as "social contact: calling or messaging family" or "locations: avoiding isolated areas". These categories were consolidated into six factors that shape women's sense of safety, which we describe in our findings.

Participants

The majority of interview participants were single women from middle-income households. Ten of 17 participants interviewed came from families who made more than INR 10 lakhs (approx. USD 15K) annually. Two of 17 participants came from families who made between INR 2.5 lakhs (approx. USD 3.7K) and INR 10 lakhs. Three of 17 participants indicated that they made less than INR 2.5 lakhs, but this number includes two participants who were referring to their own income, as opposed to their family's income as a whole. Family income was more representative of a person's socioeconomic status as the majority of participants lived with their family; three lived in a paying guest apartment and two lived in a hostel. Every participant traveled for work or university at least once a week, with many traveling for work or university three to four times or more per week.

Survey respondents were from 18 to 64 years old, with an average age of 30. Among them, 18 of 25 respondents were women and seven were men. Nineteen of 25 respondents' families had an income of above INR 10 lakhs annually. Respondents resided in the Indian cities of New Delhi, Gurgaon, Faridabad, Bikaner, Calcutta, Rohtak, Bangalore, Kanpur, Mumbai, Zirakpur, and Hyderabad, with a plurality residing in New Delhi. Twenty-two of 24 respondents traveled alone to work or university three to four times or more per week.

We note that our findings are focused on women of middle and high socioeconomic status (SES) who are educated and lead lives of relative privilege. These women's transportation choices, access to technology, and familial support likely differ from those of women from lower SES. As a result of these differences, the women in our sample are, broadly speaking, at lower risk of safety concerns that come with the inability to afford private transportation, not having a smartphone with mobile data, living in places that lack security, and respectability politics. Nevertheless, our participants are still target users of the panic button–women with mobile phones. By interviewing these women, we wished to examine what the panic button could change for women who had abundant access to resources because, despite this access, they still face pervasive and serious safety concerns. Understanding personal safety in a high-resource context is illuminating because it sets a standard of what safety technology can and cannot accomplish even in 'best-case scenarios'.

Reflexivity

Our interpretation of the data we collected is undoubtedly shaped by our background and experiences with safety. We are both women of Indian origin and were in New Delhi during the time of the study. We have both also experienced personal safety concerns in New Delhi, and on a regular basis.

As a result, we had an experiential understanding of participants' responses and chose to view the findings and make design recommendations via the lens of feminist HCI so as to draw out the way power imbalances make safety an ongoing concern for the women we studied.

FINDINGS

We now present the findings from our study, highlighting six factors that we found most influence women's safety. We use a feminist HCI framework to asses how each factor exerts control over women's safety, or in asking "the who questions" [25], how each factor speaks for women and designs the process of ensuring safety.

Safety in Public Spaces

Every participant talked about safety in terms of the various public spaces they encountered in their daily lives. Public spaces that exhibited certain characteristics that we will describe below were deemed safe or unsafe, to roam freely in or to avoid altogether.

Intensity of Crowds

Locations could always be categorized as isolated or crowded, with isolated areas judged to be unsafe. Crowded areas tended to be main streets that had the most shops or vehicles, public transportation during the day, markets, and malls. Participants preferred such areas because crowds could be a deterrent to street harassment or sexual assault due to the fact that there was an increased likelihood of someone intervening in the case of an emergency or supporting a woman in rebuking a harasser. When asked why she considered malls to be safe places, P2 said the following:

> *"In malls, there are so many people... You can't eve-tease in front of people, you might get beaten up... In Delhi, 70% percent of the time, people will come and help you."*

Women preferred crowds whether it was day or night, with some participants disliking isolated areas even during the daytime, which was considered the safest time to be in public spaces by every participant. In fact, isolation was the most cited reason New Delhi was considered unsafe past 9 pm, after which the number of people in public spaces dropped considerably. Notably, the presence of crowds only made it more likely that there would be helpful bystanders. Some participants still felt that there was a chance no one would care enough to intervene in an emergency and that they had to be aware of their surroundings even in non-isolated areas.

On the other end of the spectrum, participants thought extremely large crowds were unsafe as well. While isolation meant there may not be anyone nearby to help, high-density areas provided a cloak of anonymity to perpetrators of street harassment. P1 described a situation in which crowds helped facilitate an instance of street harassment:

> *"So in India the carnivals or exhibitions are very, very crowded... even in metros, it is so crowded that people try to purposely stick to you or come closer to you as an excuse because the place is very crowded."*

At the same time, sheer numbers did not explain how comfortable a woman felt in a public space. Women did not always have to be on the lookout for danger in areas with "filtered" populations, regardless of how crowded it was. For example, participants who traveled on the metro alone preferred riding in the women's compartment because they wanted to avoid the increased likelihood of staring or groping in the general compartments crowded by men. Participants felt the safest public spaces were malls or upscale neighborhoods because one could wear revealing clothing without being harassed. Mall security would limit what a person could bring with them into the building and malls generally only attracted people of higher socioeconomic status, which many participants felt was an indicator, albeit an unreliable one, of a more tolerant mindset towards women's freedom of choice. Finally, women generally felt safest in their homes because their surroundings were limited to their family and people purposefully allowed in the house. In all these areas, there are limits to the type of people who women could potentially come in contact with, filtering out people who seemed more likely to threaten women's safety.

These scenarios represent Rosenfeld and Noterman's argument that power determines whether a space is safe, as opposed to a space being objectively safe or unsafe [29]. Large crowds could be a negative factor because they allowed groping, but crowds of women in the women's compartment of the metro were acceptable because women do not exert power over one another in the same way men exert power over women with the threat of harassment or assault.

Cities and Cultural Norms

The attention New Delhi has received for women's safety, being dubbed the "rape capital," prompted us to question whether or not women felt New Delhi as a whole is unsafe compared to other cities in India.

For some survey respondents and interview participants, New Delhi was not any more unsafe than other cities. For these participants, lack of safety stemmed more from being in an unfamiliar area, hearing about unsafe situations in any foreign cities, or not having family residing in the area, rather than New Delhi's reputation as an unsafe city. Many interview participants with this mindset felt that there is no place that is truly safe and one must always be cautious of their surroundings. Often, they could also cite unsafe experiences in other cities. P5 explained the following:

> *"For example, when we went on vacation last year... We were in London... It's relative. They think that it's safer, because of the media hype that is created, but there's stabbings and other things you don't get to know unless you read the papers. In terms of women going out, there's more women that you can see on the tube, but I wouldn't say it's safe because I've seen women being harassed on the tube as well and people are more openly harassing them because the culture is such that you can greet people... you wouldn't talk to strangers, but over there, it's rude not to."*

For others, New Delhi was especially unsafe in comparison to other places they had visited, lived, or heard stories about. Sixty percent of survey respondents felt that personal safety is more of a concern in New Delhi than in other parts of the world. Fewer than half of them resided in New Delhi. These respondents generally cited a perception of more frequent reports of sexual assault in New Delhi. Twenty-seven percent of those who responded felt that personal safety may be more of a concern in New Delhi than in other parts of the world. Once again, fewer than half of these respondents resided in New Delhi. Of the respondents who resided in New Delhi, all but one respondent said personal safety is more of a concern in New Delhi than in other parts of the world. The city most commonly cited as being safer than New Delhi was Mumbai. Mumbai was considered a safer city by many participants because women were not as restricted–they could travel on the streets at night without fear of harm, wear more revealing clothing, and were not often approached by strangers. As a result, there were indeed more women on the streets, even late at night, reinforcing the feeling of safety. While Mumbai provided a sense of safety that was largely cultural, specific regulations in other cities afforded women a sense of safety. P12 described Chandigarh as a highly regulated city:

> *"Everything shuts off by 12... so there is no late night clubbing... In Delhi... they know that if somebody drops [trash] over there, you let it be over there. Nobody else is going to pick it up. Chandigarh is considered one of the cleanest cities because they know you don't have to drop it on the road. They follow all the traffic rules because there are regulations... Over here, there is no rule of dropping a girl back after 6 pm Over there, if any girl has a problem, or anything, if she wants to be dropped after 6 pm, there are police vehicles doing that."*

Regulations played a role in women's perceptions of other cities as well. Ahmedabad, for example, is in Gujurat, a dry state, which one participant felt made it safer due to a lower likelihood of encountering drunkards loitering at night who might harass women passing by.

Once again, participants displayed a preference for places where they are able to exercise power. Regulated places use law and order to ensure power imbalances between men and women do not have to be confronted. Places culturally different from New Delhi, like Mumbai, actually level the imbalances through a self-reinforcing cycle–people do not feel the need to control women's freedom of choice, so women continue to exercise freedom of choice.

Role of Technology

ICTs were naturally integrated into participants' daily safety routines. As we describe, women used smartphones to hold strangers accountable for their actions and to simulate their social network even when alone. We also describe the caveats that participants felt technology has in the realm of safety.

Holding Strangers Accountable

In the event that one entered a situation in which someone could *potentially* harm them, participants used their phones to create accountability. Participants felt that if a potential perpetrator knows he can be held accountable for any crime he might commit, he would be less likely to commit one. Using phones for accountability primarily applied when traveling. When using a hired car or auto rickshaw, participants would save and send photos of the driver and license plate to family members before getting into the vehicle. P17 explained how accountability made her feel more safe:

> *"One thing that I've learned from my elders or my brothers is that even if the cab driver doesn't do anything to you, just be safe, just do it in front of him–click a picture of him, click a picture of the cab, and say that I'm sending it to my brother or wherever I'm going, so that they have a track of it. He'll at least be sure everybody at least knows who he is, so he better not do anything."*

Participants also used their phones to send their location to family or friends when riding in a hired car or auto rickshaw. This practice was very common and Uber and Ola, ride-sharing services commonly used in New Delhi, implement this feature directly in their mobile apps. The idea behind sending one's location was that if the driver were to go somewhere other than the intended destination, loved ones would know where to find the participant and track down the driver. Here, women use phones to hold strangers accountable in situations where there is no accountability.

Accessing One's Social Network

Accessing one's social network via phone was another method of maintaining a sense of safety in potentially dangerous situations. When in isolated areas or riding in cars or auto rickshaws, participants would talk on their phone or pretend to talk on their phone to a family member or friend, giving potential perpetrators the perception that they have someone to notify in case of an emergency. This finding corroborates previous studies conducted in western countries that show that mobile phones signal a connection to others when in unsafe areas [22, 30]. We found in addition that many participants made a ritual out of it, always calling a parent, sibling, or friend on their commute from work or when traveling at nighttime. One participant described a time when she was traveling via a hired car alone at 3 am, and her family planned ahead to be on the phone with her for the entire ride. In these scenarios, women use ICTs to simulate their social network, though this does imply that perpetrators view a lone woman as powerless.

Notably, finding oneself in the situations described above with regards to transportation was greatly related to income level. According to the survey, not having one's own personal transportation was more prevalent among those with lower family incomes. Sixty-two percent of those who responded used a personal car to travel to and from work or university, while the rest of the respondents used methods such as public transportation, auto rickshaws, hired cars, or walking. Personal car was the most popular mode of transportation for both men and women. However, personal cars were overwhelmingly more popular among those whose families earn more than INR 10 lakhs (approx. USD 15K) annually.

Caveats to Technology Use

Despite the usefulness of mobile phones in the above scenarios, there were still issues that could arise when relying on phones for safety. Participants noted that phones were the first thing perpetrators would try to take away from a woman to ensure they cannot call for help or send their location to anyone, highlighting the amount of power ICTs provide women in ensuring their safety. Even if the perpetrator did not take their phones, some participants mentioned that their phone was not always an accessible form of aid in an emergency because it could be lost in their handbag or requires multiple button presses to unlock and then contact someone.

The panic button was mostly talked about in the context of its effectiveness as well. Many participants felt that the panic button would not be useful because perpetrators of a crime will not be deterred by anything. P10 described how a perpetrator's desire to commit crimes against women is stronger than any deterrent:

> *"What is the button eventually going to do? . . . If someone wants to do something, I mean . . . the chances of being caught are anyway there. I'm not sure it's going to make a difference in terms of how the person committing the crime looks at it."*

Participants also had little faith that there was enough workforce and technological infrastructure to respond to all the incoming calls to a national emergency number. As a result, many participants said they were very skeptical about the national emergency number, but would use it in a true emergency in the off chance that it actually results in the police arriving. However, with the qualification that these measures do work, some participants felt that the panic button could be useful because it would be a deterrent, as described by P9:

> *"A person who would be thinking about trying to do something . . . he'll also know that this person has a device with a panic button, and it can be tracked back to him, so it is a deterrent. There would be some problem or there would be investigations and things like that and can act as a deterrent."*

Like-minded participants felt that if the perpetrator of a crime knew there could be consequences or at least complications in the process of committing a crime, they would be less likely to attempt to do so.

Social Presence and Influence

Intersecting with location and technology use to affect participants' sense of safety were their interactions with people in public spaces and the influence of their social network.

Strangers and Friends

Participants felt the most unsafe in the presence of strangers that seemed likely to sexually harass or assault women, especially when alone in public spaces. Participants generally had a set of descriptors that they felt were characteristic of this type of stranger, including being inebriated, poorly dressed, or having a leer. However, some participants also explained that it is impossible to actually tell who has bad intentions and who does not–perpetrators of street harassment or sexual assault could be the complete opposite of the description above. Though these participants had a heuristic of what a dangerous person looked like, they still felt they could not rely on it entirely.

Participants also felt unsafe when they were required to rely on strangers to accomplish something, such as when taking a hired car or auto rickshaw. Because participants' mobility was temporarily controlled by an unfamiliar person, the potential for a dangerous situation increased. Such a situation would be made even more dangerous if there was no possibility of external help, as described by P9:

> *"There was this guy, and he felt sleepy, and I had to go to Greater Noida. He left me in the middle of the road saying 'I'm sleepy, I cannot drive you.' So I had to get out of the car. . . I asked him to go back to a very crowded sort of a market place that I had seen. . . which he did, and then I stood in a place where there are shops, you know, public place kind of a thing and booked another cab. . . Being on the road alone, where there is no other human being walking on the road other than me, cars moving past me, it was very far from my house, I didn't know anybody there."*

Having family or friends, particularly male friends, accompanying participants made them feel safer. When asked if there are situations in which she feels completely safe, P12 said the following:

> *"When I'm with someone. . . it's a very sexist statement but I would feel more safe if I'm with a guy. I don't know any martial arts or something like that, so physical strength. . . "*

A man was seen to offer not only physical strength, but also the perception that the woman was protected and not to be approached. Similarly, participants assumed they were protected when accompanied by family. P5 described the extent to which she expected family to be a protective measure:

> *"We were in CP, the poshest of all places. . . This creepy guy was stalking my sister, fully aware that we are with my family. . . That's one of the weirdest things I've ever seen. He had the abandon to do that when I was with my family."*

Here, a woman's companions have power over her safety. It is easy to imagine scenarios in which women's mobility is limited by the availability of her friends or family. Some participants' preference for male companions also points to how perpetrators might view women as only having power by virtue of the man who is with her.

The Concern of a Loved One

In expanding our lens outside of occurrences in public spaces, we learned how women's social networks affected their sense of safety. For some participants, having their parents worry about their safety made them *feel the need* to feel unsafe and avoid certain areas. P1 described how her parents' concern made her concerned as well:

"...my parents, who are staying out of Delhi have started feeling that Delhi is very unsafe although it is equally safe or unsafe. So that is a concern. They have become more conscious. Because they are over concerned about me, that disturbs me."

As a result, the concern of family, if perceived as exaggerated, could cause women to worry excessively about safety or take more precautions than they would otherwise. The power exercised upon women's safety here stems from parents' concern imposed upon women's perception of their own safety.

However, social influence was not always perceived negatively. Many participants, when asked which areas they felt were most unsafe, would list particular roads around their homes or college campuses that they avoided. When asked why they felt those areas were unsafe, it was often because they had heard of incidents happening there from family and friends. Based on these accounts, the space developed a reputation for being unsafe and was therefore avoided.

Pervasive Sexist Attitudes

Beyond personal social networks, many participants felt that New Delhi harbored a large proportion of people that still held onto sexist attitudes. When asked why New Delhi might be particularly unsafe for women, participants mentioned the large influx of rural migrants from the states of Haryana and Uttar Pradesh. Participants felt these migrants held tightly onto traditional gender roles, relegating women to the domestic sphere and viewing them as sexual objects, especially when they deviate from their specified roles. P6 described the phenomenon as such:

"If somebody is coming from a village to the city, they see that women are working everyday, they travel late at night, they're unaccompanied also, they wear whatever they want, and they can even talk back to you, so they can't handle it. It's more of a power assertion... When they're adjusting to globalization or urbanization, then such changes happen and it takes generations to fix it."

However, patriarchal values did not always manifest so blatantly. Some participants felt that the very structures in place to keep women safe perpetuated the idea that it is the woman's responsibility to protect herself from men. P6 also mentioned the following issues:

"If there are girls who go to the metro in a miniskirt, they're laughed at... A lot of families don't let their girls go anywhere unaccompanied... You also have to deal with the opposite sex very carefully... do not give the wrong idea, or do not seem provocative... There are stigmas around women who may have casual relationships. People might call them sluts or whores."

In such a culture, the burden is placed on women to protect themselves from unsafe situations, instead of expecting men to respect women's choices and bodies.

Perceptions of Law Enforcement

As Blom et al. [6] and Ahmed et al. [1] describe, women's perceptions of police tend to be mixed. We describe the perception women in New Delhi have of the police and the situations in which they are helpful or unhelpful.

Police and General Safety

When police were in charge of general regulation of the population, participants felt they were effective in maintaining law and order and deterring crimes against women. Participants who saw the New Delhi metro as a very safe mode of transportation said that it is highly regulated, with security screenings, guards, and train stops every few minutes, all of which ensure that someone committing a crime will eventually be noticed and punished. For the same reason, participants felt safer in areas where there was more security. P8 described the difference security regulations make in a private neighborhood compared to a government-owned complex:

"I stay in a normal development made by government authorities. When you're part of a private development, your whole locality is owned by an organization and they charge you to keep you safe. So there'll be guards, there'll be security systems always that'll be monitoring who enters... which car is coming. So the chances of someone breaking into your house–very less."

Women feel they can trust the police with more general public safety duties, such as monitoring and screening. In these scenarios, police act as a deterrent that prevents crimes from happening in the first place.

Police and Women's Safety

By contrast, police were considered highly untrustworthy not only in responding to calls for help in the event of an emergency, but also when it came to dealing specifically with street harassment or sexual assault. Participants felt that initiatives like the panic button and national emergency number would only work if there was an efficient and reliable police system in the back-end (which they agreed was absent). They were unsure of whether or not there would be a response if someone pressed the button or called the number. If there was a response, it was not certain if police would arrive on time or if they would further harass the person in need of help.

Participants said that police officers could themselves be the source of harassment, with officers being complicit in staring or teasing. One participant recounted an experience that greatly influenced her perception of police, where she was walking down a busy street and it was a police officer who stared her up and down as she walked by. P5 summarized her experience as follows:

"On governmental measures, I'm very skeptical... I don't find things working. The political system is a mess. Especially in Delhi, you don't have the police in your control. It's luck if you get to meet good people."

The kind of power police have is very different when it comes to public safety as opposed to women's personal safety. With regards to personal safety, the fear is not only that police cannot use their power in a constructive way, but that they will abuse their power, manifesting in victim-blaming and harassment.

Mass Media Coverage of Safety Concerns

The media was another entity that we found to shape women's sense of safety. Through coverage of street harassment and sexual assault in public spaces, the media increased awareness of possible unsafe situations. As a result, women changed their safety practices to avoid such situations. A significant example would be the greatly reduced use of private buses after the Nirbhaya rape case (mentioned earlier) was publicized in 2012 [21]. P12 described a similar instance of media coverage changing her behavior:

> *"You know more things... I remember this one time–the whole dressing room situation. I think they said that you should check once before you change in a dressing room because... it's like a mirror and behind it, it's actually a window, so there were some ways of how you check that. So I think that's how you build up precautions and during that time, I actually did that. Yeah, they do inform you about a lot of things. It's a good thing."*

Particularly for participants who lived with their parents, parents would doubly warn their daughters to avoid such situations and take precautions based on what the media suggested. P12 described why her mother is more concerned about traveling in cabs at night than she is:

> *"Sometimes it's just annoying... I'm not in a very restricted house but yeah, I would definitely get a call from my mom if I'm not home by 10:00, 10:30... I'm OK with it, but my mother is not OK with it. She's like, 'I don't want you to travel in a cab at night.'... I know what to do. I can send the status. But still, again, those stories, the bad things, they stay in her head for a long time."*

The media and social networks clearly exercise power over women's safety–the media provides knowledge that social influences use to speak *for* women. The media provides an image of women's safety which women can either agree or disagree with, as seen in P12's contrasting descriptions of media's influence. However, even when a woman is not particularly concerned with safety, social influence is more guided by the media than the woman, resulting in her taking a precaution because of someone else's imperative.

Personal Choices Regarding Safety

In navigating the factors mentioned above, participants designed their daily habits to take back as much control of their safety as they could. Participants avoided traveling alone, particularly after 9 pm. They planned their routines such that they were home by 9. They also planned their attire according to what they would be doing that day. Staying indoors or in upscale areas and using personal cars instead of walking or taking public transportation and auto rickshaws meant one could wear more revealing clothing. If they knew they had to walk or take an auto rickshaw that day, they would have to carry a cover up or wear more conservative clothing. P3 also explained the significant toll such precaution-taking had on her:

> *"As a woman, it becomes my duty to protect myself... I cannot trust the people around me... So I just trust myself and my senses or very close friends of mine or my family, because you hear about so many instances... that you really feel uncomfortable."*.

Participants greatly preferred acting in a precautionary way rather than in a reactionary way, because of the serious impacts an unsafe situation could have. P1 shared the following thoughts on using the panic button in case of an emergency:

> *"If something happens to me, I will call. It is very reactive. It is not [about] doing anything to protect safety. If something happens, we will call. If something doesn't happen..."*

The extent to which participants would make any attempt to ensure safety even if it might not be effective is highlighted by men's survey responses when asked if they would use the panic button. Twenty percent of men who responded said they would not use the panic button. Meanwhile, no women responded saying they would not use the panic button, despite the respondents being made up of 28% men and 72% women.

In the actual event of an emergency, reactions to threats to personal safety were very different based on the intensity of the threat. When asked how they respond to street harassment, participants' reactions varied widely. When confronted with staring, many participants said they ignore it, while others glare back or escalate to verbally telling the person to stop staring. In response to inappropriate touching, many participants said they berate the person publicly. In fact, one participant said she felt it was her duty to do so in the hopes of preventing that person from doing something similar in the future. Such experiences with day-to-day street harassment were commonplace and participants described their reactions in terms of what they have done in the past. When asked what they would do in an emergency situation, where there was an imminent high intensity threat, many participants had to speculate as they had not experienced such situations before. Participants said they would first try to attract attention in order to get immediate help. They would also try to escape in any way possible, including trying to run away or fight back with something on hand, like a pen, heavy object, or stones. Some participants mentioned that if possible, they would try to call someone for help on their phone. Participants who had experience with serious imminent threats described the same patterns of reaction–they tried to escape in any way possible and fight back while drawing attention from anyone that happened to be nearby.

DISCUSSION

Our findings highlight that women's sense of safety is incredibly complex. There are multiple factors that exert power over women, affecting their sense of safety and behavior accordingly. Hypothetically, a panic button should be able to utilize law and order to prevent instances of sexual assault in public spaces. However, the mandate will likely be ineffective in doing so because it does little to interact with and even misunderstands the power that the factors we mentioned above have on women's safety. In the following sections, we describe the gaps in how a panic button interfaces with these factors, recommendations for closing the gaps, and an explanation of why these recommendations would be effective situated in the feminist HCI framework.

Limits of the Panic Button

The panic button in its current form does not address the realities of emergency situations, women's perceptions of technology and safety, and structural aspects of women's safety.

Flaws in Form

Integrating the panic button into mobile phones may seem intuitive since these devices are pervasive and heavily used across the country [33]. However, focusing on **participation** as per the feminist HCI framework, we have found that using phones as a container for this technology subjects the panic button to the same limits phones have in emergency situations. Participants explained that a phone is not always easily accessible in an emergency because it could be hidden in their handbag or out of their reach. Perpetrators are also aware of the fact that phones are useful devices for calling for help and would likely take it away from a woman as soon as possible. Though a panic button might make calling for help more accessible by requiring fewer button presses, the physical device itself may not be accessible.

Misalignment with Women's Values

The current design of the panic button is not very compatible with the principle of **pluralism**, discounting the diverse ways women view safety. Thinking of threats to personal safety in two stages, where a women starts to feel unsafe and is then confronted with an actual threat, the panic button intervenes too late in the timeline, making it little more than a reactionary tool. Some participants felt that the impacts of sexual assault were too significant to risk and valued proactively reaching out for help much more than reaction. However, other participants were more concerned that using the panic button any earlier in the stages of escalation would be problematic because the situation might not escalate, resulting in embarrassment if the police were to arrive for no reason. As a result, being able to walk the fine line between the two stages is highly preferred.

Additionally, all women do not always want to contact the police in an emergency, which the panic button automatically does. Because of a common perception of the police as not only unresponsive, but also complicit in indifference to safety issues experienced by women, victim-blaming, and even harassment, they are not always seen as trustworthy. Such a universal design could actually result in some women avoiding using the panic button.

Lack of Infrastructural Support

The panic button has little infrastructural backing. The panic button's success depends on assumptions that may not hold true according to women's conceptualizations of safety. Namely, implementation of the panic button assumes that police will respond quickly every time the button is pressed. The Indian government has made an attempt to make this a reality by consolidating India's emergency numbers. However, due to the sheer number of people the police system must support and the existing culture of non-response as perceived and experienced by women, the panic button may not result in any useful help. Even worse, the deterrent value that some participants felt the panic button could have could deteriorate if perpetrators realize a police response is uncertain or unlikely. Currently, the button also has no supporting campaign or targeted media coverage that provides awareness of its implementation. The question remains as to whether awareness is expected to arise naturally out of media coverage, is the responsibility of the companies marketing their phones, or is the responsibility of the Indian government. Based on our findings, mass media can prompt behavior change, but this characteristic can be more purposefully leveraged to make safety technology like the panic button more effective.

Finally, the button does not interact with social influence on women's safety. Parents' worry about their daughters' safety stemming from stories they hear from the media and their social network will not likely abate due to phones having panic buttons. Our findings showed that some participants sent parents their location or called them while traveling alone because their parents wanted them to. A panic button alone does not address the parents' worry and the resulting burden placed on women to take precautions for their parents' sake. From a standpoint of **ecology** from the feminist HCI framework, there is much room to observe how the implementation of the panic button needs to address multiple stakeholders and be backed up by key institutions.

Expanding the Limits of the Panic Button

To bridge these gaps between the panic button and other factors that influence women's safety, we offer recommendations for redesigning the panic button and addressing systemic issues that are likely to impact its effectiveness. Such a focus is particularly important for safety technology to be implemented by a national government on a large scale. A top-down mandate from an authoritative actor presents itself as an opportunity to ask for specific requirements as needed and to make widespread systemic changes that would be in alignment with the mandate.

Designing for Values First

As mentioned above, mobile phones, though they have a wide reach, are not the best form to ensure accessibility. A standalone wearable device, a device that connects to one's phone like a smart watch, or an add-on to an accessory could be methods of ensuring the panic button is almost always reachable. The button itself could be made easy to press but also to require enough presses to avoid accidental activation, perhaps utilizing a series of multiple quick presses or a single long press. Such a design could make it unlikely that someone would activate emergency functions by accident on a device they wear all the time, avoiding embarrassment and needless pressure on emergency services.

Additionally, some women may want the safety of notifying their social network as they start to feel unsafe or simply need to placate worried parents. While phones best provide the perception of access to a social network because women can audibly talk on the phone about where they are, where they are going, or who is around them, the panic button could be programmed so that women can effortlessly update their social network with their location if necessary. The function should also fit women's conceptualizations of safety. Because

women may not always want to contact police in emergencies, the panic button could have configurable contacts to easily reach family, friends, or co-workers based on where one is traveling [1].

Designing to match these values is key to fulfilling the participatory and pluralistic aspects of feminist HCI. Our design recommendations are informed by a nuanced understanding of women's perceptions of personal safety, ensuring women are the ones speaking and designing for themselves. Though women unanimously faced safety issues, they did not all perceive them in the same way. Therefore, we design the panic button to address as many needs as possible. For example, there were indeed some participants who were okay with calling the police in an emergency, but there were many who were not, creating a limiting factor that we must design for. As a result, we make design recommendations keeping customizability in mind.

Integrating Infrastructure

Different functionalities and form factor, however, are not sufficient to make a panic button effective in the sociocultural context of New Delhi. First, it is imperative that the government increase the accountability of police in terms of responsiveness to emergencies. There could be a system that evaluates how frequently and why stations do not respond to emergencies in order to evaluate the cause of non-responsiveness in police stations and penalize them if necessary. There could also be measures to address slow response time. One possible solution to this issue proposed by researchers in Fiji is a system in which the police force is tracked by RFID chips so that officers closest to an emergency can quickly be assigned to respond to it [3]. The system could also be used specifically in New Delhi to prompt the assigned officers to respond to the emergency if they are not making an attempt to do so. Another ICT-oriented solution that places the responsibility of safety on physical spaces is to implement components of a smart city [8], such as emergency call buttons located along sidewalks. Both these examples of ICT use could reestablish reliability and predictability in women's navigation of public spaces, forming a stable "context of trust" [31] in New Delhi that women do not have to constantly create by themselves.

The government could work with mass media to accurately promote the panic button (and hopefully still will). Carefully guiding the information disseminated by media about the panic button and national emergency number could make more people aware of how the technologies work together to make it easier to get help in an emergency. A purposeful media campaign would follow the principle of self-disclosure by avoiding any misinformation about what the button can and cannot do so as to prevent false senses of safety.

At this point, we note the challenges in designing for the quality of **advocacy**, i.e. transformative change. Sterling explains that interventions like the panic button are designed for something that should not be happening in the first place and that they rely on certain assumptions of how sexual assault "typically happens" [35]. Certainly this means that a singular intervention cannot be a panacea for violence against women. Therefore, we ask how we can make the panic button more than a technology that expects women to protect themselves against sexual assault. Additionally, though many participants valued precaution over reaction, precaution encourages women to restrict their movement and continuously worry about their safety. As a result, we define progress as women being free of the cognitive burden of ensuring their personal safety. We emphasize the importance of addressing infrastructural issues so that reactivity may be a legitimate option for women. This is especially pressing when less tangible sociocultural values are deeply entrenched in patriarchy.

Furthermore, advocating for infrastructural reform enables participatory and pluralistic technology to begin reflexively designing the ecosystem it is in. For example, if issues with the police system in New Delhi are properly addressed, a panic button could better pose a legitimate threat to perpetrators of sexual assault. Without addressing the law enforcement system, the panic button would be ineffective in the first place, no matter how well it might address women's safety needs. Without addressing or utilizing the external factors that have power on women's safety, safety technology may not be effective on a large scale.

Limitations

Though these recommendations could have a positive impact on women's safety, they are based on a relatively homogeneous sample that does not include women who face the safety risks that come from lack of economic privilege. Findings and recommendations related to having a smartphone or wearables are not wholly applicable to women with feature phones or no phones because their technology practices differ. Interaction with the media and one's social network regarding safety may also differ because of cultural and lifestyle differences. A deeper examination of how safety practices differ among socioeconomic strata would strengthen recommendations for large (or small) scale safety interventions.

CONCLUSION

In the process of studying women's reactions to the recent mandate issued by the Indian government to implement panic buttons on every phone by 2017, we produce a nuanced assessment of how women view personal safety in public spaces in New Delhi. We describe the power exercised by physical characteristics of spaces, ICTs, social networks, media, police, and women themselves on women's safety and discuss how these interactions might adversely impact the effectiveness of the current implementation of panic buttons. We then provide technological and infrastructural design recommendations based on Bardzell's feminist HCI framework [5] to improve the likely effectiveness of the intervention. As these recommendations are a starting point, future work might *(1)* pursue a thorough understanding of safety issues of women from more diverse economic backgrounds and *(2)* examine the realities and challenges of infrastructural change in New Delhi, drawing from research on large-scale collaboration and information systems.

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