Improving the Safety of Homeless Young People with Mobile Phones: Values, Form and Function

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ABSTRACT

By their pervasiveness and by being worn on our bodies, mobile phones seem to have become intrinsic to safety. To examine this proposition, 43 participants, from four stakeholder groups (homeless young people, service providers, police officers, and community members), were asked to consider how homeless young people could use mobile phones to keep safe. Participants were asked to express their knowledge for place-based safety and to envision how mobile phones might be used to improve safety. Detailed analysis of the resulting data, which included value sketches, written value scenarios, and semi-structured discussion, led to specific design opportunities, related to values (e.g., supporting trust and desire to help others), function (e.g., documenting harms for future purposes), and form (e.g., leveraging social expectations for how mobile phones can be used to influence behavior). Together, these findings bound a design space for how mobile phones can be used to manage unsafe situations.

Author Keywords

Safety, homeless young people, mobile phones, security, Value Sensitive Design, value scenarios, value sketches

ACM Classification Keywords

K.4.2 Social Issues: Miscellaneous

General Terms

Design

INTRODUCTION

Safety is a basic human need. Not only do people wish to keep themselves and their families safe, one of the most human of acts is to come to the assistance of another in a moment of threat or accident.

Across societies and socio-economic classes, the mobile phone is fast becoming intrinsic to safety. Not only are mobile phones pervasive, they are, like eye-glasses, generally worn on human bodies or kept nearby. By being ready-to-hand, if a person encounters a potentially unsafe place or situation, or happens across an accident, the mobile phone can become an instrument for improving safety. At the same time, in some situations, the use of mobile phones may occasion moments of vulnerability and an over-reliance on its safety functions may undermine a person's overall resilience, especially if the phone malfunctions.

In situated use, moreover, the mobile phone can be seen as ambiguous, in purpose and in form. The computational and representation capacities of mobile phones are multi-faceted, suitable for pleasure, for commerce, among other purposes. In addition, the form of the mobile phone can also be transformed to suggest varying purposes. Related to safety, this ambiguity can be seen in technological adaptations. For example, in one direction, when on-board instruments detect poor driving or an accident, the car can become a mobile phone with communication functions; in the reverse, the physical form of a mobile phone can cunningly conceal a *real* gun. In a different vein, when the mobile phone is held in particular ways it can be *perceived* by others as particular things, such as a handgun.

How might mobile phones improve safety? Homeless young people, living in urban settings, present a testing case for addressing this question. One reason is that homeless youth are maturing and when they share information about their whereabouts and activities, they may benefit from the experience of caring others, like teens in stable families. For a second, homeless youth face risky situations in day-to-day life on the street. Specific technological solutions would not only be of great benefit to homeless youth, they would, in general, more fully define the design space of mobile phones and safety for all urban dwellers.

In this on-going research [24,25,26,27,28], therefore, we investigate how homeless young people manage unsafe situations. Specifically, in Seattle (the research site), we engaged homeless young people and other stakeholders and asked: How do homeless young people perceive safety in their daily lives in urban places and how do they bring mobile phones into these perceptions? What kinds of unsafe situations do they encounter? What stakeholders and institutions are implicated, and how do mobile phones interpenetrate? How do homeless youth avoid or mitigate unsafe situations, and when they do occur, how are they

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responded to? Finally, how do and how could the informational, communication, and form-based features of mobile phones be used to help keep young people safe?

To address these questions we engaged multiple stakeholder groups, as well as created a strong link between empirical research of current conditions and generative co-design activities that envision future possibilities. In this paper, though, we focus primarily on the empirical findings.

BACKGROUND

HCI Work Related to Homelessness and to Teen Safety

Recently the field of HCI has begun to address questions about how homeless people adopt and make use of digital and mobile technology and how specific applications can be designed to improve their welfare. One major finding of this work is that homeless people, like most people in developed and developing nations, desire digital technology in all its forms for many purposes. Moreover, homeless people are adept at overcoming economic and technological barriers to obtain access [16,26]. Additionally, through the use of digital technology in public and semi-public settings, tensions among the homeless and other urban dwellers can become prominent [18]. The need to connect personal devices to infrastructure, for example, to recharge batteries, may lead the homeless to come together into postures that are perceived as threatening by some people. We interpret these findings to suggest that the widespread diffusion of digital and mobile technologies into homeless communities is changing the nature of homelessness in ways just being discerned, with potential opportunities for equalization across social and economic classes, along with dangers of further stigmatization and entrenchment.

Another area of related work concerns a new class of mobile applications for improved safety of "homed" teenagers [4]. In short, these applications enable parents to monitor their teen's activities, providing information on what they are reading online, where they go, how they drive, who they are with, and so forth. By the availability of such intimate information, parents are called upon to balance their desire to keep their children safe with other values related to the raising of children including trust, privacy, autonomy, independence, and maturation.

Place, Homelessness, and Safety

As noted above, tensions arising from the use of mobile devices by the homeless are a contemporary example of a long-standing theme. In short, since Elizabethan times, the "homed" have often viewed the "homeless" with trepidation. Consider, for example:

> In the western world 'Home' is an ideal as well as a place – a spatially constructed ideology usually correlated with housing…. homelessness also signifies 'displacement' – an existential lack [of identity and morality] that is perhaps even more fundamental than being without shelter" [3, p. 115].

In other words, in the struggle to meet basic needs, homeless people are often forced to work against, or at least around, society's dominant norms. People without shelter become without "place." In turn, by their efforts to live, homeless people can be seen as threatening to both the physical and psychological well-being of others [6,14].

Responding to citizens' feelings of unease, city governments, including Seattle, often pass civility laws. These laws, in brief, aim to improve safety by prohibiting such public behaviors as sitting on sidewalks, sleeping in parks, and loitering in areas of drug-dealing. However, homeless people, in part, by their living circumstances and by their search for dignity often violate such prohibitions and thereby risk incarceration [22]. In fact, field work has shown that civility laws tend to be disproportionately enforced against people of lower socioeconomic standing, particularly people who are homeless [1].

The linkages between civility laws, how they are enforced, and the activities of homeless people on the real and perceived safety of city dwellers, including themselves, are complex. Here, we do not explicate them; that said, we do make two basic claims that help frame our work. First, homeless young people, in the struggle to meet basic needs, frequently encounter unsafe situations, with civility laws often being implicated. Enforcement against sleeping in public parks, for example, may lead young people to less safe sleeping situations. Second, the desire, and increasingly the need, to access digital infrastructure can also bring young people into unsafe situations. The need for electricity to recharge a phone, for example, may lead young people to trespass at secluded power outlets [24].

Value Sensitive Design

To enable a comprehensive analysis of safety and other value tensions at the research site, we drew on Value Sensitive Design [11,12,20,21], with the key theoretical constructs and methods used in this work described here:

Stakeholders. Value Sensitive Design makes a distinction between direct and indirect stakeholders. The former interact directly with the system; the latter while not interacting directly are affected by the system's use [11,12]. In the framing of this research, we assumed that homeless young people are the primary *direct* stakeholders who will adopt mobile phone technologies for keeping safe. We also assumed that other direct stakeholders might emerge as the work progressed. In addition, in prior stakeholder analysis [28] we identified three key groups of *indirect* stakeholders: service providers, police officers, and community members. Importantly, we also assumed that under certain circumstances indirect stakeholder groups might take on the role of direct stakeholders [4,8,9]. However, in keeping with our emphasis on homeless young people as the primary direct stakeholders, in the work reported here we asked all participants to consider how mobile phones might be used to keep a homeless young person safe.

Value Tensions. Prior work [5,20] has identified the importance of engaging value tensions. In our work with

homeless young people we anticipated complex value tensions within an individual (e.g., a homeless young person both wanting to be self-sufficient on the street and wanting to be cared for by service providers), with an individual's relationship to a stakeholder group (e.g., at times a homeless young person might feel threatened or less safe around police and at other times the same person might call upon police for help in an unsafe situation), and among different stakeholder groups (e.g., when homeless young people's needs for physical safety, such as using a doorway of a store in order to stay dry, are in tension with community members' feelings of safety in public).

Value Sketches. For people who live in the public and must frequently move to obtain basic needs, perceptions of safety are largely situated in place and time of day. To better understand this way of life, we employed a sketching activity, called *value sketches*, which prompt participants to represent place, mobility, and safety. Sketching is a common qualitative method for uncovering knowledge for physical and conceptual structure [10,13,15,19,23]; value sketches in particular emphasize participants' values and involve a systematic analysis of the drawn elements.

Value Scenarios. While value sketches are well suited to elicit knowledge situated in place, not all types of knowledge and feelings can be most readily expressed through drawings. Stories that emphasize social and value considerations of new technologies, called value scenarios [4,21], can fill this gap. For foregrounding value implications and envisioning systemic effects, *value scenarios* were first proposed for use by designers as an extension to *use* and *problem scenarios* [2]. Here, we evolve the use of value scenarios by placing their creation in the hands of the participants to elicit ideas for how mobile phones could be used to improve the safety of homeless young people.

METHODS

Methodological Considerations

Given the complexity of homeless young people's circumstances introduced above, we took a deliberately exploratory approach. We did not want to commit to tightly focused research instruments; rather, we sought to develop instruments that would allow us to bound the design space broadly and that would lend themselves to adaptation as the work unfolded. For instance, we did not define the value "safety," instead we provided instruments which we hoped would afford the opportunity for participants to reveal their own perceptions and experiences of safety. In addition, we sought to involve a wide spectrum of stakeholders, including homeless young people, service providers, police officers, and community members. Thus, we needed to accommodate their unique characteristics by collecting data in different contexts. Finally, while the empirical work was to provide significant stand-alone data on homeless youth, mobile phones, and safety it was also undertaken with a view toward informing future co-design activities. In consequence of these considerations, the data we collected are not always completely comparable across all stakeholder groups. Accordingly, we are careful to make appropriate qualifications as needed.

The Research Setting: The U-District, Seattle, WA

This research was conducted in the University District, hereafter the *U-District*, a neighborhood located adjacent to the University of Washington. Since the 1960s, community members have developed an urban place for welcoming "wanderers" with free medical, counseling, and shelter services. Today, an alliance of nine agencies provides a continuum of care for homeless young people [25].

Researcher Stance

The research team is comprised of people with backgrounds in HCI, design, and security. We work from a design stance that seeks to both understand the situated context as well as to create meaningful change. Because of our prior volunteer work at a community technology center [26], we were able to quickly establish a trusted rapport with participants – especially important when asking questions about "safety." In varied ways our research efforts are connected with our collaborating organizations, the young people they serve, and the greater U-District. On reflection, we have also found that this work changes us, especially how we apprehend the U-District and think of the young people we have met in research and later encounter on the street. In these public encounters, we are trained to acknowledge the person but subtly, so as not to reveal our inter-personal familiarity to bystanders.

Participants, Recruitment and Data Collection Contexts

The recruitment and interviewing procedures varied somewhat by stakeholder group as follows: (1) *Homeless young people* (14 men, 5 women; ages 19–32, M=24). Service providers at one of the local agencies in the U-District recruited two same-sexed groups of homeless young people with group interviews taking place on separate days at a well known drop-in facility. (2) *Service providers* (4 women; ages 21–41, M=29; 2, 4, 36, and 72 months experience). Employees at service agencies who work with homeless young people were recruited by personal contact and interviewed as a group in their place of work. (3) *Police officers* (1 man, 1 woman; ages 38; M=38; 4 and 12.5 years experience). University police officers who have patrolled the U-District were recruited by personal contact and interviewed in their place of work. And (4) *community members* (14 men, 4 women; ages 18–84, M=52). Other people who attend school, visit, live, or work in the U-District were recruited and interviewed individually at the annual U-District Street Fair.

Special considerations for working with homeless young people. Homeless youth self-selected to be included in this research. To protect their identities they provided oral assent and participated under the auspices of a collaborating service agency. Older participants (into their early 30s) who identify with the community of homeless young people

were welcomed to engage in the research activities. Following norms for remuneration at the research site, the homeless young people participants received a $25 gift card (other participants were not compensated).

Procedures

Participants in each stakeholder group completed, in this order, a value sketch, a paper and pencil survey, and a value scenario; and engaged in a semi-structured discussion concerning safety in the U-District.

Value Sketches. To gain insight into participants' perceptions of safety in the U-District for homeless youth, participants completed a value sketches activity, where they used green and red markers to indicate "safe" and "unsafe" areas respectively on a 17×20 inch map of the U-District. Of note, community members' value sketches did not address their perceptions of safe and unsafe places for homeless young people; thus, we do not report on value sketches for community members here.

Stakeholder-specific Surveys. To collect information on demographics, mobile phone use, and related topics participants completed a 3-page survey, with stakeholder-specific questions. The surveys included questions primarily on cell phone use (e.g., Homeless young people were asked "Have you ever owned a cell phone?").

Value Scenarios. To elicit ideas for how a mobile phone could help homeless young people stay safe, participants were instructed to write a value scenario, with this prompt:

> Homeless youth and young adults may face special challenges in keeping safe from harm. Please write a story about how a cell phone could help to keep a homeless youth or young adult safe. There are no right answers. The story can be as long or short as you like. It can be about a real situation or about a fictional situation.

Importantly, these instructions ask for real or fictional scenarios, with the rationale that if participants could mask some of the facts in their stories they might be more likely to reveal intimate, subversive, or otherwise risky, though plausible, ideas about the use of mobile phones.

Discussions. Finally, to provide an opportunity for open-ended conversation about safety for homeless young people, participants engaged in a discussion guided by a set of 15 questions, which were tailored to the stakeholder groups (e.g., "What kinds of things or circumstances make [*you / homeless young people*] feel [*safer / less safe*] in the U-District?" and "Imagine a situation in which [*you / a homeless youth or young adult*] might feel less safe. Can you think of a way that a cell phone could help?). For the community members, the semi-structured discussions (20–60 min.) were one-on-one and hand-written notes were taken; for all other stakeholder groups, the semi-structured discussions (60–90 min.) were audio taped and transcribed.

Coding and Reliability. Drawing on prior work [9,12], we developed coding manuals for both the value sketches and scenarios (see Tables 1 and 2). Coding manuals were developed from the homeless young people data and applied to the data for other participants. To test the inter-rater reliability for the value sketches, a second independent coder was instructed in the coding manual and re-coded all the sketches. Inter-rater reliability was assessed using Cohen's kappa, a measure of the level of agreement between two coders, with $\kappa = .788$. Inter-rater reliability for the value scenarios followed a similar procedure, with $\kappa = .815$. Two commonly referenced benchmarks for interpreting the values of Cohen's kappa are Fleiss [7], who rates any value of κ over 0.75 as excellent agreement, between 0.40 and 0.75 as intermediate to good, and below 0.40 as poor; and Landis and Koch [17], who rate a κ of 0.81 to 1.00 as "almost perfect" and between 0.61 and 0.80 as "substantial" agreement.

RESULTS

Stakeholder-Specific Surveys: Participant Backgrounds

To provide a context for understanding the data, we first establish that all stakeholder groups have some prior interaction with homeless young people and that the homeless young people we worked with had prior mobile phone experience. To begin, the service providers reported extensive ad hoc and regular weekly face-to-face interactions. Complementing their face-to-face exchanges were a variety of technologically meditated ones, including email, landline and mobile phone, MySpace or Facebook, and text messaging. The university police officers (16 years of combined experience) reported they generally interacted with homeless young people 1–10 times in a week. These face-to-face interactions included both ad hoc friendly social interactions and responding to complaints filed about or by homeless young people. In contrast, only one-third of the community member participants reported prior interactions with homeless young people, such as being asked for spare change.

In terms of prior mobile phone use, 11 of the 19 homeless young people currently own a phone (length of ownership: 2 days to 7 years; M=1.5 years) and 5 additional young people have owned a phone in the past. Additionally, more of the young women (100%) than young men (43%) currently own a phone (Fisher's exact test, $p = 0.045$).

Value Sketches

The value sketches provide a window into how participants viewed the physical space of the U-District in terms of safe and unsafe places for homeless youth. The data is anchored in place, highlighting *spots*, *paths*, and *regions*. Daytime and nighttime maps provide a means to understand the impact of daylight/daytime-activities vs. dark/nighttime-activities on perceptions of safety.

A total of 50 maps (one daytime and one nighttime map for each of the 19 homeless young people, 4 service providers, and 2 police officers) were analyzed. To analyze these maps and as shown in Table 1, our coders were instructed to begin with the identification of spots (Category I), specific locations that people can walk to; paths (Category II), along

I. SPOT
- A. Private
  - 1. Labeled
  - 2. Unlabeled
- B. Public
  - 1. Bar, café, etc.
  - 2. Church, etc.
  - 3. Park
  - 4. Service agency (see Fig. 1a, 1b)
  - 5. Municipal building
  - 6. Other place

II. PATH
- A. Unlabeled (see Fig. 1c)
- B. Labeled
  - 1. With safety focus
  - 2. Without safety focus

III. REGION
- A. Unlabeled
- B. Labeled
  - 1. With safety focus (see Fig. 1d)
  - 2. Without safety focus

IV. COMPOSITE
- A. Listing
- B. Nested
  - 1. Exceptions (see Fig. 1e)
  - 2. Elaborations

Table 1: Value sketches codes. (Uncodeable codes not shown.)

which people can walk; and regions (Category III), within which people can walk to many spots and along many paths. These features, each of which can be seen in Figure 1, were expressed through the varied use of graphic marks (e.g., spots were expressed by Xs, circles around a building, or other shapes, etc.). Overall there were a total of 146 spots, 68 paths, and 55 regions marked on the 50 maps.

Labels on the maps served multiple functions, at times acting to identify landmarks and at other times to indicate temporal, person-based, or activity-based qualifications of safety. Some participants made use of pre-existing labels on the map (e.g., University Bookstore); other participants wrote their own annotations, which were often placed in the maps' margins. Such linguistic, along with pictorial and iconographic, marks were associated by proximity, enclosure, and connectivity. For example, a green drawing of trees, labeled "Ravenna" (the name of a local park) indicates a safe location whereas a red foamy beer mug, labeled "drunken danger" placed near a bar indicates an unsafe location.

Participants often employed graphic marks in combination, at times placing spots within paths, spots and paths within regions, and regions within regions. These composite visual structures (Category IV), along with linguistic marks, provide a good deal of expressive power for indicating information about place-based safety. For instance, "COP SHOP," depicted as a red rectangle, is placed on a major thoroughfare, depicted by a thick green line (see Figure 1e).

Given our emphasis on homeless young people as the direct stakeholders in this research, we now turn to two aspects of their sketches: location, the consistency with which homeless young people view specific places in their environment as safe or unsafe; and time, the overall patterns

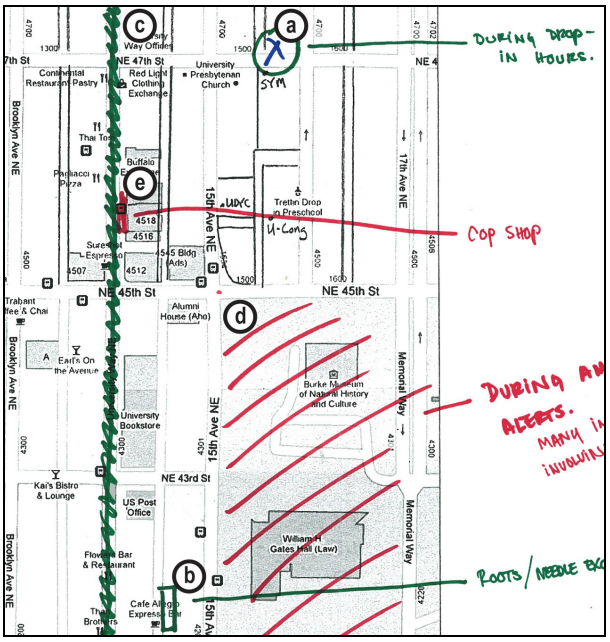

Figure 1: Value sketch (daytime), showing two spots (a and b), a path (c), and a region (d), and a nested exception (e), made by a homeless young person (cropped image). Green and red represent safe and unsafe features, respectively.

with which homeless young people perceive safety in the U-District during daytime and nighttime.

In terms of location, against a background of substantial variation in the features (e.g., many features labeled on the maps were unique to a single individual), a large amount of consistency emerges in how the young people view most types of locations as either safe or unsafe. For example, the homeless young people generally consider service agencies to be safe places; service agencies were marked a total of 32 times and indicated safe in 28 cases (88%). Interestingly, while both young women and men marked service agencies as safe spots, the young women marked service agencies as safe spots on their maps more frequently than the men ($Z = -3.52$, $p = .0004$, Mann-Whitney U test). Similarly, churches were indicated safe in 10 of the 11 cases (91%) where they were marked. In terms of unsafe locations, bars were marked a total of 8 times, always indicated unsafe (100%). The youth also seemed wary of college students, with the university campus indicated unsafe on 6 of the 7 maps (86%) where it was marked and "frat row" indicated unsafe on all 4 maps (100%) where it was marked.

In terms of time of day, we expected homeless young people to view the U-District as safer during the day than during the night. Specifically, we expected young people to indicate fewer unsafe locations on their daytime than nighttime sketches. There is some suggestion that this is the case, with 29 of the 100 (29%) features marked on the daytime maps indicated unsafe as compared to 39 of the 93 (42%) nighttime features indicated as unsafe, but the difference is not statistically significant. In addition, three young people marked the entire U-District as safe during

I. SITUATION
- A. Reactive
  - 1. Hostile
  - 2. Accident
  - 3. Authority
  - 4. Environmental
- B. Preventative
- C. Secondary effect

II. PURPOSE
- A. Warnings
- B. Calling for help
- C. Maintain relationships
- D. Documenting
- E. Information gathering
- F. Leveraging social expectations
- G. Preventative

III. MOBILE PHONE TECHNOLOGY
- A. Functionality
  - 1. Traditional calling
  - 2. Customization
  - 3. Sensors
  - 4. Recording
  - 5. Technical network
  - 6. Information seeking
  - *7. Social networking*
- B. Form
  - 1. Material
  - *2. Shape*
  - 3. Visibility
- C. Monetary costs

IV. LOCUS OF WELFARE
- A. Self
- B. Other

Table 2: Value scenario codes. *Italic* codes identified conceptually but not used. (Uncodeable codes not shown.)

the daytime (possibly with a few exceptions), but did not do so on their nighttime maps, perhaps indicating that the areas where they feel safe are more localized at night.

Value Scenarios

The value scenarios take off from where the value sketches end. Whereas, the value sketches provide a good deal of insight into participants' nuanced conceptions of the U-District as a place with safe and less safe physical spaces for homeless young people; the sketches tell us less about the social relationships within those spaces, subtleties tied to the situation and contexts of interactions, the nature of people's purposes, and the specific role of mobile phone technology including its functionality, form, and material costs. Participants largely freeform value scenarios brought forth all of these and other considerations.

Table 3 shows 10 illustrative scenarios, selected mainly for their coverage of the coding manual, from the 43 collected (19 homeless young people, 4 service providers, 2 police officers, and 18 community members; scenario length: 5-150 words, M=44 words). As shown in Table 2 the analysis yielded four distinct dimensions: situation, purpose, mobile phone technology, and locus of welfare. Each scenario was coded for each of the four dimensions. Complex scenarios received multiple codes within each dimension to reflect the depth and nuance of the scenario. Given our exploratory goals, we sought to uncover statistical differences in the coding of the scenarios based on stakeholder groups or gender. However, perhaps due in part to the small sample sizes, no statistically significant differences were found.

Situation refers to elements in the environment that suggest or explain why the mobile phone is used; for example, in reaction to a hostile event (Code I.A.1) or accident (I.A.2), to prevent an anticipated event from occurring (I.B), or due to secondary effects that followed from the presence of the mobile phone (I.C). *Purpose* refers to the protagonist's aims for taking action with a mobile phone; for example, to warn others of an impending event (II.A), to call for help (II.B), to document an event (II.D), or to actively leverage social expectations (II.F). *Mobile Phone Technology* refers to the technology used in the scenario; for example to the phone's functionality in making calls (III.A.1) or recoding audio or video (III.A.4), to the phone's form such as its shape (III.B.2), or the costs entailed in owning and using a mobile phone (III.C). Lastly *Locus of Welfare* refers to

H1. If you need help you can call for it. If your car runs out of gas you can call your friends to bring you some gas. And a whole bunch of other sh*t too. [Male]
H2. Some friends of mine had gone to get more beer. My phone rang, my homies called to tell me the boys were heading my way. I had enough time to put my weed away before they arrived. [Male]
H3. I would use devices in my cell phone to record law enforcement, when they choose to harass me. [Male]
H4. I don't think cell phones keep people safe because if you call the cops for seeing a crime you might get beat up later for snitching. [Male]
H5. I feel when hitching rides, with a cell phone you can be kept safe. If you're walking down the road with your thumb out and a cell phone to your ear a "weirdo" is less likely to pick you up. [Female]
H6. Once upon a time there was three little pigs, one lived in a house, one lived on the street, and the last one lived in a squat. One day a big bad wolf was looking for a squatter, the big bad wolf was out to get all the little pigs. The first little pig called the second pig, and he found the third pig through word of mouth. Thank cellphone. [Male]
H7. Usually if you have a phone people know the police are on the way. If someone is using an expensive phone, it might escalate the situation. [Male]
C1. Perhaps they might be a bit safer w/a cell phone if someone were to take advantage of them, they could call police. The question is would the police come to his/her aid? [Female]
P1. Being homeless is a challenging experience. Without a job and access to food, shelter, & other basic necessities, living on the streets is emotionally & physically draining. Having a cell phone would at least allow me to be able to call other homeless persons that I have networked with to work on attaining these difficult to get necessities. Knowing that I could call a shelter to get a bed, or 911 for an emergency would make me at least feel safer and closer to services that I need while living on the streets. Others can check on me as well to make sure that I am safe throughout the day. [Male]
S1. A man was harassing a youth in her sleeping spot. She was able to snap a picture of the man and forward it to service providers & police. With this photo the man was picked up and charge [sic]. Hopefully he will not be sexually harassing any more homeless young women. [Female]

Table 3: Value scenarios, labeled by stakeholder group: Homeless Young People (H1-H7), Community Members (C1), University Police (P1), and Service Providers (S1).

whom the protagonist directs a concern for safety, to him or herself (IV.A) or toward others (perhaps including the protagonist) (IV.B). Overall, there were a total of 50 situation, 49 purpose, 51 mobile phone technology, and 43 locus of welfare codes for the 43 scenarios.

To provide a flavor for how these dimensions and the categories within them characterize the scenarios, consider some of the exemplar scenarios presented in Table 3. For example, scenario H1 was coded as reactive/accident (I.A.2) as the protagonist faces a situation in which the mobile phone is used in direct response to "running out of gas;" calling for help (II.B), indicating the protagonist's purpose in using the mobile phone to "call your friends to bring you some gas;" traditional calling (III.A.1), to indicate the technical aspect of the mobile phone that is employed to make a "call;" and self (IV.A), to indicate that the scenario's protagonist is concerned with his own safety as in "if you [the protagonist] need help."

While allowing for rich diversity in the details and as exemplified by H1 above (see also C1, P1), one common narrative structure emerged from the data and accounted for roughly half (49%) of the scenarios. Perhaps not surprisingly and as reflected in the coding manual, this narrative structure describes reactive situations (I.A) in which the protagonist seeks help (II.B) by using a mobile phone to make a traditional phone call (III.A.1) for his or her own benefit (IV.A). Eight of the scenarios were coded with exactly this group of four codes, and an additional 13 scenarios were coded as minor variations that included at least three of these four codes. That said within this common structure, scenarios portrayed diverse situations and conveyed rich details from "staying on the street" where homeless young people are "harassed," "beat up," or "raped," to protecting "my squat" from the police, to getting "lost in the mountains," or to "running out of gas."

Other less frequently occurring patterns were also identified. For example, the codes *documenting* (for purpose) and *recording* (for functionality) were both rarely used, but tended to occur together in cases where they were used (p = .0008, Fisher's exact test). Scenarios H3 and S1 exemplify such a case, in one instance recording harassment from law enforcement (H3) and in the other harassment from a man on the street (S1). Only 5 scenarios were assigned the code *recording*, and 3 of the 5 were also assigned the code *documenting*; these were also the only 3 scenarios that were assigned the code *documenting*. That is, scenarios with the purpose of *documenting* always mentioned a *recording* function, showing how the coding manual represents purposes and functionality.

Working within the structured but open-ended value scenario format, participants were generative and imaginative in linking technological opportunities to problematic situations. For example, in their value scenarios homeless young people proposed "map apps to find safe places" (III.A.6), envisioned "self aware" artificial intelligence systems with "internet profiles and database access" to plan for improved safety (III.A.5), and imagined the materiality of the phone being used to "save your life by jumping in front of a bullet for you" (III.B.1).

Scenarios surfaced not only direct impacts from the mobile phone but secondary ones as well that typically resulted from the form or monetary cost of the phone. One homeless young woman wrote in H5 that when hitchhiking, visibly holding "a cell phone to your ear a 'weirdo' is less likely to pick you up." Here, the perceived benefit to safety comes from others who might cause harm "seeing" that the homeless young person could contact someone via phone; not that a particular phone call has been made.

Finally, not all uses of mobile phones were perceived as improving safety (H4, H7). For example, in H4 a homeless young man suggests that in reporting a crime to the police "you might get beat up later for snitching." In H7, another young man calls attention to the risks to safety from possessing relatively expensive technology.

DISCUSSION

On the Meaning of "Safety"

Recall that we did not define "safety;" rather we presented participants with open-ended yet structured activities to elicit their perceptions and experiences. Participants told us through sketches and stories the myriad of places, situations, and people who come together to make homeless young people more or less safe. From these materials, we have seen that safety is fundamentally situational. Homeless young people face both ordinary and extraordinary risks – running out gas (scenario H1) or getting lost in the mountains, along with chronic exposure to the possibility of harassment from police and community members (H3, S1), together with the possibility of isolated, severe violence (H4). The police are perceived to be a threat, but so too are community members, service providers, and other homeless young people. At the same time, and herein lies a major conundrum, the data also show that youth look to these same stakeholders and places, at least at times, for safety. Within this context, the coding manuals provide some specific dimensions for characterizing the uses of mobile phones for keeping safe.

On Distancing Mechanisms: Sensitivities around Safety

For many people, safety is a highly sensitive topic. Particular details about keeping safe might put a youth or his or her friends at risk, be embarrassing, or even traumatic to recall. We might expect, therefore, that some people might try to create distance between themselves and their views on safety, perhaps by obscuring some facts, using ambiguity, or stepping away from specificity. In a telling example of this sensitivity, which arose during the group discussion, one young person said: "Letting people know where I feel safe, makes me feel less safe."

Accordingly, we intentionally employed methods that provided the means for participants to control both the

precision and ambiguity of the information provided. For example, in the value sketches participants could provide more or less specific information about location (e.g., labeled or unlabeled, spot vs. region). Moreover, in the value scenarios participants were not asked to differentiate between real and fictitious but plausible situations.

For both methods, indeed, it appears that some homeless young people did in fact create distance between their own experiences and what they were comfortable sharing with us. In the value sketches, three participants marked places, otherwise mundane, as safe or unsafe without indicating why (Category I.A.2). These were puzzling. Perhaps, we conjectured, the marks indicated locations of one-time altercations or places related to safety that should otherwise remain unelaborated. If so, with more focused procedures, it might be possible to elicit greater detail about these spots. However, paradoxically, by seeking to elicit greater detail, young people might be unwilling to say anything at all. We conclude, therefore, that some marks on the value sketches might be a form of "distancing," that is, conveying something important while keeping oneself out of it.

Further examples of distancing might be present in the value scenarios, where narrative forms can convey essential information but without indicating a personal connection to the events, protagonists, or conflicts. Scenario H6, a "fairy tale" about three little pigs and a big bad wolf, was such an example. Interestingly, the basic content and structure of this scenario – namely, that cell phones can be used to warn of an impending police presence – can be conveyed through different forms of writing. Scenario H2, in "realistic" style, illustrates the contrast quite well.

In a different vein, participants might create distance between themselves and their experiences by the use of language, by, for example, placing events in the passive voice or in hypothetical terms. While we have not completed a close analysis of how language might be used to "create distance" we speculate that by the use of such conditional words as "if," "would," and "could" participants might remove themselves from particular situations but convey their essential content and structure. This linguistic analysis remains for future work.

Value Tensions

For considering "relationship," instead of dichotomies or conflicting points of view, we prefer "value tensions." Value tensions capture the mutuality of relationship; they are not necessarily problematic, nor do they always cross a contentious space. Instead, tensions can keep two points of view together in balance or enable two conflicting views to coexist. This analytical orientation, in short, allows us to present and reason about relationship with nuance.

While homeless young people might help each other keep safe (H1, H2, H6, P1), by using a mobile phone to call for help, they may also be seen as "snitching" (H4), a violation of the rules of the street. The use of a phone in many situations is ambiguous – is that young person calling a "homie" or the "police?" Young people must work within this uncertainty, leading to the importance of secondary effects, leveraging social expectations, and form.

Homeless young people have complex relationships with the service providers. While young people may look to the service providers for help, they also may react negatively to particular responses and rules, as might a "homed" adolescent to his or her parent. We saw, for example, that all the young women marked service agencies as safe on their value sketches; however, in discussion they also expressed frustration with particular service providers' actions. In a similar sentiment, a young man said: "The service providers sometimes don't make me feel safe… a lot of people think they are all friendly… but it turns out they are harsh."

The relationship between homeless young people and police officers is similarly ambivalent. While the police were often seen to pose a threat (H2, H3, H6), they were also seen as potentially beneficial (H7, C1, S1). While young people's sketches do not contain a single positive statement about the police (but a fair number of negative statements), young people in discussion and in the scenarios did indicate that they would call upon the police and 911 in some emergences. At the same time, while police officers conveyed a certain dislike toward homeless young people ("It's like they own the parking lot, the donut store, the [sandwich shop],") they also appreciated the difficulty of surviving on the streets (P1).

Finally, homeless young people saw different groups of community members as safety risks. One group, called "angry Christians," was described as intolerant and violent. Concerning fraternity members a young person said: "You ever woke up to them [frat kids] rummaging through your stuff and then kicking you in the face when you said 'Get out of my stuff.'" Recall too that "frat row" and regions of the university campus were indicated to be unsafe in the value sketches. Community members used words such as "squatters," "street kids," and "Ave rats" to name the people who were perceived to make the U-District unsafe. Like the police officers, however, the scenarios showed community members to be empathetic (C1), with some scenarios envisioning communication networks specifically designed to keep homeless young people safe.

Design Opportunities

When discussing the limitations of mobile phones and when justifying new possibilities, the stakeholder groups brought forward a variety of functional criteria, operating constraints, and general desiderata for evaluating features. The general desiderata included: (1) low cost; (2) outdoor durability for repeated drops, wet, and cold; (3) flexible powering options, decoupled from infrastructure (e.g., solar recharging); (4) 24/7 reliability for emergency use; (5) independent and separate communication channels, protected from surveillance; and (6) the possibility for recovery when lost by inattention or stolen. These grounds

for judging features, quite obviously, come from the circumstances of homelessness and provide a backdrop for the following opportunities for design:

Support for shifting trust relationships among homeless young people and enabling young people's desire to help others (H1, H2, H6, P1). While young people face an environment of shifting alliances, they also come to trust and rely on each other to respond to calls for help. When young people are in trouble, they could benefit from ways to reach out to trusted peers or groups, albeit the specific individuals might change quite frequently. *Technical features*: Provide capability to represent alliances, to diplomatically bring people into and out of them, to phone specific contacts, to broadcast calls for help or warnings, and to communicate without the possibility of surveillance.

Support a homeless young person's need to document abuse (H3, S1). Homeless young people described occurrences of harassment and violence, from police officers and other community members, as well as other homeless people. Documenting such events can empower young people to seek redress and, over time, may deter future harassment. *Technical features*: Provide capability to document events in real-time (e.g., audio and video recording) as they unfold, and to place such documentation into the hands of someone who or an institution that can facilitate an appropriate response.

Support a surreptitious call for help (H4, H7). Being seen or "perceived" as making contact for help or documenting a situation as it unfolds can put a homeless young person at risk, as telling of street activities to outsiders can be seen as a form of weakness or "snitching." *Technical features*: Provide capability to call and/or document a situation without being visible (e.g., eyes-free "panic" button), to represent emergency networks or trusted others, and to diplomatically bring people into and out of those networks.

Support for homeless young people as urban dwellers with specific information needs. The value sketches and scenarios capture something of the distinct perspective that homeless young people have for their physical environment (e.g., churches as places of safety, areas of parks safe at different times, etc.). *Technical features*: With location-based services, provide the capability to represent specific kinds of information that homeless people and those living in poverty might seek alongside other information about a city. Addressing this goal will foreground tensions between homeless communities and the other stakeholders [25].

Support for safe, non-stigmatized access to infrastructure. The value sketches alerted us to perceptions of safe and unsafe areas in the U-District. Recall, for example, that the university grounds, areas of student housing, and the neighborhood service center (i.e., "cop shop") were considered generally unsafe by young people. At the same time, the discussions based on the value scenarios pointed to the need for access to electricity to recharge batteries. *Technical features*: Provide access points to electricity and wireless capability at sites not considered unsafe. Moreover, enable access points to be moved to different locations so that no one location in the U-District becomes known as "that place for the homeless." One possible solution, or at least design direction, is large-sized tricycles [27] that act as mobile power and Internet connectivity sources, placed at suitable locations for all urban dwellers. Such infrastructure might mitigate the risk that homeless young people experience additional forms of stigma by the need for infrastructure.

CONCLUSIONS AND CONTRIBUTIONS

Implications for Co-Design. The coding manuals for the value sketches and the value scenarios shape a design space for further investigation of design opportunities. We intend, for example, to use the scenarios as prompts for considering specific design solutions and to use the coding manuals to situate particular solutions. In addition, we expect that value sketches, together with particular prototypes, will enable homeless young people and other co-designers to enact and envision the consequences of particular designs in action.

Contributions. In addition to the design opportunities, we: (1) Documented rich knowledge about the interaction among place, mobile phone technology, and safety for a historically underrepresented population, homeless young people; (2) Demonstrated the use of innovative open-ended yet structured methods to elicit views on a sensitive topic (personal safety) in a non-threatening and dignified manner, leaving what information to reveal and how under the control of the participant; (3) Constructed coding manuals that can be used and extended by others to analyze the relationships among place, mobile phone technology, and safety; and (4) Extended a method (i.e., value scenarios generated by participants) in Value Sensitive Design, thereby contributing to that growing literature.

Final Words. Surviving on the street requires that young people develop expertise for managing unsafe situations; mobile phones are surely implicated because of their pervasiveness and because they are worn on bodies. By investigating this setting through the systematic and synthetic analysis of place-based representations (value sketches) along with narratives of possible uses of mobile phones (value scenarios) we have been able to more fully explore the design space of mobile phones and safety. In some ways, elements of this setting are at the same time both extraordinary and ordinary [26]. Thus, much of what we have uncovered in this extraordinary setting, along with the methodological approach and methods employed, is likely to be applicable to other settings and circumstances where people look to their mobile phones for safety.

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