STREET SAVVY

2014 MASTER'S PROJECT

UC BERKELEY
SCHOOL OF INFORMATION

TEAM

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ABSTRACT

Pedestrians get stressed when they are routed through unexpected areas by existing mobile mapping applications which account for traffic jams, tolls, and hills—but not safety. StreetSavvy is a web-based mobile mapping decision-support tool that aggregates data pertinent to female pedestrians and provides easy-to-remember directions. StreetSavvy provides users with a combination of contextual time-sensitive data about safety, an easy way to define their own safety preferences, and memory devices to help them navigate a route “hands free.”

We successfully researched, identified, and applied UX principles that also encouraged walkers to filter and explore safety data in new ways that challenge negative neighborhood stereotypes. This project aims to improve the pedestrian experience by helping users make informed and thereby confident decisions about which route to walk, increasing the likelihood that women will choose to walk more.

INTRODUCTION

Pedestrians get stressed when they are routed through unexpected areas by existing mobile mapping applications which account for traffic jams, tolls, and hills—but not safety.

This project aims to improve the pedestrian experience with a web-based mobile mapping tool that helps users make informed decisions about which route to walk. We hope to support people walking through unfamiliar neighborhoods by providing a combination of time-sensitive data about safety, an easy way to define their own safety preferences, and the ability to navigate a route "hands free." While we want to help all walkers make confident decisions on-the-go, we're particularly interested in the unique challenges faced by **female pedestrians**.

It's important to note that we are not developing a "safety algorithm." Safety is an incredibly contextual concept that deserves to be tailored and personalized. Unlike socially tone-deaf applications that have been criticized for helping users simply avoid areas, we want to develop a tool where people can explore data based on their own idea of what safety means to them.

By letting users explore positive data beyond standard crime statistics, we want to provide a more balanced, socially conscious tool for data-driven discussions about safety. We hope StreetSavvy will challenge negative neighborhood stereotypes as much as it will help people get home in one piece.

PURPOSE & RATIONALE

MITIGATING THE GUESSWORK

You've just gotten off the last BART train to arrive at Civic Center. You have been cautioned by your friends to be careful in this neighborhood at night. Which of these walking routes do you choose and why?

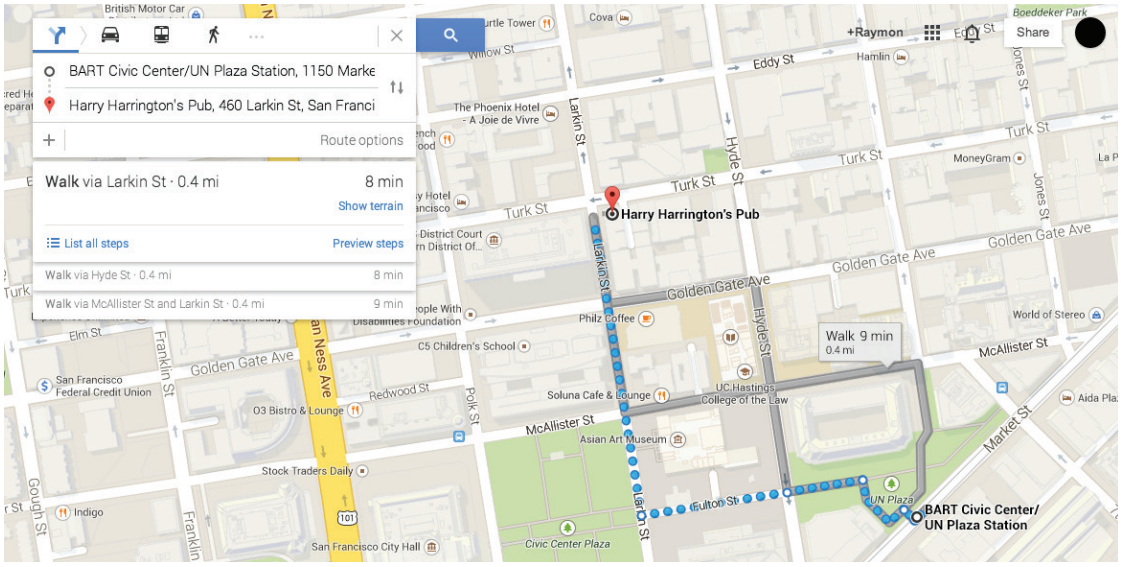


FIGURE 1
SAMPLE WALKING ROUTES

Walking is an important part of leading a healthy urban life. As of 2010, more than half of the world's population already lived in cities and towns (World Health Organization). Given this fact, the importance of walking is only increasing. Walking allows people to connect with their neighborhood, encourages local economies, and improve community ties. However, **many women don't enjoy walking or avoid walking because they don't feel safe on the streets of their own city**. This can be disempowering and anxiety provoking.

For many women, picking a "safe" route to walk involves considerable mental math, guesswork, and neighborhood stereotyping. StreetSavvy hopes to inform and mitigate the stress of this decision making process. By displacing negative neighborhood stereotypes and anecdotal stories with data-driven decision making, StreetSavvy aims to make women feel more confident in their choice to walk.

To address these issues and make the decision to walk easier for more women to make, the StreetSavvy team set out to answer a seemingly simple question: **When you have to walk through an area that doesn't make you feel safe, what is the best route for you to take?**

A MORE HONEST DEPICTION OF NEIGHBORHOODS

StreetSavvy is intended for use by all walkers, but it's specifically designed to help female pedestrians better navigate the neighborhoods that they love and live in, even if those neighborhoods are a little rough around the edges. A key element of this design challenge is providing a more honest depiction of neighborhood data.

> … television news coverage of crime exaggerates the prevalence of violent interpersonal crime…

In the US, ordinary citizens often depend on television as an information source, such as 24/7 news channels. Yet, researchers consistently find that such crime reporting is distorted. For instance, "television news coverage of crime exaggerates the prevalence of violent interpersonal crime, while it underplays the extent of white-collar crime" (Maguire, et al). Looking at how technology and data had been abused in the past, we become concerned that raw safety data could be similarly used to further fear-based narratives. Our Master's Thesis therefore became an attempt to provide a thoughtful alternative to the managment of politically sensitive data.

Underserved neighborhoods don't frequently receive positive press and rarely do local news stations provide these communities with a fair voice. While StreetSavvy is primarily designed as a directional tool for pedestrians, we also hope it can provide a more nuanced perspective about the ways neighborhoods change for the benefit of residents within those neighborhoods. We hope this data will not only lead to better, more actionable, understanding of these communities, but provide residents a place to exchange information via our user-generated data partners. We think that StreetSavvy could help fill a void local news has left in underserved communities by closing the gap between observed neighborhood changes and when people learn about those changes.

THE RISK OF DESIGNING FOR SAFETY

We intentionally selected a politically complex topic as a way to challenge our our informatic design and user experience (UX) design skills. For our Final Project, we didn't want to invent or tease out a mild problem simply to showcase our strongest talents. We wanted to use the incredible and rare opportunity to work on a Master's project to address a ubiquitous real world issue. But designing for safety isn't just ambitions, it can be risky because addressing any real societal issue involves high stakes.

The topic of safety is complicated by the fact that much of the data available is incomplete or collected for an entirely different purpose; endangering the quality and content of the information we, in turn, present. A great example of this can be found in looking at the distorted views presented by your average city crime map which make underserved neighborhoods look like war zones.

Our primary tactic for challenging this informational status quo was to rethink how we engaged users around sensitive and incomplete data. One way we accomplished this was to avoid black-boxing what data we were displaying; using UX to involve the user in key decisions and promote exploration of socially complex data. Another way was to clarify a user's personal definition of safety by identifying and staging the decisions we ask them to make. We feel this combined approach avoided distracting users with commonly misunderstood details.

Aside from well intentioned friends and family inhaling through clenched teeth before they gently asked, "Are you sure you want to do this? Didn't Microsoft get accused of being racist for doing something like this?" We were also left with the impression that people weren't comfortable with a safety related tool because of how safety apps had been reviewed in the past. Previous safety apps were accused by the media as existing for the sole purpose of helping privileged white smartphone users avoid poor black areas (Holmes). We were frequently advised to avoid designing for safety all together for fear that we would come under similar fire. **However, instead of shying away from the topic of safety entirely, we embraced it as an opportunity.**

StreetSavvy is primarily an attempt to display sensitive incomplete data in a balanced, responsible way. While this may limit the information our app ultimately communicates, we believe *how* we communicate about issues of safety is far more important.

HOW WE ARE DIFFERENT

As mentioned above, we have intentionally chosen an edgy and difficult topic because we see our time at Berkeley as a valuable chance to explore issues that a for-profit or weekend-hacker approach wouldn't support. But it's important to acknowledge the recent history of safety mapping applications less we are doomed to repeat their mistakes.

> *GhettoTracker's and its purpose is to show nice, law-abiding families (like the smiling, conspicuously white foursome on its homepage) what neighborhoods are "safe" to visit and which are, in the website's offensive parlance, "ghetto." … First it's pretty detrimental to society when we reinforce the idea that poor or crime-heavy areas are places to be categorically avoided or shamed. As if to assume that every person who lives in an area with comparatively high crime or poverty is a criminal, or that these areas are devoid of culture or positivity.*
>
> *—David Holmes*

As recently as 2013, a moronic iPhone app going by the name "GhettoTracker" was released and subsequently slammed into oblivion by the media.

The name of the site was eventually changed to "The Good Part of Town" but sensitivity to apps with such politics remains, which is why it might surprise some to learn that there has been a slew of apps similar to Ghetto Tracker—not the least of which was a Microsoft Patent that came under fire in 2012 (Keyes).

> *Microsoft was granted a patent for "Pedestrian Route Production" that was dubbed the "avoid ghetto" feature for GPS devices. The new feature was meant to help pedestrians avoid unsafe neighborhoods, bad weather and difficult terrain by taking information from maps, weather reports, crime statistics and demographics, and creating directions that take the user through neighborhoods with violent crime statistics below a certain threshold. "Some say the feature is racist, while others say it's simply the next step in GPS technology."*
>
> *—Allison Keyes*

Because of this unfortunate trend, the StreetSavvy team wanted to remain sensitive to these issues throughout every step of our design process. We view ourselves as different from these previous safety apps for the 12 following reasons:

1. **WE ARE NOT AN ALGORITHM.** We force our users to tailor their own definition of safety each and every time they use the tool while using very conservative default settings. StreetSavvy's objective is to merely act as a data aggregation tool.

2. We won't be releasing this to the public until we've done a comparative analysis with existing safety tools and traditional (non-technical) means of assessing safety. Contrary to the Bay Area's current social business philosophy of "shoot first ask questions later," we want to ensure that our tool won't contribute to a negative impression of underserved areas. First, do no harm.

3. All data is within the context of the existing "multiple choice question" posed by the walking routes users already have to choose from. We simply want the decision of which route to take to be data-driven and not based on stale anecdotal stories that unfairly typecast neighborhoods.

4. We incorporate positive data sets beyond crime, such as streetlights and open shops, which were identified during user research as being safe spots. We also avoided using data that may unfairly cast low income neighborhoods in a disproportionately negative light. For example, we avoided the use of real estate data, zoning data, or frequency of public trash disposal.

5. Further, we intentionally identified and leveraged UX patterns that strongly encourage users to filter crime data by time. We did this because we believe that even the most dangerous neighborhood has safe times throughout the day and we wanted to emphasise that potential.

6. We established partnerships with existing social justice organizations and city departments to aggregate user-generated citizen data. We've done this to get a more complete view of neighborhood safety than crime data can provide.

7. We're designing for women of all backgrounds and, in designing for this specific user group, we have been able to attempted to avoid overreaching our design objectives.

8. We are operating on a pedestrian scale. Very few walking routes will exceed a mile and half. What this means is that we're designing for users who who can't avoid specific areas because they will likely need to walk through the area regardless.

9. Of the crime data we show, we filter it for pedestrian specific crimes within our database—dramatically reducing neighbourhood crime statistics across the board. This has the effect of “cooling off” and visually de-escalating areas that appear on traditional crime heat maps as being “hot” with crime.

10. We’re a multi-cultural, multi-gendered team that chose to develop this app during a time of our lives when the majority of us were living in “bad areas.” While this doesn’t make use immune from design mistakes, our personal enviroments encouraged use to routinely consider how our design decisions might impact residents of negatively stereotyped neighborhoods.

11. If a neighborhood looks “bad” on our map then that’s “okay.” We want to use ubiquitous technology to draw attention to safety issues. Women who live in those neighborhoods don’t have the luxury of pretending that such safety issues don’t exist.

12. We learned from Microsoft’s failure that we shouldn’t hide our objectives by sugarcoating difficult socio-technical topics. For example, we’re not building a running app or mapping algorithm that “slips in” crime data. We’re being very transparent about the data we’re using.

PROCESS

ASSUMPTIONS

StreetSavvy made a few key assumptions before beginning this design process—the most significant of which was that people might choose to walk more if they knew what to expect and felt safer. We also assumed that no one has the current technology or data to tell people what is definitively safe on a walk because safety is a fluid and highly contextual concept.

As such, we focused on helping people decide between the existing walking routes already generated by popular mapping tools instead of developing a "safety algorithm." It's important to note that we are not criminologists and that StreetSavvy is designed to aggregate data about *perceived* safety instead of *actual* safety. Finally, we assumed that crime data simply wasn't enough to help walker's make better decisions. Beyond finding better ways to filter and display current crime statistics, we assumed that people probably weigh more heavily the opinions of those who are familiar with an area and included features driven by user-generated data.

NEEDS ASSESSMENT

For our preliminary needs assessment, we developed a short survey that evaluated participants' walking habits and opinions about safety in addition to gathering basic demographic information (see Appendix A). Survey subjects were recruited from our personal social networks (through Facebook) and the general public (via a post on Reddit.com). Over the course of 48 hours, we received 161 respondents. The average age of respondents was 29.2, median 28, range 16–53. The gender breakdown was 54% male, 45% female, and 1% other. Our respondents were mostly from an urban (42%) or semi-urban (35%) population with 66% of all survey participants reporting that they walked frequently or always.

54% MALE 45% FEMALE 1% OTHER

161
RESPONDENTS

77%
LIVE IN URBAN OR SEMI-URBAN SETTINGS

29.2
AVERAGE AGE

66%
ALWAYS OR FREQUENTLY WALKS

The prime goal of the needs assessment survey was to get a quick understanding of our prospective users and the problem space. To that end, the survey was a success, as we received a large number of qualitatively rich responses in a short amount of time. However, there were some drawbacks to the design of the survey that later became clear to us when we attempted to perform quantitative analysis of the data.

The main issue was that a number of the questions were formatted similar to a Likert scale, with answers ranging from 1-6. This was problematic when it came time to make comparisons between subjects and groups—how can we know whether subject A's "5" is the same as subject B's?

FIGURE 2
SAMPLE NEEDS ASSESSMENT QUESTION

We knew we couldn't run the survey again because we had already primed and polluted the sample pool. That said, we were able to salvage the following general findings from the needs assessment:

1. **Urban dwellers view crime as contextual**
   People had very different responses about whether their neighborhood changed between day and night. But most people who live in urban areas report that it changes. People most often learn about safety by talking to locals or looking up official crime statistics. These two observations were particularly encouraging because it validated our assumption that crime data alone isn't enough to measure safety.

2. **People have reservations about whether an app could help**
   We also asked a series of questions about whether people would use a hypothetical walking app. These results were somewhat discouraging. Of those who commented, more people seemed to think an app would not be useful or would even be harmful than those who seemed neutral or positive. While we were pleased that our concept was easily understood to the point of producing this polarization, we were hoping for a different reaction. However, when we drilled down on these results, we made two interesting observations:
   + Of those who reported that they would or would not use the app, women seem more positive about it.
   + Urban dwellers had the most concerns and strongest opinions.

3. **Subjects shared many of the same concerns**
   In their response to whether they would use an app like StreetSavvy, survey participants listed a number of factors that contributed to their decision one way or another. A number of the factors were common across participants, including:
   + Phone theft
   + Too many variables / won't be accurate enough
   + Distractions are anti-safety
   + Awareness doesn't help prevent danger
   + The app might provide a false sense of safety

+ “Ghettoization” of neighborhoods
+ People might choose the shortest route regardless

4. **User input on possible features was valuable**
   The needs assessment survey also contained a section in which we encouraged participants to suggest features. Although many of the features suggested ended up being outside the scope of our project, we identified two very good suggestions that informed the design of our final product:
   + List or map of nearby open businesses as “safe spots”
   + Neighborhood watch app to connect people

PRIMARY TAKEAWAYS FROM THE NEEDS ASSESSMENT

1. There was moderate interest in the app, but many people have reservations about its usefulness as a real-time tool because of its potential to be a distraction.

2. We should emphasize a people-centric view of safety.

3. Women in 20s and 30s who live in urban areas seem like the best target demographic.

PLATFORM AGNOSTIC: DESIGNING A GEOSPATIAL TOOL FOR THE WEB

Web-based location services currently offered through HTML5 aren’t often a first choice for projects because they have lower specificity and slower response times. The HTML5 geolocation functionality uses triangulation techniques that are less accurate than GPS, which is accurate up to 10m (Devlin). Despite these limitations, StreetSavvy ultimately chose to design for the web for the following reasons:

1. There are past works that deal with vibro-tactile feedback to assist with walking directions. The success of these experiments has been strongly correlated with the use of devices close to the body, whether it’s a belt worn on the waist (Pielot, et al.) or a mobile phone held on one’s hand (Robinson, et al.). However, many people, especially women, carry their phones away from their body (in pockets or bags). As such, using haptic feedback does not seem to be the most optimal solution considering the context of our application.

2. Designing for the web means that we are platform agnostic, which allows us to focus on our core design concepts instead of getting lost in platform specific features.

3. GPS navigation features are only important if one is tracking activity on a screen and our needs assessment clearly indicated that we should avoid developing a visually “needy” tool.

Discouraging eyeball hungry UX aligned with our goals of limiting visual dependency. Upon further consideration, we realized how absent this design principle is from current mobile trends, which often require frequent—almost neurotic—visual confirmation. Exploring UX alternatives to this trend is an affordance of developing StreetSavvy in an academic environment. It was soon after the needs assessment that we came to appreciate the unique opportunity to develop this type of tool shielded from the world of pixel-pushing profit models.

The decision to develop for the web also led us to consider new, less data hungry ways of extending the cognitive capability of our users. From this line of inquiry evolved the natural language processing feature of our mnemonic device direction generator. Discussed at greater length in our product walkthrough, the mnemonic device direction generator was an attempt to help walkers remember their selected route so they wouldn't have to consult their phones mid-walk. We felt this was a far more appropriate application of technology and an ideal balance of human-computer interaction because **it leverages the associative strength of the human mind and the creative variability made possible with natural language processing.**

INTERACTIVE LO-FI PROTOTYPING

After the needs assessment, we jumped right into a series of low-fidelity (lo-fi) prototypes to gather input from direct user testing. Our lo-fi prototype consisted of Balsamiq mockups that we wired up with POP, a mobile application geared specifically for prototype testing. This allowed us to run our tests directly on a phone and identify problems and affordances related to the smaller mobile form factor. For example, we observed that most participants slightly gestured directions with the phone as they attempted to remember turns and an inordinate number of subjects could not resist clicking buttons in a physical area of the screen before being prompted to do so—something that could not have been observed on a desktop or paper prototype.

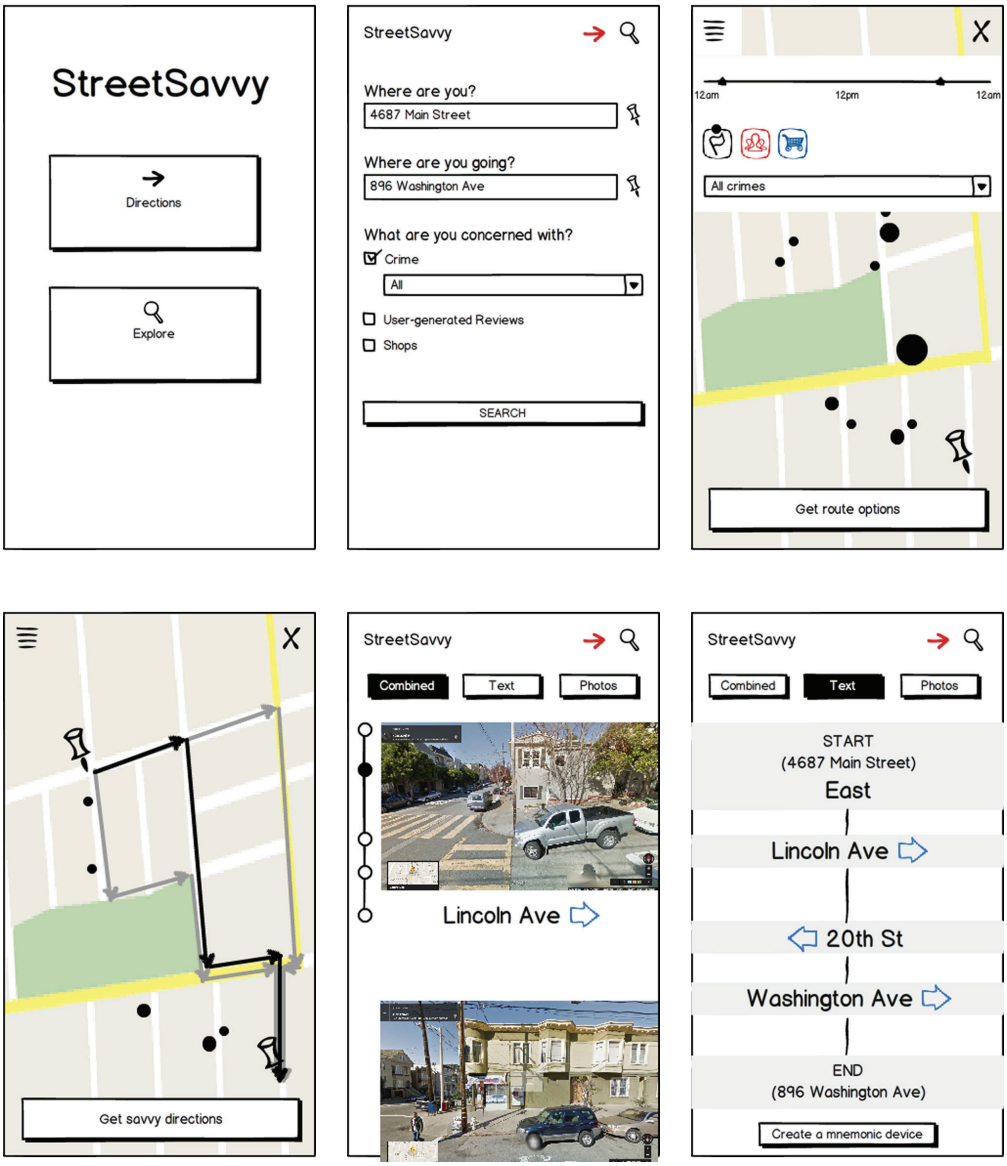


FIGURE 3
LO-FI PROTOTYPE SCREENS

We spoke with 11 participants (2 male, 9 female) within the age range 23–33 in a lab setting using the "Think Aloud" user testing protocol. All interviews were conducted in a closed lab setting with the subject and researcher located on opposite sides of the table. The researcher would walk the subject through a set script asking users to perform a series of tasks. Notes were taken on a computer by a separate researcher sitting off to the side, audio of the session was recorded, and photos of the subject using the tool were taken (see Appendix B and C for our testing script and consent form).

We also considered conducting contextual interviews since they would have provided a less sterile, more natural environment, which is particularly important in qualitatively evaluating the role a mobile tool might play in a user's routine. However, we went with lab interviews because it allowed us to have a private dialog with participants about what made them feel unsafe. This approach was significantly more valuable for this stage of our research than moving straight into contextual interviews because **the private lab setting fostered honest dialog about potentially taboo topics.**

During lo-fi user testing, we asked participants to complete basic tasks such as searching for directions, exploring an area, filtering data for specific variables, editing searches, and evaluating direction format. Once they selected a route, we also asked them to identify a preferred method of directions and to remember sample directions. We ended the session with an open discussion about street safety, guided by two following prompts:

1. What are some positive things about streets that make you feel safe?
2. If you could know anything about a new street before you walk down it, what would it be?

FIGURE 4
USER TESTING SESSIONS

RESULTING DESIGN DECISIONS

FIGURE 5
AFFINITY DIAGRAM

User testing ended up affirming our assumptions and choice of target audience. The subsequent affinity diagramming process helped us tease out the valuable quotes and observations from this user testing that deeply impacted our final design decisions. Key themes are discussed below.

WOMEN'S ATTITUDES TOWARDS SAFETY

In going through the user interview process, it was clear that our female research subjects were very interested in this tool and had little to no questions about its overall purpose. All of our female research subjects reported at least one (if not several) stories of being followed, verbally harassed, feeling unsafe while walking, or being physically attacked. While they were very interested in the details of our execution, comments they made and stories they shared made it very apparent that developing for a female audience was the correct choice.

> *I know I shouldn't walk through shady areas but I do it anyways because it's my city.*
>
> *—Female research participant*

Many had interesting observations about environments at night. There was a lot of concern about parking lots, industrial areas, empty lots, and alleys because these urban spaces were “not a source of help if anything were to happen.” There was also a great deal of attention paid toward an area’s lighting. One research participant explained that a traditional Google Maps, “might say it’s two blocks away. But what it doesn’t say is that those two blocks are up a hill and in a shadowy area.”

> … almost all qualified how unsafe they’d let a situation become before they avoided it.

Most of the women interviewed described themselves as independent and outgoing at night. That said, almost all qualified how unsafe they’d let a situation become before they avoided it. One user explained, “I can handle a street with verbal harassment but rape? No.” Another made a distinction about her safety versus the safety of others stating that, “I don’t care if I have a bad experience, but I really don’t want my mom to have a bad experience.” One research subject touched upon how her notion of safety had changed over time, “verbal harassment is just part of life—when I first moved to the city I was a little taken back, but now I know that people just scream at certain points in the night.”

Reviewing these observations in the affinity diagram process, it was easy to identify this feedback as more reason to keep and enhance the options people could use to filter the results for their ever changing safety needs.

HAMBURGER MENU AND OTHER TASTY BUTTON DISCOVERIES

During prototype testing, we observed that users were particularly likely to click certain buttons and hesitated when clicking others. A button and workflow that we ended up eliminating as a result of the prototyping process was a drop down menu button many of our users referred to as the “hamburger button.” Users called it the hamburger button because our prototype’s icon shared some visual similarities with a hamburger but, more importantly, the ability to edit searches was not as fluid with a drop down. When users clicked on the menu button, almost all expected to go back to the introduction screen where they were initially allowed to filter the elements on the map.

FIGURE 6
"HAMBURGER MENU" IN OFF (L) & ON STATE (R)

One of the most prematurely clicked buttons was a large high contrast “search” button within easy thumb range. Another button, with similar layout and contrast, had a label that confused some people—yet it still attracted a frequent number of unprompted clicks. While this became a laughable annoyance during testing, we we were able to leverage this phenomenon to solve a larger informational challenge, discussed in the following section.

UX SOLUTION: THE “NOW” BUTTON

A question we had to confront was: What are the most appropriate time parameters and defaults for crime mapping? Do we want to start with 24-hour clock? Distinguish by western terms for daylight hours e.g. “twilight” or “evening?” Give users full minute by minute control? With all of the available options, we focused on user-centered design principles to get a better idea of what was most appropriate. To examine how users might be primed by existing maps, we asked them to estimate what amount of time our unlabeled prototype map represented.

Many of our research subjects assumed we were showing them a prototypical crime map using a 24-hour clock that captured crimes which occurred over 1–3 months. We saw this standard as merely the product of the digital tools police use to record, store, and retrieve crime data and something worth challenging.

While we are far from criminologists, we did perform some basic exploratory data analysis in Tableau to see how time of day might affect crime. We binned 3 months worth of crime data across a 24-hour clock to see which hours experienced the most cumulative crime and what types of crimes were common. We observed that there was a consistent rate to some crimes throughout the day as well as easily observed peaks and lulls. However, these patterns could have been caused by many factors which we were not in the position to analyze for this project. For example, we didn’t want to misinterpret these patterns by falling victim to the base rate fallacy since there is no good proxy for the volume of people walking on the street at any given time. We bring this up because it’s important to note that we didn’t want to extrapolate our findings beyond a loose justification for time filtering.

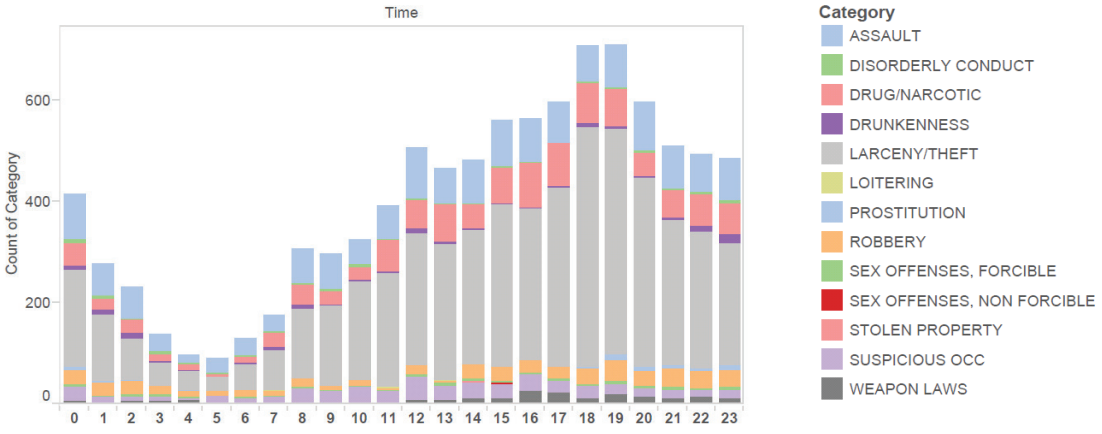


FIGURE 7
EXPLORATORY CRIME DATA ANALYSIS

Since we were designing a mobile decision support tool, we needed to make StreetSavvy's time options simple to both set and interpret. However, we were weary of misleading our users. For example, if a user isolates a 1-hour window, we still want to show them the double homicide that happened in a 1-hour, 2-minute window. Such concerns can be addressed with defaults that show generous time buffers but it illustrates the importance of these UX decisions.

We considered the option of a "Day / Night" toggle button in which a "Day only" selection would filter out "Night" crimes but "Night" crimes would include "Day" crimes. However, this would make the day seem artificially safer than the night and make some neighborhoods look worse than they really were, going against a core principle of the project to show neighborhoods at their best.

Our ultimate decision involved a time slider-selector with a 24-hour default, combined with a very intentionally placed "NOW" button that would highlight a 3-hour window based on user's device time. Leveraging user's proclivity to click high contrast buttons (regardless of what those buttons said or did) meant we could encourage users to filter by time without violating the default behavior they expected. By prompting users to take this action, they make a filtering choice which intentionally shows the selected neighbourhood in a better light.

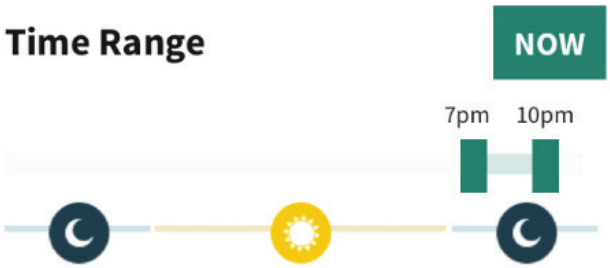


FIGURE 8
"NOW" BUTTON

DIRECTIONAL RECALL

There was no clear pattern in how participants remember directions. Some liked the mnemonic device generator, while others prefered a combination of text directions and the turn-by-turn streetview photos. But there was one—very clear—pattern from our user testing: Not a single participant wanted "photo only" directions. If these photos had been combined with our ultimate animated map, it's possible that they may have garnered some favor. But, without context, pictures of intersections alone were not enough for our users to feel confident in their direction memorization tasks.

INTENTIONALLY OBFUSCATING DATA

Throughout testing we watched many users drill-down on individual crime pins to get details. The problem of drilling down on this data was that our users drew a wide range of conclusions about what those details meant. In seeing how our research subjects interpreted fake data, we knew it wouldn't be appropriate to show crime in greater detail because: 1) their understanding of crime

metadata varied, leading to extreme characterizations of our hypothetical neighborhood, and 2) it distracted them from the primary purpose of the tool which was to help them make confident decisions.

We saw the use of intentionally ambiguous heat maps as a way of using data visualization to mitigate an associative weakness of the human mind.

For these reasons we moved away from traditional crime “pins” or “dots” to intentionally ambiguous heat maps. We allow users to identify what crimes they are interested in but we don’t distinguish which crime is present in the map view nor do we give users the ability to weight some crimes more heavily than others. We saw the use of intentionally ambiguous heat maps as a way of using data visualization to mitigate an associative weakness of the human mind.

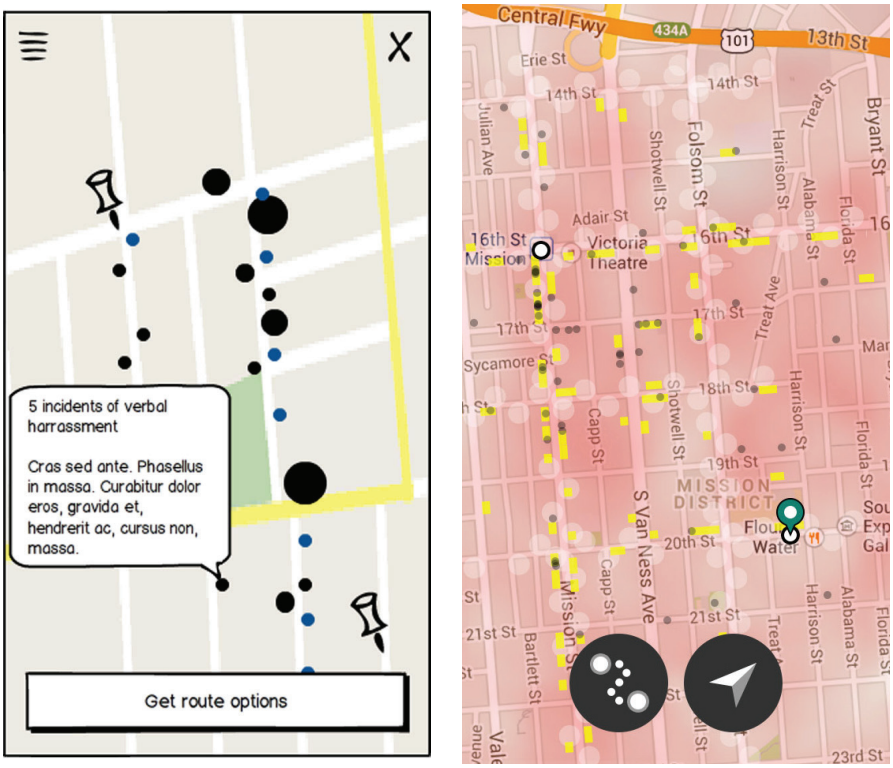


FIGURE 9
(L) CRIMES REPRESENTED BY DOTS ON A MAP
(R) CRIMES REPRESENTED BY A HEAT MAP

ENVIRONMENTAL DATA

Although strongly observed in user comments, data pertaining to real estate, industrial zoning, commercial non-mixed zoning, open lots, food deserts, trash, and topographic data will not be incorporated into this project. Most of these data sources are formatted as shapefiles that would have slowed down performance and clutter our data visualisation. Further, some data, such as real estate prices referenced by other apps, would have artificially depressed the image of certain neighborhoods—making them look unnecessarily less walkable. As we evaluated each of these during the affinity diagram process, we found crime to be a better proxy for safety.

Many research subjects wanted to identify certain types of nighttime foot traffic before they selected their own walking route. We, therefore, considered highlighting food truck locations, liquor stores, and 24-hour fast food restaurants as separate map elements. Participants were interested in this level of detail because they saw those types of store as being correlated with varying levels of safety. Customers clustering outside food trucks offered a positive safe resource, while liquor stores and 24-hour fast food restaurants were viewed as locations where our research subjects expected to experience harassment from those loitering outside. We might distinguish types of stores in future iterations but we ultimately ended up grouping these shops together under our “open stores” feature for the following reasons:

1. While this project focuses primarily on perceived safety, there’s no proof that these locations have a higher or lower rate of safety.
2. To clarify our visualization of the area.
3. To reduce the number of API calls.

STREETSAVVY FEATURES

StreetSavvy addresses these common problems by aggregating fresh data pertinent to walkers, such as walker specific crime data, the location of streetlights, open shops, and user-generated reviews. The app allows users to tailor their own walking preferences by helping them filter the map data by time of day, location, and the environmental factors that are important to them.

In addition to focusing on positive data sources that attempt to show neighborhoods at their best, what sets StreetSavvy apart from other pedestrian safety tools is that its user interface has been designed for quick decision making that encourages users to put away the phone and focus on their immediate environment.

SUPPORTED INTERACTIONS

The user interface for our project supports the following interactions: A user can explore and filter pedestrian data between their starting point and destination and quickly re-filter this data if they have an unmet concern. Users can also toggle between a limited (2–3) number of route options as they evaluate how those variables might affect their walk. Once a route is selected, StreetSavvy then provides users with both text, animated map, and “StreetViews” of where they need to make turns. Finally, StreetSavvy encourages users to put away their mobile device and engage with their environment by providing a mnemonic device for the directions provided.

The workflow of these interactions is largely dependent upon establishing a “conversation” with users, allowing them to edit their results and hone in on trends they observe in the data. It was an important challenge to balance our primary objective to build a decision support “direction-based” tool while maintaining these exploratory design features.

PRODUCT WALKTHROUGH

HOME

The homepage is a map with the user's current position as the center.

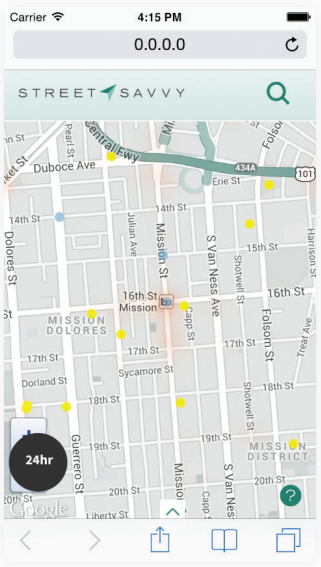


FIGURE 10
HOMEPAGE

SEARCH

The user fills in her starting and ending locations, and she has the option to use the "locate" button to automatically enter her current starting position.

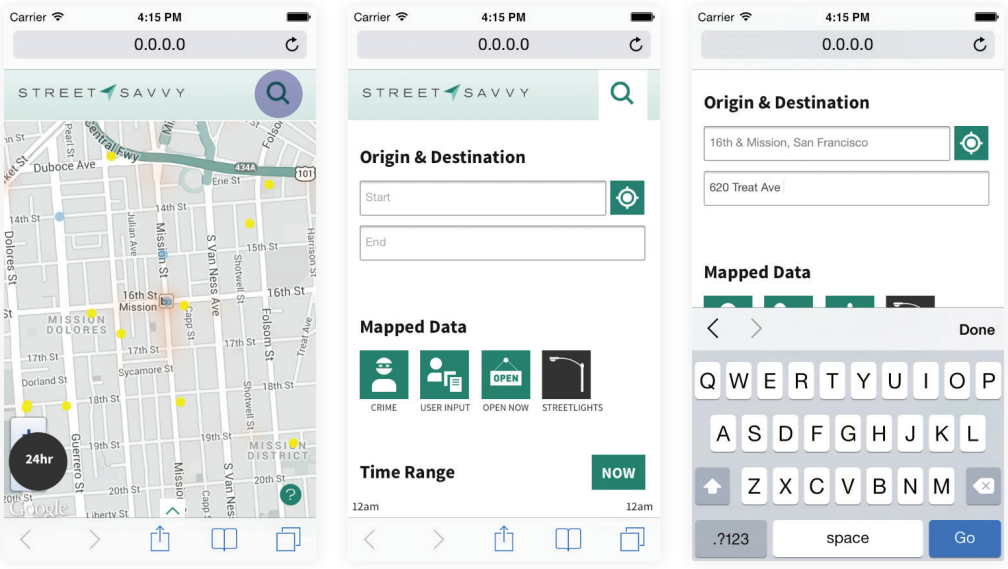


FIGURE 11A
SEARCH PANEL

In the search panel, the user can toggle two more options: mapped safety data and time of day.

Under “mapped data,” the user can select four different types of data to show/hide, i.e. crime, user input (Hollaback!), open stores, and streetlights.

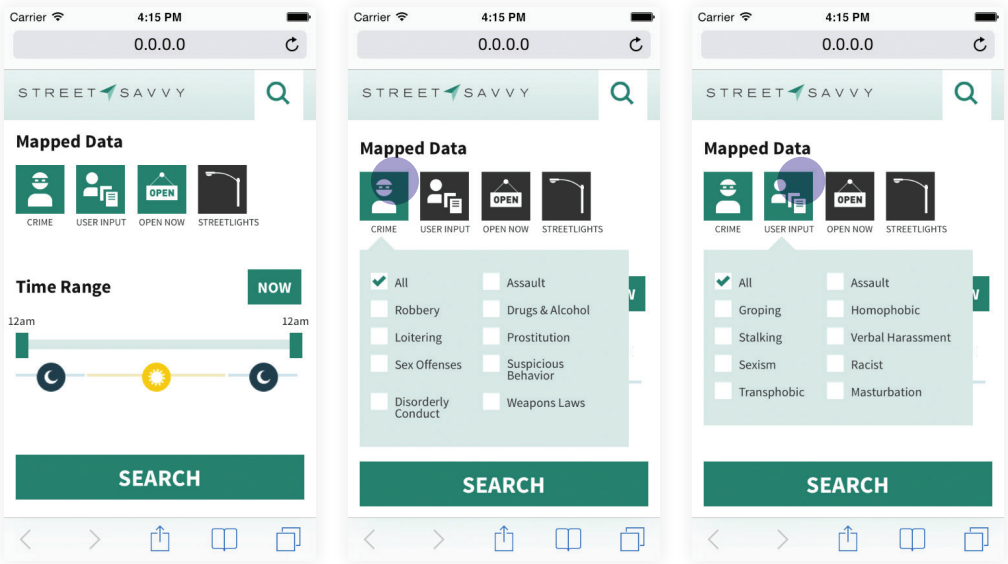


FIGURE 11B
SEARCH PANEL WITH EXPANDED OPTIONS

Under “time range,” the user can also select “now” which will automatically filter it down to a narrower 3-hour span based on her current time.

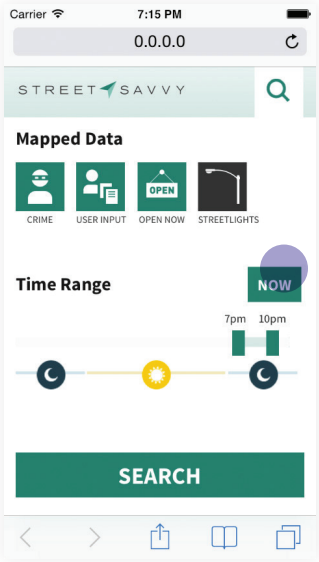


FIGURE 11C
SEARCH PANEL (AFTER TAPPING "NOW" BUTTON)

MAP + VISUALIZED DATA

On the map, the user will see three options for directions and she can pick one by tapping on the desired route.

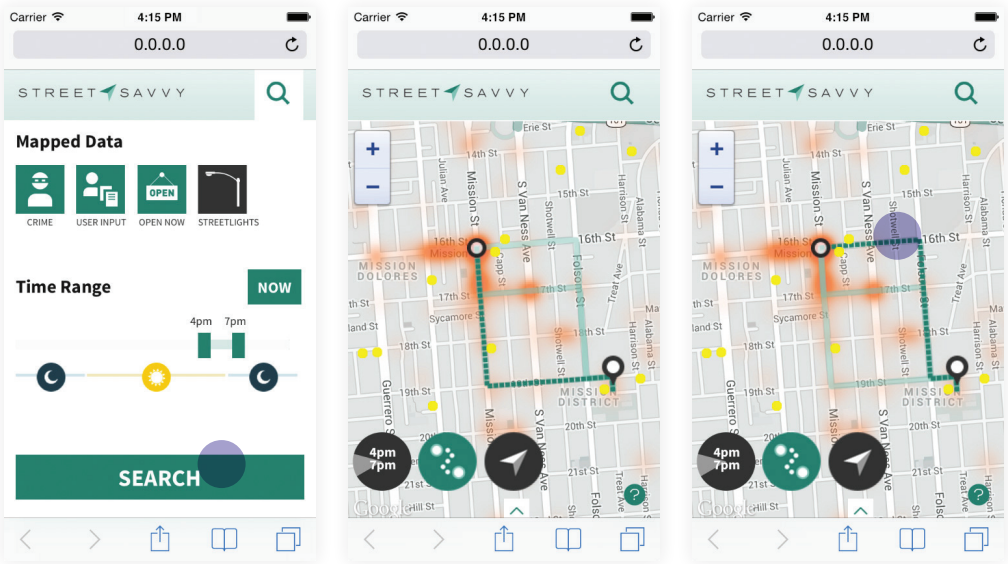


FIGURE 12A
MAP VIEW WITH VISUALIZED DATA & ROUTES

The map shows additional visualizations based on the safety data chosen in the search panel.

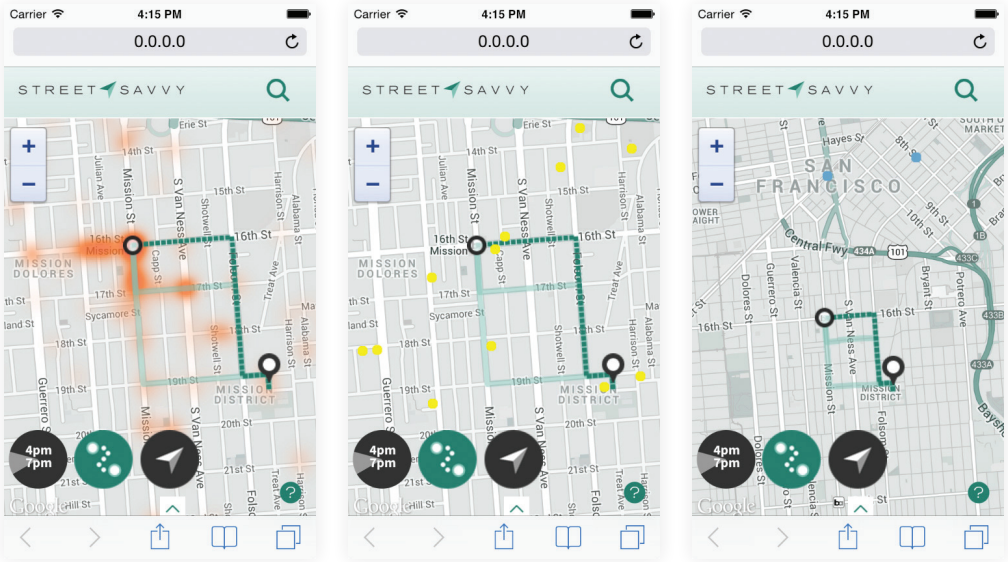


FIGURE 12B
MAP VIEW WITH DIFFERENT DATA VISUALIZED
(L–R) CRIMES; OPEN STORES; USER-GENERATED REPORTS

The night view map will be activated when the user selects an evening time range. Additionally, the streetlights visualization is only visible in the night view map.

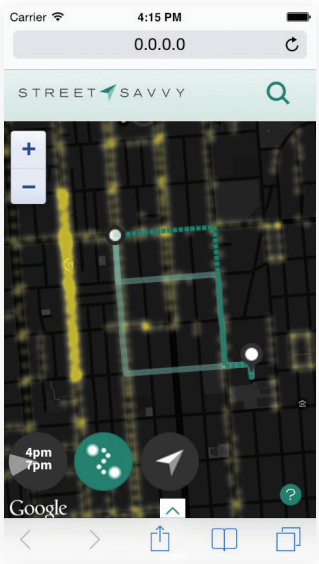


FIGURE 12C
MAP VIEW (NIGHT TIME) WITH STREETLIGHTS DATA VISUALIZED

The user can pull up the legend to see what the visual elements represent.

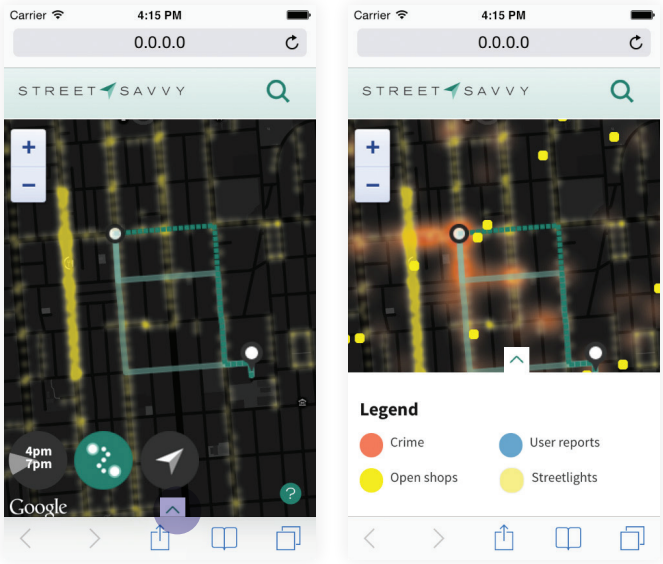


FIGURE 12D
MAP VIEW (NIGHT TIME) WITH LEGEND

At the bottom of the map, the user can see the time range she has selected, indicated by the highlighted 24-hour clock.

She can also turn directions on and off in case it's obscuring parts of the visualization.

Finally, the last button brings up the directions panel that shows walking directions for the selected route.

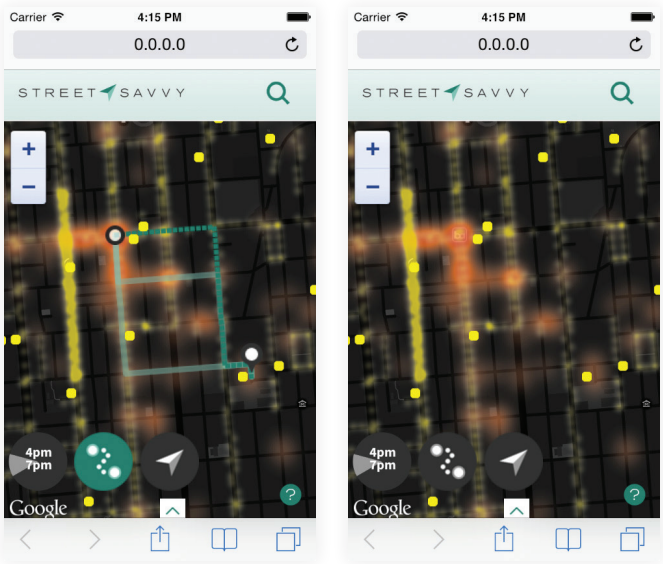


FIGURE 12E
MAP VIEW (NIGHT TIME) WITH ROUTES TURNED ON (L) & OFF (R)

DIRECTIONS

The directions panel occupies the bottom half of the screen, while keeping the map within view.

The initial view provides the user with turn-by-turn directions and images of the street intersections. As the user scrolls through the directions, the map is animated accordingly to give the user a sense of location.

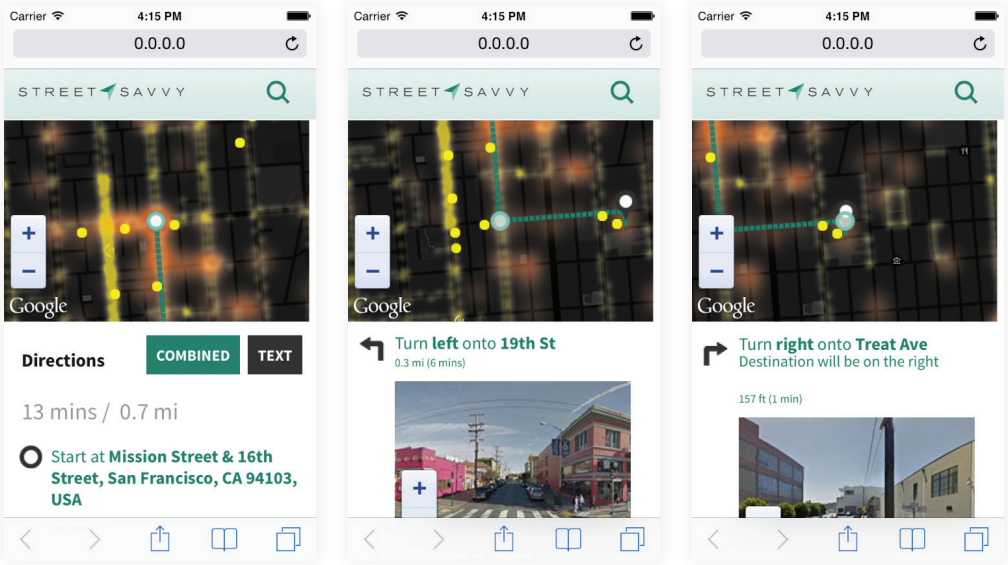


FIGURE 13A
DIRECTIONS PANEL (COMBINED VIEW)

The user can also opt to view text directions, without any photos.

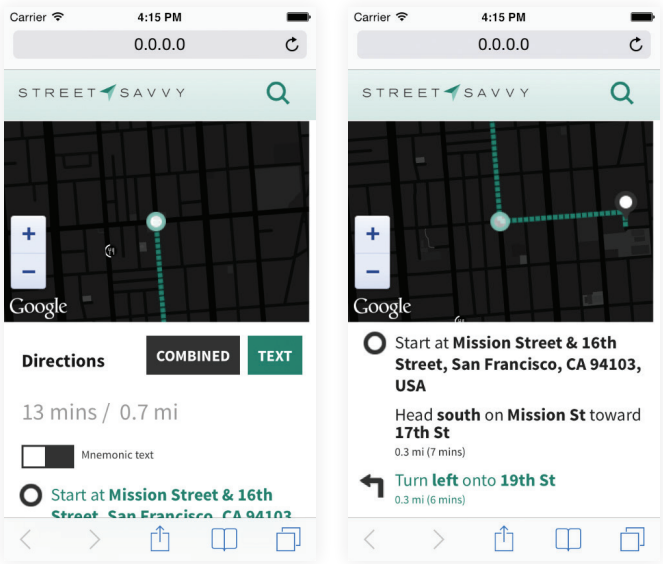


FIGURE 13B
DIRECTIONS PANEL (TEXT VIEW)

Finally, she can turn on the mnemonic option, which will transform the directions into a sentence, which the user can then try to remember.

This feature helps users navigate the route without having to consult their phones constantly and potentially exposing them to unsafe predicaments.

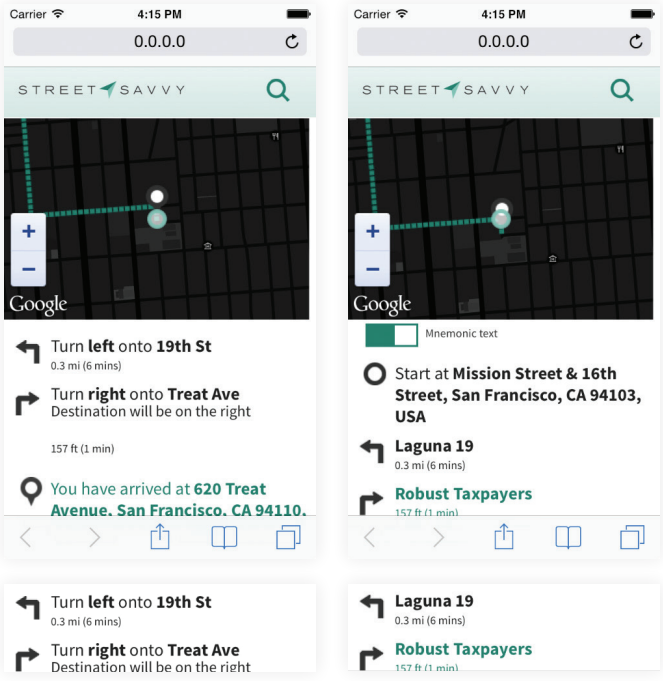


FIGURE 13C
DIRECTIONS PANEL (TEXT VIEW) WITH
MNEMONIC OPTION TURNED OFF (L) & ON (R)

DATABASE

Because our data heavily involves locations and many user interactions were map-based, we've chosen Postgres as a Database Management System (DBMS) so that we can take advantage of PostGIS. PostGIS allowed us to calculate spatial proximity in ways unsupported by other databases such as MySQL.

Our data-intensive activity involved the integration of siloed data sources, all of which operated on varying levels of granularity and updated at different frequencies. Harmonizing this data was, in part, addressed by our data visualization, but it still required a dynamic back-end solution that could accommodate non-synchronous updates and fast load times. The key to this solution was a **denormalized generated table**.

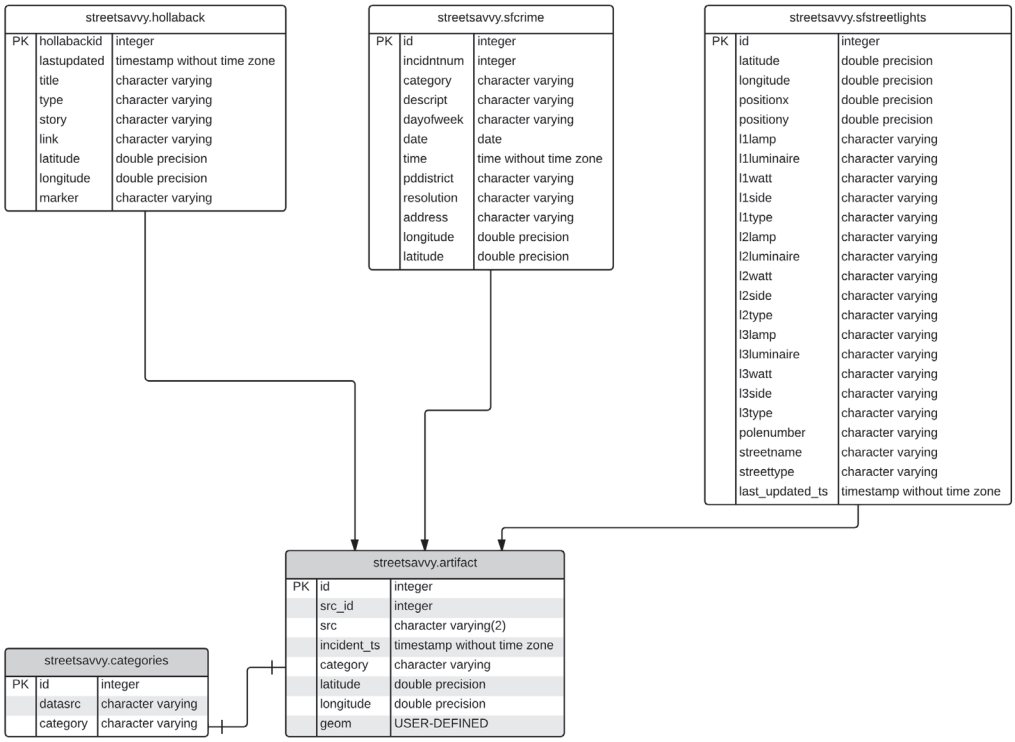


FIGURE 14
ENTITY RELATIONSHIP DIAGRAM

In this model, we selectively pulled in data from tables that consisted of our data provider's unedited content. This meant all filtering was performed by the queries we used to construct this centralized artifact table. The centralized table is, in turn, queried by our users searching in searching in limited—walkable—geographies (see Appendix D).

Column	Type	Filter or Description
id	Integer	Primary key
src_id	Integer	Primary key of source table (Hollaback, SFCrime, SFStreetlights)
src	String	Two character code indicating record type (Hollaback, SFCrime, SFStreetlights)
incident_ts	Date	Timestamp of when the incident occurred
category	String	Categorization of crime or incident type
latitude	String	Latitude
longitude	String	Longitude
geom	String	Creates point from latitude and longitude

FIGURE 15
ARTIFACT TABLE, FORMERLY KNOWN AS THE CENTRALIZED VIEW. THIS IS GENERATED BY THE FUNCTION IN APPENDIX D.

To improve performance time, the database returns all values from this centralized artifact table within the user's geographic parameters. The results of this search are then filtered on the front-end according to the user's selection. This avoids the need to call the database multiple times and makes subsequent user interactions feel more fluid. This solution worked well for the data that lent itself to a DBMS but another strength of StreetSavvy was our choice to design for the affordances of our data sources.

Instead of attempting to hoard all of San Francisco's street data in a massive, prohibitively expensive, elastic database, we chose to weave different types of data together at opportune points in the information flow. Crime data, Hollaback! data, and streetlights data (all discussed in greater detail below), were well suited for our database. However, open shops, time of day, and converting user centered addresses to geospatial coordinates were all best handled by Google API calls. While these calls had rate limits, we found this solution worked well for this iteration of the project, and allowed for a series of functions we would not have had the infastructure to accommodate.

DATA

Currently, the information most citizens use to depict safety is almost exclusively defined by police- gathered crime data. While this data is robust, it silences many voices we see as critical to improving the pedestrian experience and supporting neighborhood reform. A better data model is, therefore, an integral part of enabling pedestrians to provide and engage with more wholistic information. StreetSavvy has integrated streetlight data, crime data, user-generated reviews of street harassment, and open shops data to provide a more complete picture of street safety.

CRIME DATA

The authority control executed over traditional crime data is a informatician's dream. Crime data takes one of the most ambiguous aspects of our social experience and distills it into refined data points. Court rulings, alternate views of events, opinions of citizens, etc. all have little place in crime data thanks to the way it's collected and the strict vocabulary each police department uses. This is not to say that crime data is meaningless but it's important to note its limitations. One of the most significant limitations of this data is the way publicly available crime data is depicted.

Current crime maps have a tendency to make cities look like a war zone when the majority of these crimes aren't pertinent to walkers.

Current crime maps have a tendency to make cities look like a war zone when the majority of these crimes aren't pertinent to walkers. Crimes contributing to standard crime maps include bounced checks, child abuse, arson, etc. A core objective in our data transformation process was, therefore, an attempt to filter out these unrelated crimes in an effort to "cool off" neighborhoods that traditional crime maps show as "hot" with crime.

For example, one can observe an extreme difference around the 16th Street BART station when the crimes have been filtered for pedestrian needs.

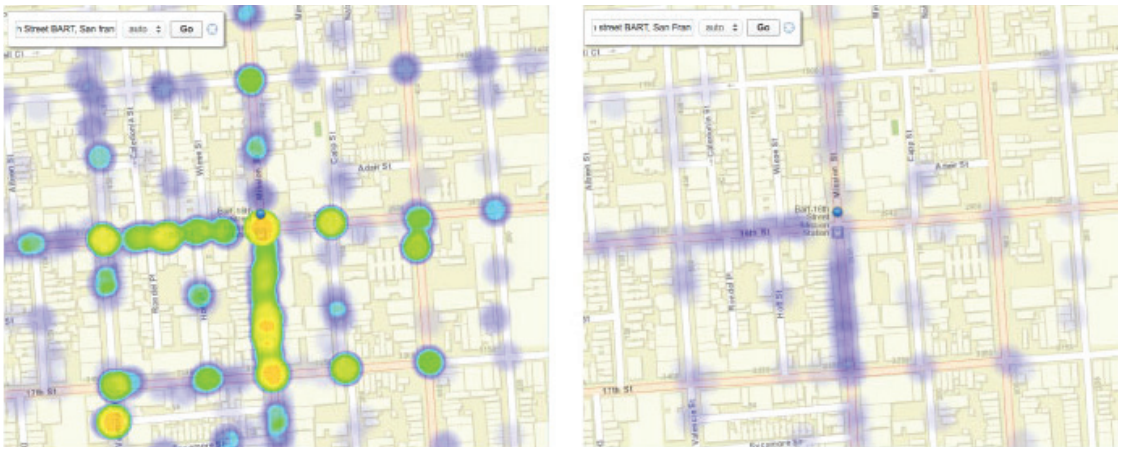


FIGURE 16
UNFILTERED (L) & FILTERED (R) CRIME MAPS

San Francisco Crime Data Schema

Format: CSV

Sync: Ad-Hoc

Description: San Francisco's crime data set for three months at: https://data.sfgov.org/Public-Safety/SFPD-Incidents-Previous-Three-Months/tmnf-yvry

Column	Type	Filter or Description
IncidntNum	Integer	SF Crime specific incident id
Category	String	Extracted to Artifact
Descript	String	
Date	Date	Extracted to Artifact
Time	Time	Extracted to Artifact
PdDistrict	String	
Resolution	String	
Address	String	
X	Float	Extracted to Artifact
Y	Float	Extracted to Artifact

FIGURE 17
SAN FRANCISCO CRIME DATA SCHEMA

HOLLABACK! DATA

StreetSavvy established a partnership with the non-profit organization Hollaback! Hollaback! is part movement part discussion platform which collects and shares user-generated data about street harassment. In exchange for their data, we agreed to share the results of our work with their team to further the cause of ending street harassment of women.

> *Street harassment is a form of sexual harassment that takes place in public spaces. At its core is a power dynamic that constantly reminds historically subordinated groups (women and LGBTQ folks, for example) of their vulnerability to assault in public spaces. Further, it reinforces the ubiquitous sexual objectification of these groups in everyday life.*
>
> *—Hollaback!*

This data represents a user-generated citizen voice that is an essential element of StreetSavvy's design theory. The definition of what the law considers safe is simply not enough because: 1) the law is biased, 2) no one data source contains "the truth," and 3) a massive amount of behavior that makes our selected user-population feel unsafe simply goes unreported or isn't defined as a "crime."

We emphasize the importance of user-generated data because crime data only tells a small part of a neighborhood's story. **Different people define safety differently.** Depending on the combination of racial, ethnic, and gender identity; how you are generally perceived by others along those axes; and the prevalence of racial profiling in your city or neighborhood, the sight of a police cruiser rolling down the street could evoke a sigh of relief or an uneasy pit in your stomach. For this reason, we look forward to partnering with more advocacy groups like Hollaback!, to integrate their data into our tool.

Hollaback! also provides another example of data designed for a different purpose. There was a great deal of cleaning that needed to be done given the narrative nature these user-generated reports and the fact that some reports happened close to the time of the incident, contributing to questionable meta data. For example, when reading through all of the cases tagged "other," we discovered many incidences of public masturbation that accompanied stories of shock, disgust, and confusion. While there was a specific tag for this event, this higher rate of user error is understandable given the disorienting nature of the incident.

While it was not in the scope of our project to build our own user data collection features, we wanted to make sure the voice of citizens was well represented. In the future, we hope to build more partnerships with activist groups, preferably groups that collect data on police brutality or race related harassment to make sure we are offering more perspectives on safety.

Hollaback! Schema

Format: CSV

Sync: Ad-Hoc

Description: The anti-street-harassment organization Hollaback!'s data sets, which reflect user-generated reports (see http://www.ihollaback.org/about/ for more information)

Column	Type	Filter or Description
ID	Integer	Hollaback specific id
Last_Updated	Timestamp	Extracted to Artifact
Title	String	
Type	String	Extracted to Artifact
Story	String	
Link	String	
Location	Float	Extracted to Artifact
Longitude	Float	Extracted to Artifact
Marker	String	Color of the map marker

FIGURE 18
HOLLABACK! DATA SCHEMA

Challenge: Most of the data found in Hollaback! has been collected for the purposes of catharsis and to increase awareness about non-crime incidents that affect women's safety. This meant hours of data cleaning and making some difficult decisions about how to preserve the authenticity of the stories.

STREETLIGHT DATA

After approximately two months of searching and calling government offices, we stumbled upon a shipping address in an industrial part of San Francisco. Not expecting to find anything but wanting to be thorough, we rang the buzzer of the dusty garage door and waited. Surprised (and slightly spooked) when the door opened, we began our partnership with the keepers of San Francisco's streetlights.

The Street Light Services Division of the San Francisco Public Utilities Commission owns, operates, and maintains over half of the street lights in the city. This diverse portfolio of 25,000 street lights

includes the latest LED lights, our city's antique light fixtures and much more (San Francisco Water Power Sewer). PG&E owns and maintains most of the other ~19,000 street lights in San Francisco.

Challenge: At the time of writing this report, the SF Streetlight Division has not released this data to the public. In an effort to respect their wishes, we have refrained from publicly posting StreetSavvy and may need to disable this feature until we get their approval (see appendix G). Further, while we weren't able to gain access to PG&E's streetlight data, we can safely say that StreetSavvy is the first mobile tool to depict San Francisco streetlight data for citizens.

San Francisco Streetlights Schema

Format: CSV

Sync: Ad-Hoc

Description: Partial list of San Francisco's streetlight types and location

Column	Type	Filter or Description
id	Integer	
latitude	Float	Extracted to Artifact
longitude	Float	Extracted to Artifact
positionx	Float	
positiony	Float	
l1lamp	String	Lamp type
l1luminaire	String	
l1watt	String	
l1side	String	
l1type	String	
l2lamp	String	Lamp type
l2luminaire	String	
l2watt	String	
l2side	String	
l2type	String	
l3lamp	String	Lamp type
l3luminaire	String	
l3watt	String	
l3side	String	
l3type	String	
polenumber	String	
streetname	String	
streettype	String	
last_updated	Timestamp	Extracted to Artifact

FIGURE 19
SAN FRANCISCO STREETLIGHTS DATA SCHEMA

OPEN SHOPS

Our user interviews revealed that many female walkers would use open shops as emergency resources. If they felt they were being followed or needed to look at their phone, many women reported ducking into a shop because they knew the shop owners had a mutual interest in maintaining the safety of their store. We are able to provide this data for our users using Google's API.

Google's API allows us to place a call from our front-end for up to 20 open shops within a geographic area. Once this data is returned, our front-end then makes a second call to get the their hours of operation. Finally, we filter the returned data based on the selected time of day.

Challenge: While we were surprised at the API rate limiting, we feel that it's an adequate number of shops for a proof of concept. As mentioned before, designing for a human scale means that our geographic parameters will generally be within one mile and 20 stores offers a reasonable degree of saturation. In future iterations of the project, we might offer additional shop data as a premium feature for subscription users.

MNEMONIC DEVICE

StreetSavvy's mnemonic device was created using Python Natural Language Toolkit grammars. Specific structured grammars are declared based on how many turns are found in the user's text-based directions. The mnemonic Python script generates a word for the direction of the turn and another word for the corresponding street name. Using this model, StreetSavvy can currently support a maximum of five turns. The device also has built in support to accept alternate text sources with parts of speech if low mnemonic quality is detected in the user's directions.

We have no plans to expand the leangth of the grammars since basic usability tests showed that a ten word mnemonic was pushed the limits of users' memory and directions with more than five turns weren't commonly required with distances shorter than one mile.

While generating mnemonic devices from street names is relatively straightforward, issues arose with streets that had numbers instead of names e.g. 9th Avenue or 21st Street. A number can only be prefixed to a limited set of parts of speech, like nouns or adjectives. To further complicate the model, where a numbered street falls within a grammar changes the mnemonic's overall structure; requiring multiple permutations of grammars to accommodate numbered streets at each and every point of a route.

INFORMATION SCHOOL CONCEPTS

StreetSavvy represents many of the concepts central to the School of Information's curriculum. Improving retrieval of data, user centered design, data visualization, the intended and unintended social impact of technology, legal concerns, systems performance, and distributed design solutions are briefly discussed below.

IMPROVING DATA RETRIEVAL

Challenges overcome with the technical execution of various data sources has been discussed throughout other section of this report, but an overarching theme of this project was **transforming data that was intended for completely different purposes outside of safety.** Improving the retrieval of data primarily designed for easy storage became a critical objective of StreetSavvy.

USER-CENTERED DESIGN

The core of this project has been our design process. We conducted needs assessments, lo-fi prototyping, user interviews, affinity diagramming, data visualization decisions, and hi-fi mockups. This approach also required us to take the occasional leap of user experience faith by designing for data we hadn't yet acquired. In the name of our users, we had to make strong arguments to city officials to liberate data that had never before been made public.

DATA VISUALIZATION

Our project depends on leveraging pre-attentive properties and **responsibly displaying data that varied in granularity and social significance.** We went through a series of exploratory diagrams, but the real strength of our data visualization came through in our ultimate map layout. The data visualization gave us the opportunity to help users re-imagine their relationship with their neighborhood.

Clarifying a large volume of data that is often misrepresented by traditional maps required careful consideration of mapping elements. We opted to use a heat map for visualizing crimes. We also allow users to filter by time of day and data type, but we eliminated users' option to view details of each individual data points. These decisions were intentional—we wanted to give users a general sense of the environment without overwhelming them. In our user testing session, we found that users wanted to tap on each available data point and read them in detail. However, such exploration becomes counterproductive to the application's main goal to assist with decision making on-the-go.

SOCIAL IMPACT OF TECHNOLOGY

This project also highlights the social impact technology has on the thought process of both users and unintended users. As discussed in the section above, we spent a considerable amount of time weighing the impact a tool like this might have on unintended users or non-users. If an area was turned red by a heat map, what does that mean for the people living there? Concepts such as Actor Network Theory led us to consider **what values we chose to crystalize in our tool and how this nonhuman actor might influence our larger social assemblage** (Latour). Responsibly managing partial or problematic data that, if displayed in the wrong way might do more harm than good, meant constantly questioning how our tool might be abused. It also meant identifying the strength of developing within an academic environment.

LEGAL CONCERNS

Designing a tool to help people assess safety has inherent legal concerns.

What, if any, are our responsibilities if StreetSavvy were used by someone who was then assaulted? Would they be able to say that we lead them to believe an area was safer than it actually was or can we claim to be a neutral platform? If someone's property is devalued by user-generated reviews or crimes, what legal actions could be brought against StreetSavvy? In response to these questions, we would emphasize that StreetSavvy is, merely, a data aggregation platform and develop a strong terms of service agreement that also valued user privacy. However, there are aspects of our current data transformation process that rely on a series of individual human judgment calls. This is mostly the result of our small scale and limited scope but a factor which might make it difficult to argue that we're an entirely neutral platform at this time. Regardless, this remains a grey-area of law and probably wouldn't prohibit us from functioning in a public capacity as a future business or non-profit.

There were also questions around intellectual property and copyright. As mentioned, Microsoft has a patent for a mapping algorithm that will route users around high crime areas. Does that mean we should avoid developing for this space entirely? Our assessment was that we are not reading on the Microsoft patent but the situation is an example of intellectual property issue that could require future legal council.

Finally, we worked to develop a series of agreements with our data providers that avoided stifling our design process and derivative works. An example of our negotiations over the use of streetlight data with the City of San Francisco can be found in Appendix G. Similar arrangements were made with the organization Hollaback!.

All of these questions required us to consider the legal implications of our design choices. Quickly identifying the needs of our technology, users, and the existing legal parameters was a regular piece of this project.

TECHNICAL PERFORMANCE

Aggregating disparate data sources to tell a new story about the streets of San Francisco required us to **distribute solutions across both the front- and back-end**. The needs of our users could not simply be addressed by a sleek front-end design or powerful back-end performance alone. UX solutions such as the time filter, or back-end solutions like the higher performance non-normalized view, were not developed in isolation. Working with a technically experienced team and a wealth of data allowed us to genuinely explore the depths of strategic solutions instead of settling for bare functionality. With many ways to solve the same problem, we had the privilege of picking what was best for our users.

NEXT STEPS

We would like to **work with local community groups** to build our own data input for at risk youth and women. We were inspired by the work of some local Oakland youth hackers who developed a means of sharing data about violent crimes with community members in low income areas (Garofoli). As discussed above, improving the retrieval of data intended for a narrative form was time consuming but important to preserve. If we had the chance to develop our own reporting features, we would strive to combine the cathartic elements of sharing events with a more structured data model.

We would also like to **highlight neighborhood improvement along routes users walk frequently** by letting them subscribe to quarterly email reports evaluating their route. Additionally, we would like to make it easy for users to share and generate these reports so they can directly inform discussions about their neighborhood.

As mentioned above, **we won't be releasing this to the public until we've done a comparative analysis** with existing safety tools and traditional (non-technical) means of assessing safety. Contrary to the Bay Area's current philosophy of "shoot first ask questions later," we want to ensure that this tool won't contribute to a negative impression of underserved areas. First, do no harm.

More cities and investors! The design of StreetSavvy is intended to scale. Many other cities have easier access to data such as streetlights and our highly modular architecture would be very adaptable to new data.

Identifying profit models and providing access to premium features such as more open shops and streetlights. Current limitations are only a product of API restrictions we could pay to avoid. Other, bureaucratic, challenges may simply require more time to sort out.

Improving the fidelity of streetlight data since each type of light emits a different level and pattern of light. We know the build of the 55 different types of streetlights across San Francisco. It's therefore possible to categorize each type of light on our map by opacity and shape to improve the accuracy of our night view map.

Building a native app to take advantage of the more precise GPS features and improve overall performance. A native app would also have the benefit of establishing a profit model and better data analytics about who was using StreetSavvy and for what purposes.

Performing a more thorough legal analysis to gain a better understanding of what our responsibilities might be when it comes to moderating user-generated data and existing patents. It would also be necessary to assess existing patents to see if we had novel intellectual property residing in our the UX design or data aggregation techniques. While we are pretty sure we aren't treading on the Microsoft patent, it would be important to perform research if we were to pitch this to investors.

We would also like to **consult criminology resources** to see if there is any correlation between amount of light, crime, open shops, time of day, street harassment, and future crimes.

Finally, we would like to incorporate a feature we've been calling **"Tag-Up"** which would help walkers check-in once they've arrived at a destination safely. Other apps like Kitestring (Kitestring) have offered similar features. However, their lack of sophistication in who and how they notify

emergency contacts leaves a large socio-technical gap (Akerman, 179). We'd want to let users tailor a lightweight personal notification system that would offer a more nuanced solution than automatically "going to DEFCON1" by calling all their emergency contacts.

CONCLUSION

Navigating urban spaces by foot can be a highly rewarding experience, but this process can be frustrating for some pedestrians, particularly women. StreetSavvy is our attempt to improve that experience.

We developed the product with user-centered design principles front and center. We successfully researched, identified, and applied UX principles that encouraged walkers to filter and explore safety data in new ways that hopefully challenge negative neighborhood stereotypes. The resulting information architecture is highly modular and capable of scaling to other cities.

Along the way, we also discovered challenges with obtaining datasets that, in theory, should be more accessible to citizens. This process highlights the importance of the Open Data Movement and how future efforts to publicly release data can contribute to civic innovation.

WORKS CITED

"About Hollaback!" *Hollaback! You Have the Power to End Street Harassment*. Hollaback!, n.d. Web. 07 May 2014. <http://www.ihollaback.org/about/>

Ackerman, M.. "The Intellectual Challenge of CSCW: The Gap between Social Requirements and Technical Feasibility." *Human-Computer Interaction*, 15(2-3), 179-205, 2000.

Devlin, Ian. "HTML5 DoctorFinding Your Position with Geolocation." *HTML5 Doctor*. HTML5 Doctor, 14 June 2011. Web. 07 May 2014.

Garofoli, Joe. "Low-income teens design apps that reflect their neighborhoods." *SFGate Politics*. SFGate, 20 March, 2014 . Web. 07 May 2014. <http://www.sfgate.com/politics/joegarofoli/article/Oakland-teens-design-app-to-make-their-streets-5332775.php>

Holmes, David. "GhettoTracker Is the Worst Site on the Internet." *GhettoTracker Is the Worst Site on the Internet*. PandoDaily, 3 Sept. 2013. Web. 07 May 2014.

Keyes, Allison. "This App Was Made For Walking - But Is It Racist?" *NPR*. NPR, 12 Jan. 2012. Web. 07 May 2014. <http://www.npr.org/2012/01/25/145337346/this-app-was-made-for-walking-but-is-it-racist>.

"Kitestring." *Kitestring FAQ*. Kitestring, n.d. Web. 07 May 2014. <https://www.kitestring.io/>

Latour, B. "Where are the Missing Masses? The Sociology of a Few Mundane Artifacts." In W. E. Bijker & J. Law (Eds.), *Shaping Technology, Building Society: Studies in Sociotechnical Change*. Cambridge, MA: The MIT Press, 1992.

Maguire, Brendan, Diane Sandage, and Georgie A. Weatherby. "Crime Stories as Television News: A Content Analysis of National, Big City, and Small Town Newscasts." *Journal of Criminal Justice and Popular Culture* 7.1 (1999): 1-14. Web. 7 May 2014.

Pielot, Martin, Niels Henze, and Susanne Boll. "Supporting map-based wayfinding with tactile cues." In *Proceedings of the 11th International Conference on Human-Computer Interaction with Mobile Devices and Services*, Article No. 23. ACM, 2009.

Robinson, Simon, Matt Jones, Parisa Eslambolchilar, Roderick Murray-Smith, and Mads Lindborg. "'I did it my way': moving away from the tyranny of turn-by-turn pedestrian navigation" In *Proceedings of the 12th international conference on Human computer interaction with mobile devices and services*, p. 341-344. ACM, 2010.

"Street Lights." *San Francisco Public Utilities Commission*. San Francisco Public Utilities Commission, n.d. Web. 07 May 2014. <http://www.sfwater.org/index.aspx?page=410>

"Urban Population Growth." *WHO*. WHO, n.d. Web. 05 May 2014. <http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/>.

APPENDIX

A / NEEDS ASSESSMENT SURVEY

Thank you for taking this survey, your input is appreciated! Your responses are anonymous and will only be used to help us improve the design of our final project.

WALKING HABITS

When you are going somewhere that is within walking distance, how often do you choose to walk? (As opposed to taking the bus, driving, taking a taxi, etc)

- ○ Always
- ○ Most of the time
- ○ Half of the time
- ○ On occasion
- ○ Never

What is your primary reason for choosing to walk over another method of travel? (Please pick no more than 2)

- ☐ For exercise
- ☐ For fun
- ☐ Environmental concerns
- ☐ To save time parking
- ☐ Save money
- ☐ Dislike driving/transit
- ☐ Don't have other options
- ☐ To stay connected with my neighborhood

When a destination is close enough to walk but you choose another method of travel, what is the most likely reason? (Please pick no more than 2 reasons)

- ☐ Don't have time
- ☐ Too tired
- ☐ Safety concerns
- ☐ Have to transport something (groceries, passengers)
- ☐ Too many variables / Don't know what to expect
- ☐ Avoid bad weather
- ☐ Other

  _____

When you walk, how often do you walk with other people?

- ○ Always
- ○ Most of the time
- ○ Half of the time
- ○ On occasion
- ○ Never

When walking, how often do you consult a mobile app to figure out your location or plan a route?
Never 1 2 3 4 5 6 Every time

What apps do you currently use?

WALKING HABITS

What factors are most important to you when choosing where you live? (Please pick at least 2)
- ☐ Good schools
- ☐ Length of commute
- ☐ Entertainment offerings (bars, restaurants, museums, etc)
- ☐ Safety
- ☐ Affordability (of rent or mortgage payment)
- ☐ Walk or bike-friendly
- ☐ Proximity to church or community centers
- ☐ Low taxes
- ☐ Proximity to parks and other nature areas
- ☐ Other

Which of the following resources do you use to learn about the safety of a neighborhood? (Please select all that apply)
- ☐ Asking people who live in the area
- ☐ Looking up official crime statistics
- ☐ Reading local news
- ☐ Visiting location-specific forum websites (such as Yelp, subreddits on Reddit.com)
- ☐ A crime mapping website (like Oakland Crimespotting)
- ☐ Google StreetView
- ☐ Other

How safe is it to walk in the neighborhood where you live?
Dangerous 1 2 3 4 5 6 Safe

How much does the safety in your neighborhood change throughout the day? (Does your neighborhood have the same feel at 3pm as it does at 3am?)
Dramatic Change 1 2 3 4 5 6 Feels the same all day & night

How safe is it to walk in the neighborhood where you work or go to school? (If you do not work, consider the neighborhood that you visit most often aside from the one where you live)
Dangerous 1 2 3 4 5 6 Safe

Which of the following most affect your feeling of safety when walking? (Please select at least 3 factors that could have a positive or negative effect)

- ☐ The people you see
- ☐ The surroundings (appearance of buildings, streets)
- ☐ Street lights
- ☐ Police presence
- ☐ Your physical stature/strength
- ☐ Whether businesses are open or closed
- ☐ Knowledge of crime statistics
- ☐ Carrying a self-defense tool (eg pepper spray)
- ☐ Whether you are alone or with someone else
- ☐ Familiarity with the area from prior walks
- ☐ The time of day
- ☐ Other

How might a mobile application improve walking safety? (If you do not think an app would help, why?)

DEMOGRAPHIC INFORMATION

What is your age?

What is your gender?

- ○ Male
- ○ Female
- ○ Other

How would you classify the neighborhood where you live?

- ○ Urban (city center)
- ○ Semi-urban (within city outskirts)
- ○ Suburban
- ○ Rural

How would you describe your physical presence??

- ○ Large frame
- ○ Average frame
- ○ Small frame

Do you use a mobility device? (Such as a cane, wheelchair, forearm crutches, prosthesis etc.)

- ○ Sometimes
- ○ Always
- ○ Never

THANK YOU FOR YOUR PARTICIPATION!

B / USER TESTING SCRIPT

WELCOME

Thanks for agreeing to do this.

Early user-testing plays a large role in the design of the product and we're excited to get your contribution!

We're working on an app to improve the pedestrian experience related to safety. Ultimately we want to encourage people to walk more and in new areas. We hope to provide more context to directions with street data and improve users' cognitive ability to remember directions so they leave their phone in their pocket and focus the walk itself.

At this stage in our research, we're trying to get a better idea of pedestrian needs and preferences which is why we're talking to you.

This will take 15min. First I will give you a scenario, then I'll have you click through some Balsamiq prototypes, a lo-fi version of our initial design. We'll give you 6 specific "tasks" to complete. If there's any time I'd like to get your thoughts on some broad questions about what makes you feel safe.

We intend for this to be a relaxed gig. At any point we can stop the test, at any point you can ask questions, answer your phone, and at any point you can leave. We're eager to get your thoughts on our initial concept but it's important that you know you can end this at any time.

Do you have any questions? Do you still want to do this?

Here is our consent form (go over bold items out loud so they don't waste time trying to actually read the whole thing)

Okay let's get started!

INTRO QUESTIONS

You recently moved to San Fran, you're going to this event. You just got off the train, it's night, and your friends are waiting for you. We have a tool that could help you navigate this situation. The information visualisations will change dramatically as we develop high-fi prototypes but we still want to get your thoughts on how you'd like to see this data displayed on a mobile device.

Task 1: Enter directions
Enter your current location by text and enter your destination by map
Now focus on crime and please search for directions
What are you seeing on this map?

Task 2: Open Shops
You're interested in seeing which shops are open along your route.
What are you seeing in this menu?
How would you adjust for time? (a passive question because we don't have this wired up)
What change did you notice after this selection?

Task 3: Investigate the bottom left artifact
What are you seeing?

Task 4: Filter by type of crime
You're interested in verbal harassment how would you filter for verbal harassment.
What changed when you selected this option?

Task 5: Select a route
Assume these are google walking route highlighted in blue.
Which route would you pick and why?

Task 6: Get savvy directions
(Combined) What are you seeing?
(Do they notice the dots on the side representing relative distance?)
How would you get new street views? (Tap for new street views)
How would you get text directions?
If they notice mnemonic device you can test that now
(Do they notice relative distance?)
How would you get directions by photo?

Let's go back to text—we want to help people remember directions better—how would you explore that from this screen?
Please explain what you're seeing with the mnemonic device (Do they notice spatial arrangement)
Including the original map view, which direction device would you use?
Okay do what you can to remember these basic fake directions—we'll ask you about them after a few min. (Observe if they do anything with their hands and see where they're looking)

Great! We're done with the most of it!
Thank you!
Would you like a break?

DISCUSSION

Do you have any questions about the project so far?
What are some positive things about streets that make you feel safe?
Can you tell me the directions we asked you to remember and what are you picturing as you try to remember the directions—what are you recalling this information from / what would help you remember the route?
If you could know anything about a new street before you walk down it, what would it be?

C / USER TESTING CONSENT FORM

STATEMENT OF INFORMED CONSENT

We are a group of students preparing a Master's Thesis at the School of Information at UC Berkeley.

We are conducting studies to better understand the needs and preferences of pedestrians. If you volunteer to participate in this study, you will be asked to perform some tasks related to pedestrian navigation, and to answer some questions. Your interactions with the computer may also be digitally recorded on video, audio and/or with still photographs. This research poses no risks to you other than those normally encountered in daily life. All of the information from your session will be kept anonymous. We will not name you if and when we discuss your behavior in our work, and any potential research publications. After the research is completed, we may save the anonymous notes for future use by ourselves or others. Your participation in this research is voluntary, and you are free to refuse to participate or quit the experiment at any time. Whether or not you chose to participate will have no bearing in relation to your standing in any department of UC Berkeley.

If you have questions about the research, you may contact Deb Linton at 781-507-3336, or by e-mail at deb@ischool.berkeley.edu. You may keep a copy of this form for reference.

If you accept these terms, please sign and date here:

PARTICIPANT SIGNATURE _____

RESEARCHER SIGNATURE _____

DATE _____

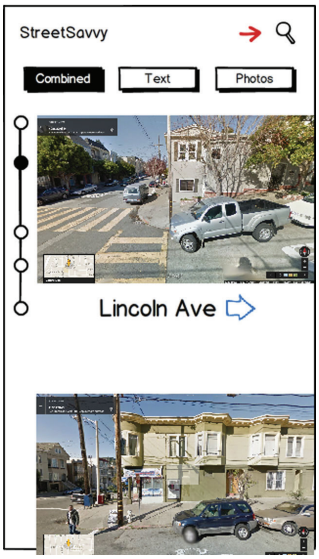
D / MAIN ARTIFACT TABLE CREATION FUNCTION

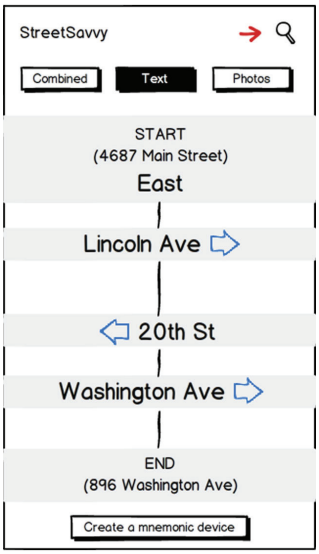
```
CREATE OR REPLACE FUNCTION streetsavvy.create_artifact_table(tname text)
  RETURNS void AS
$BODY$
BEGIN
    -- need to research dynamic query generation
    EXECUTE 'CREATE TABLE streetsavvy.' || quote_ident(tname) ||
    ' (id serial PRIMARY KEY,
    src_id integer NOT NULL,
    src varchar(2) NOT NULL,
    incident_ts timestamp without time zone,
    category character varying,
    latitude double precision,
    longitude double precision)';

    -- Insert into artifact table pertinent values from hollaback
    EXECUTE 'INSERT INTO streetsavvy.' || quote_ident(tname) || ' (src_id,
src, incident_ts, category, latitude, longitude)
    SELECT  shs.hollabackid,  ''HB'' as src, shs.lastupdated, shs.type, shs.
latitude, shs.longitude
    FROM  streetsavvy.hollabacksf as shs
    WHERE shs.type like any(
        SELECT ''%'' || sc.category || ''%'' FROM streetsavvy.categories as
sc WHERE sc.datasrc = ''hollaback'')
    ORDER BY shs.hollabackid ASC';
    --SELECT hollabackid, ''HB'' as src, lastupdated, title, latitude, longi-
tude FROM streetsavvy.hollaback';

    -- Insert into artifact table pertinent values from sf crime
    EXECUTE 'INSERT INTO streetsavvy.' || quote_ident(tname) || ' (src_id,
src, incident_ts, category, latitude, longitude)
    SELECT  scd.id, ''CD'' as src, (scd.date + scd.time), LOWER(scd.catego-
ry), scd.latitude, scd.longitude
    FROM  streetsavvy.sfcrime as scd
    WHERE scd.category like any(
        SELECT ''%'' || sc.category || ''%'' FROM streetsavvy.categories as
sc WHERE sc.datasrc = ''sfcrime'')
    AND scd.descript not like ''%MARIJUANA%''
    AND scd.descript not like ''%PREMISE%''
    OR scd.descript like ''%MENTAL DISTURBED%''
    ORDER BY scd.id ASC';
    --SELECT id, ''CD'' as src, (date + time), LOWER(category), latitude,
longitude FROM streetsavvy.sfcrime';
```

```
    -- Insert into artifact table pertinent values from sf streetlights
    EXECUTE 'INSERT INTO streetsavvy.' || quote_ident(tname) || ' (src_id,
src, incident_ts, category, latitude, longitude)
    SELECT ssl.id, ''SL'' as src, ssl.last_updated_ts, ssl.l1lamp, ssl.lati-
tude, ssl.longitude FROM streetsavvy.sfstreetlights as ssl';

    --Once all values are inserted from other tables, Add a new “geom” column
    PERFORM AddGeometryColumn( 'streetsavvy', quote_ident(tname), 'geom',
32661, 'POINT', 2 );
    EXECUTE 'UPDATE streetsavvy.' || quote_ident(tname) ||
    ' SET geom = ST_Transform(ST_SetSRID(ST_Point(longitude, lati-
tude),4269),32661)';

END;
$BODY$
  LANGUAGE plpgsql VOLATILE
  COST 100;
```

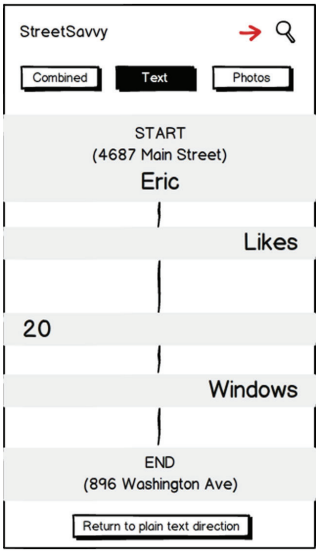
E / LO-FI PROTOTYPE

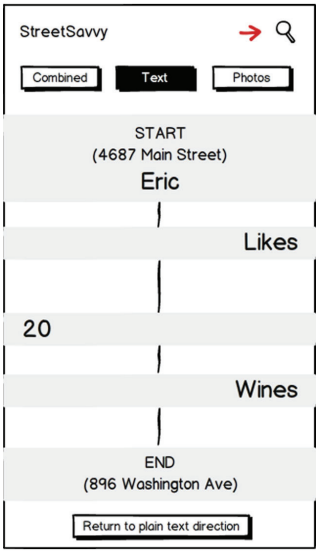

5 incidents of verbal harrassment
Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa.
Get route options
12am
12pm
12am
All crimes
5 incidents of verbal harrassment
Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa.
Get route options
12am
12pm
12am
Verbal harrassment
Get route options
Get savvy directions
Get savvy directions
StreetSavvy
Combined
Text
Photos
START
(4687 Main Street)
East
Lincoln Ave


StreetSavvy
Combined
Text
Photos
Lincoln Ave

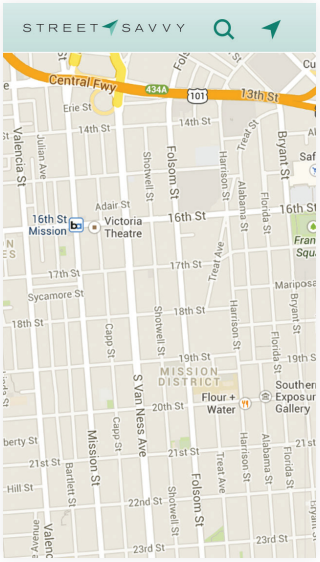

StreetSavvy
Combined
Text
Photos
START
(4687 Main Street)
East
Lincoln Ave
20th St
Washington Ave
END
(896 Washington Ave)
Create a mnemonic device

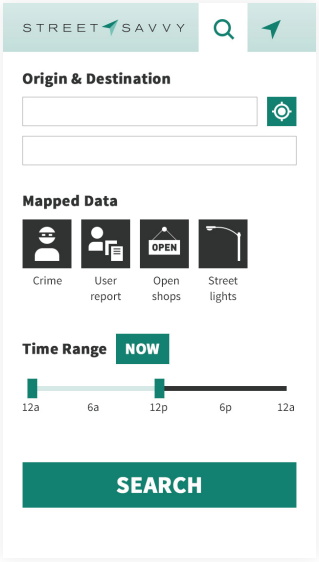

StreetSavvy
Combined
Text
Photos

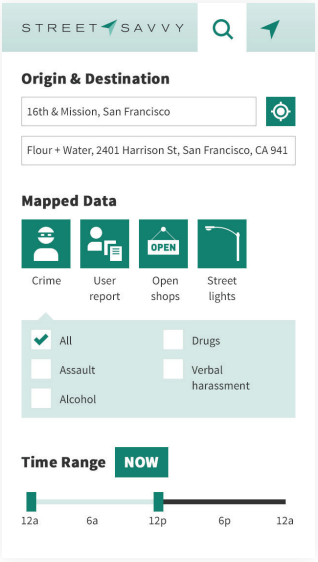

StreetSavvy
Combined
Text
Photos
START
(4687 Main Street)
Eric
Likes
20
Windows
END
(896 Washington Ave)
Return to plain text direction

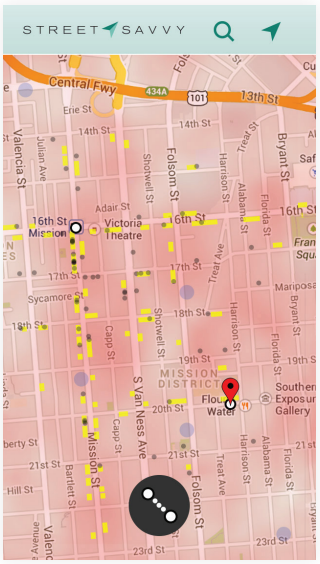

StreetSavvy
Combined
Text
Photos
START
(4687 Main Street)
Eric
Likes
20
Wines
END
(896 Washington Ave)
Return to plain text direction

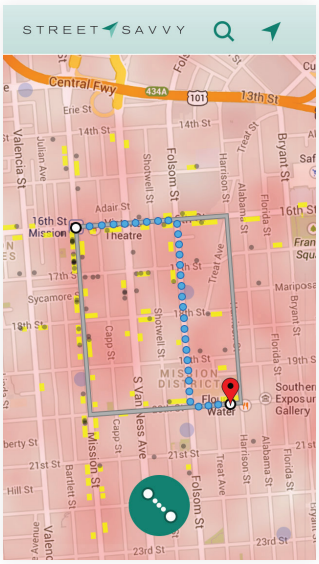
F / HI-FI PROTOTYPE

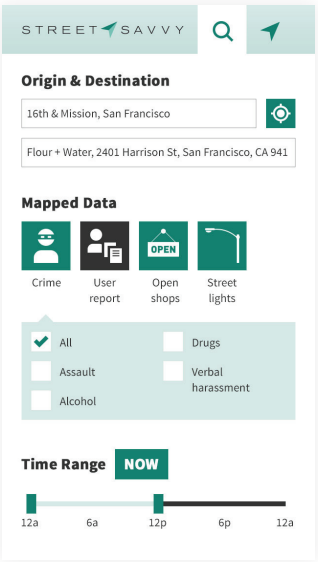


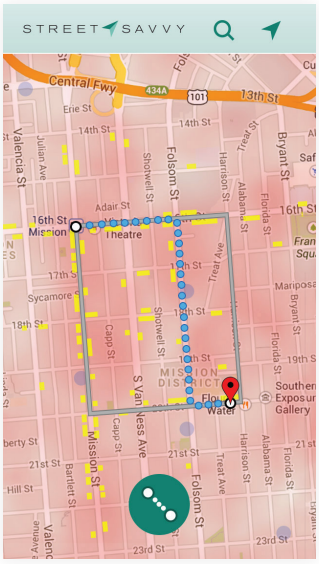


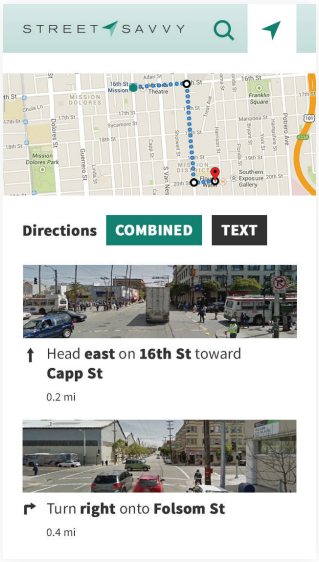


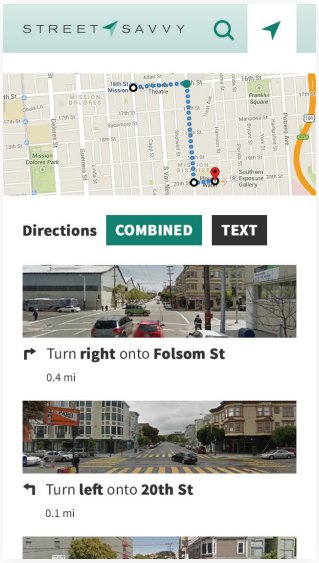


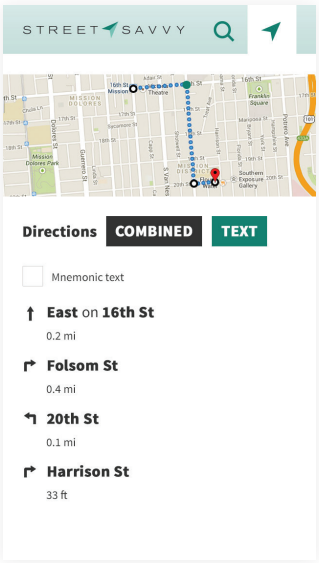


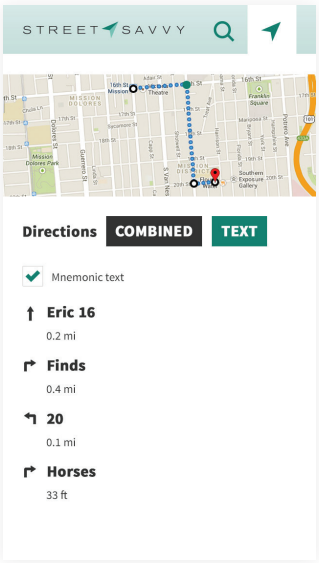



STREET SAVVY
Central Fwy
434A
101
13th St
Erie St
14th St
Valencia St
Julian Ave
Folsom St
Shotwell St
Harrison St
Treat St
Bryant St
16th St
Mission
Adair St
Theatre
Sycamore
18th St
Capp St
Florida St
Mariposa
19th St
MISSION DISTRICT
S Van Ness Ave
Mission St
Alabama St
21st St
Barlett St
Hill St
Treat Ave
23rd St


STREET SAVVY
Directions
COMBINED
TEXT
Head east on 16th St toward Capp St
0.2 mi
Turn right onto Folsom St
0.4 mi


STREET SAVVY
Directions
COMBINED
TEXT
Turn right onto Folsom St
0.4 mi
Turn left onto 20th St
0.1 mi


STREET SAVVY
Directions
COMBINED
TEXT
Mnemonic text
East on 16th St
0.2 mi
Folsom St
0.4 mi
20th St
0.1 mi
Harrison St
33 ft


STREET SAVVY
Directions
COMBINED
TEXT
Mnemonic text
Eric 16
0.2 mi
Finds
0.4 mi
20
0.1 mi
Horses
33 ft

G / TERMS OF USE FOR SAN FRANCISCO PUBLIC UTILITIES COMMISSION STREET LIGHT DATA

U.C. Berkeley School of Information Master's Thesis team, StreetSavvy agrees to the following terms in the management of San Francisco Public Utilities Commission (SFPUC) Street Light data:

1. We acknowledge that we are working with a partial data set that only represents a fraction of street lights across the city of San Francisco within a limited window of time. As street lights are added or removed over time, the dataset will become less accurate.

2. We will communicate to users that the frequency of street lights on a street does not directly reflect the lighting levels on a street.

3. Team StreetSavvy's functional project using SFPUC street light data may be tested by, displayed to, or shared with others, but no member of our team will distribute the SFPUC street light dataset itself to a party outside of our internal thesis team. In the case that Team StreetSavvy distributes any of the datasets incorporated into our thesis to an outside entity, WE WILL STRIP OUT THE SFPUC STREET LIGHT DATASET BEFOREHAND.

4. Team StreetSavvy retains all rights to their product, design, data analysis, and any derivative algorithms developed as a part of our research. The team reserves the right to publish findings that may involve or reference street light data but we will not distribute the data itself.

About the StreetSavvy project: This project aims to improve the pedestrian experience with a web-based mobile mapping tool that helps users make informed, real-time decisions about which route to walk. We hope to support people walking through unfamiliar neighborhoods by providing a combination of contextualized time-sensitive data about safety, an easy way to define their own safety preferences, and the ability to navigate a new route "hands free." While we want to help all walkers make confident decisions on-the-go, we're particularly interested in the unique challenges faced by female pedestrians.

By letting users explore positive data beyond standard crime statistics—such as information about public street lights—we want to provide a more balanced, socially conscious tool for data-driven discussions about safety. We hope StreetSavvy will challenge negative neighborhood stereotypes as much as it will help people get home in one piece.

Printed Name, Team StreetSavvy: Deb Linton

Signature, Team StreetSavvy: _____

Date: _____