Exploring the design of a Human-Centered safety-focused navigation application for solo-women travellers

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Abstract

The purpose of the research is to understand how a human-centered safe navigation application can be designed for the needs of solo women travellers to support them in their travel journeys, and how safety-data can be integrated in a useful and desirable way. The research starts with a literature review that revealed the gap of existing safety applications for solo women travellers, being based on the actual needs of the user group. The research then follows a design thinking process, starting with empathising with the users with semi-structured interviews to understand their safety needs, concerns and strategies in various travel scenarios, their perceptions on data-types and the communication and usage of those. It then uses thematic analysis and journey maps to analyse the data, leading to user insights presented in themes, and three travel journeys with insights, covering different scenarios. The following sections cover the formulation of a problem statement, opportunity identification, and the ideation and design concept creation of a safe navigation application, that will be tested with users from the target group. The main findings show users' main needs and pain points when it comes to safety, particularly around planning and taking confident decisions, their strong preferences for women-generated reviews, and their various opinions and preferences for the display, interaction and communication of crime-data.

1 Introduction

1.1 Motivation

Navigation applications are widely used for different purposes in everyday life, helping us get around, plan routes, and find destinations. We especially rely on them when navigating unfamiliar environments or traveling to new places, where their role becomes particularly important (Williams, Cooper & Dew, 2023). Most mainstream navigation apps prioritize speed and efficiency, often overlooking the diverse safety needs and risks faced by different users, particularly in more vulnerable modes of transport like walking, which involves distinct safety and navigational challenges (Delikostidis et al., 2014).

When reading about the differing safety needs that user groups have across various contexts and situations in the literature, the user group of solo female travelers stood out due to their high safety risks, concerns, and fears. This is related both to their identity as women (Williams, Cooper & Dew, 2023) and to the additional safety risk associated with traveling alone (Burdisso, 2014).

Previous research has examined applications aimed at enhancing safety during navigation across various transportation contexts (Galbrun et al., 2015). For instance, apps like Waze help drivers avoid accidents and traffic disruptions (Wu, Song & Chang, 2023). There are also several studies on safety apps specifically designed for women (Williams, Cooper & Dew, 2023; Young, 2014).

However, many of these solutions are technology-driven, focusing on data types and features without being grounded in real user needs, concerns, or behaviors, or based on human-centered design practices (Binkhorst & Den Dekker, 2009). In addition, there appears to be a lack of studies or applications addressing the full travel journey of solo female travelers, and how a navigation application could support them throughout that journey in feeling safer.

This gap made me interested in exploring what solo female travelers actually find useful and desirable when traveling alone, particularly in terms of features and safety data, and how such elements can be designed to support their safety without contributing to increased fear.

1.2 Problem formulation & Research questions

How can a human-centered navigation application be designed in a feasible and desirable way to help solo female travelers feel safer during their journeys, without increasing fear, and how can safety-related data be included and communicated to support this goal?

Research questions

1.What safety concerns, needs, and strategies do solo female travelers have, in different stages of their travel journeys?

2. What types of safety-related data are considered valuable and useful by solo female travellers to support them in feeling safe, and in what situations?

3. What are the most important safety features for solo female travellers to feel safe in a safe navigation application, and how can safety data be used for these in a relevant, useful and desirable way?

4. How should safety data be visualized and communicated to support the travelers safety needs (in their different steps of their journey?), without increasing fear?

2 Literature review

2.1 Literature review process

The purpose of the literature review was to identify a research gap and narrow down the direction of my thesis topic within the broader idea of designing a human-centered, safety-focused navigation application, while also gaining a deeper understanding of the topic itself (Randolph, 2009). When starting the review, I already had the initial idea to explore how a navigation application to enhance safety could be designed, as safety features for the user, besides vehicle safety, seemed to be missing in widely used tools like Google Maps.

To move from a broad topic to a more focused research direction, I needed to understand what safety needs and concerns various user groups have when navigating and choose a user group, explore what has already been done in designing navigation systems to enhance safety, and understand what to consider when designing an application like this. To structure this exploration, I conducted the literature review with three primary aims: (1) to identify a research gap and define the direction of my

thesis, (2) to understand the safety needs of different user groups, and (3) to investigate what has been done in designing safe navigation systems (Randolph, 2009).

Search strategy

To guide and structure my literature review, I applied a building block search strategy, where I first identified the main concepts relevant to my topic and then combined them in various ways to create targeted searches.

This method, as outlined by Kerstin et al. (2006), is a requirement for a successful search, and involves creating blocks representing concepts, that includes keywords and terms connected to the concept. The building blocks I used were labeled: Safety, needs & concerns, user groups, navigation, navigation application, safety data & human-centered, each associated with related keywords. These blocks were then combined in three main areas of interests: 1. safety needs and concerns in navigation and travel, 2. existing safety-focused navigation applications, and 3. the use of safety-related data in navigation or travel applications.

Additionally, I used a pearl growing approach, a method in which relevant sources are used to discover additional relevant literature by tracing their citations and related works. Searches were performed in databases such as Scopus, Google Scholar and Primo. For the searches, I used Boolean operators as "AND, OR and NOT (Kerstin et al. (2006), and I used a search log to document my searches, to understand which combinations had been tried and which ones that gave the most precise results.

The literature search process

I started with exploring what types of safety concerns and needs various user groups have when navigating unfamiliar areas. I considered a variety of user groups, including men, women, elderly pedestrians, and travellers. However, it became clear through the literature that women, especially solo female travelers, experience the highest levels of safety concerns and risks when navigating and travelling. Interestingly, while safety was a major concern, papers also pointed out that a motivation for solo female travel is the desire to feel empowered and independent. The combination of experiencing fear while wanting to feel safe and empowered was considered an interesting element of my research direction.

Simultaneously, I examined the second interest area: Existing navigation and safety applications. I found studies for mainly vehicle navigation safety, but also travel safety or navigation safety for women. Most of these were highly technical or engineering-driven. They focused on calculating safe routes using data like crime statistics, lighting, or environmental sensors, and the technical aspects. Some applications included safety features aimed for women, such as emergency alerts or location sharing. However, the main thing missing was the lack of any involvement of the target users in the design process and asking users what they want from such

systems, and in what situations they would need it. This gap in user involvement and human-centered thinking helped focus my thesis direction.

I realised that the various data types were crucial aspects of designing a safe navigation system, so I decided to dig deeper into safety-related data types, to understand the implications of using these in the design, what they mean for safety and how it could be used in a safety application for women, to make sure the design involves the "feasibility" part of design thinking. Many studies explored the technical feasibility of using crime data, lighting conditions, or crowdsourced reports to suggest safer routes, although without the user perspective. This raised the interest area of whether the same safety data that aims to increase the sense of safety also could increase the fear of women further if not designed with their needs in mind.

Other topics that I reviewed were subjective and objective safety, and design considerations and guidelines for mobile navigation applications. When it comes to the user needs from the literature review, I decided to only include the needs of women and pedestrians, and not vehicle or cycling, as I was not focusing on traffic safety.

In summary, the literature review was an iterative and evolving process. It helped me move from a broad goal of designing a safe navigation application to a clearly defined problem statement, research questions and target user group, which Bryman highlights is one of the outcomes of reviewing literature (Bryman, 2021, Chapter 4). It highlighted that while technical solutions and data exist, the missing element is often the human perspective, what women actually need to feel safe, what makes them feel empowered, and how to design safety features that enhance the travel experience without increasing fear.

2.3.1 Objective vs subjective safety

As the navigation application aims to enhance safety for women, it was considered important to understand different definitions of safety and risks, in relation to travelling and navigating. Karl & Schmude (2017), writes that safety can be described from two perspectives, objective, which is measurable calculations of risks, and subjective, which is the interpretative risk perceived from the individual's perspective. The following section will first cover the literature found on subjective safety, followed by objective safety.

Subjective safety

There are various papers covering the topic of subjective risk and safety, with different namings such as safety perceptions, perceptions of threats, subjective, perceived risk perception, and experienced safety, while most papers use both the terms safety and risk together. The terms will be used to describe the same concepts.

The literature found have different ways of describing what it is, as well as what it is based on, although they overlap and describe many of the same concepts. Zou & Yu

(2022), Zou & Meng (2019), describes tourists' sense of safety as their personal assessment of the probability of the possible threats or injuries during a travel, or the perceived assurance of being protected from it. They further describe it as an individual's emotional experience, influenced by how effectively the environment and safety conditions fulfill their personal safety needs. Similarly, Karl & Schmude (2017), describes it as the individual interpretation of possible outcomes.

When it comes to what the subjective safety depends on, the literature also mention various things, such as factors related to the individual (personality and risk tolerance, cultural and socio-economic background, gender, race and age, experiences) (Karl & Schmude, 2017), Zou and Yu (2022), (Williams, Cooper, & Dew, 2023), the destination and situation (Karl & Shmude, 2017), (Williams, Cooper, & Dew, 2023) and how the risk is communicated by for example media (Karl & Schmude, 2017). Williams, Cooper, & Dew (2023) highlight that it is the personal identity together with the situation and context that creates the subjective safety, which they call "identity-situated safety concerns".

The subjective safety also affects peoples navigation strategies (Williams, Cooper, & Dew, 2023), decision making and destination selection (Zou and Yu (2022), and has a larger role in travel decisions than objective safety (Karl & Schmude, 2017). Binkhorst & den Dekker (2009) emphasize that there is a lack of focus on users safety needs, concerns and goals when designing applications.

Objective safety:
Objective risk is one perspective of safety, which refers to the measurable calculation of possible outcomes Karl & Schmude (2017) . Although this study focuses on the perceived safety, as it is based on perceptions from the humans involved in the study, objective safety is not excluded from the study as they are two perspectives on safety. Furthermore, Zhang & Bandara (2024) found that objective risk influences individuals' perceived safety, with emotional responses acting as a mediator in this relationship. Additionally, as navigation applications use safety data to inform about risks, of which some are objective, such as crime data, the objective safety is connected to the application, although guided by the subjective safety needs and concerns. It is not only identity that affects perceived risks, but also real risks. For instance, women are at higher risk of experiencing gender-based violence, particularly when traveling alone (Burdisso, 2024). Similarly, racial or ethnic minorities may face increased risks of discrimination, harassment, or racial profiling, depending on the cultural and political context of the destination.

2.3 Womens safety needs and concerns when navigating and travelling
The aim of this section was to get an understanding of the safety needs of women and pedestrians that are travelling, and navigating to new places. This can be considered a part of the empathise phase as well, and helped guide the research forward.

Previous studies show that women have higher safety concerns and fears when navigating and travelling than men (Burdisso, 2024), (Williams, Cooper, & Dew,

2023), Reid & Konrad, (2004). Burdisso (2024) writes that this also makes women more cautious and altered when travelling alone, and they are also considered as more vulnerable. Furthermore, women are generally more vulnerable to street crime due to both social and physical factors. Their typically lower physical strength can limit their ability to defend themselves, and men are statistically more likely to commit non-domestic violent crimes (Stark & Meschik, 2018).

Studies show that women have two to three times higher fear of crimes than men (Reid & Konrad, 2004), have more fears in various situations when travelling and navigating, and have several safety concerns such as fear of sexual assault and harassment (Williams, Cooper, & Dew, 2023), (Reid & Konrad, 2003). Zhang & Bandara, (2024) study about pedestrian safety showed that women walking alone were to a higher degree concerned about being harmed by men. Stark & Meschik (2018) write that women feel especially fearful when it is dark, and in certain places such as parks and garages, and that they tend to avoid walking or taking the public transport at night.

One of the main drivers for women travelling alone is to create confidence, and a sense of self empowerment (Chiang & Jogaratnam, 2005). It is seen as something that helps with personal growth, building courage and adapting to different types of situations (Hirschorn & Hefferon, 2013).

2.4 Current studies about applications for womens safety, navigation/travel safety:

The following text will display the previous studies on safe navigation applications, displayed by safety applications for women, excluding navigation and map features, as they are still relevant, and map or route based applications based on the data type they are using, as well as a description of the data type.

2.4.1 Safety applications for women and their features (excluding safe navigation and maps)

When searching for previous studies on safe applications for women, there were many applications involving features outside of map and route based features, or in combination with those. In a content analysis of personal safety apps for women, (Maxwell et al, 2019) found that most applications have features for helping in the actual danger situation and after, with common features like location-based services, alarms, geofencing and crowdsourcing data for real-time crimes. LifeCraft is an application aimed for women in India on the go, with automatic location sharing to contacts, calling to emergency numbers, voice recording, offline modes and showing safe zones based on nearby police stations (Khandoker, et al. 2019). Dantu Sai Prashanth, Patel, & B. Bharathi (2017) developed a similar system with the difference of displaying first-aid information, and emergency numbers. Other studies, such as The Women Safety App (Dubey, et al, 2024) are including similar features.

2.4.2 Data types and map or route-based safety applications (woman and other)

The following section presents the studies of map or route based safety navigation applications, displayed by data type and a short description of the data type. The most

common data types seemed to be used were crime data and crowdsourcing data. Other types of data used were some or lightning data.

Croud-sourcing data

Crowdsourcing uses collective input to solve complex problems, spark innovation, and collect useful data. (Sari et al., 2024). It uses people called "crowds" to do small jobs for problem solving, that the computer could not easily solve itself. Smart city is a type of crowdsourcing using information and communication to help improve services for citizens or government, through information sharing or collection of data, that Waze falls under (Wu, Song & Chang, 2023).

Map-based services often use crowdsourcing to update and maintain their maps to improve their services. Human evaluations in crowdsources data differ from those made by computers, as they involve real knowledge and experiences, which can outmatch many machine algorithms (Fan, et al. 2017). Crowdsourcing enables rapid, low-cost collection of lived experiences directly from users, making it a suitable method for surfacing underreported issues like street harassment. It allows for localized, real-time input and can visualizing hidden problems. However, crowdsourced data may lack consistency, reliability, or coverage in areas where users are less active. It can also reflect reporting bias, and have privacy management, trust and data verification concerns (Young, 2025).

Crowdsourced data is used in various ways and safety purposes such as traffic safety, as Waze (source), to calculate the safest route (Elsmore et al, 2014), (Ali et al, 2015), and to map out crimes (Young, 2014). SafeStreet (Ali et al., 2015) uses crowdsourced, time- and location-tagged harassment reports from victims, observers, or agencies. It calculates the frequency of incidents in specific areas and times to generate safe and unsafe route suggestions based on when the user plans to travel. If the user is flexible, the app can also suggest a safer time to visit a location. Additionally, users can view the number of harassment reports in their area. HarassMap is a crowdsourced platform in Egypt, where users report harassment via SMS, social media, or web forms. Reports are manually reviewed and mapped using Ushahidi. It helps increase visibility and awareness of harassment and encourages reporting, but does not offer live alerts, navigation, or an app for personal safety (Young, 2014).

Crime-based data

Many studies found in the literature search were using crime-based data for the creation of safe routes or crime-based safety maps, in various ways, purposes and using various features.

Galbrun, Pelechrinis, & Terzi, (2015) used publicly available crime-data for a safe urban navigation app, assigning time-aware risk scores for street segments representing the probability of crimes happening at a location for a certain time, using (open street-map) together with crime data. The safety score is based on frequency of crimes for certain times. The app provides users with several routes with different

trade-offs between risk and distance.Their algorithmic framework can be used for other navigation contexts, that balances multiple priorities (e.g., distance and safety), and that want to give the user the option to choose between multiple routes that have different trade-offs. PASSAGE Garvey et al., (2016) is a walking safety app for Atlanta that uses police crime data to suggest the safest and shortest routes based on location and time-specific risk. The app also includes live location sharing and a quick distress alert. However, it doesn't allow users to explore area safety without entering a specific route. Hong, Kim, & Ihm (2025) created an application displaying a heatmap of crime prone areas and their severity based on crime-data, aiming to reduce fear of crimes. Additionally the app creates a safety score for the users location. They highlight the lack of real-time data integration, absence of predictive analytics, and missed opportunities to connect with government APIs for more dynamic and up-to-date information.

Social media data

With the high use of social-media, many users share their experiences publically, including information that can be useful for safe navigation-safety purposes (Lakshmi & Joseph, 2022). SocRoutes is a navigation system that integrates geotagged sentiment data from microblogs (e.g., Twitter) to suggest routes that avoid areas with highly negative sentiment. The authors found a correlation between negative sentiment and crime in a Chicago-based case study and used this insight to generate routes that are potentially safer (Kim, Cha & Sandholm, 2014).

Lightning & environmental data

Environmental factors such as lighting, street width, weather, visibility, walkability, and crowd density are used to create safe navigation systems. For example, some models prioritize well-lit, wide streets with minimal turns, while others incorporate weather conditions or evacuation risks using deep learning for route optimization. Safe routing approaches have also been tailored for specific groups, such as children or older adults, by factoring in changes in crowdedness or surface conditions. Additionally, geographical risk zones (e.g., for earthquakes) have been mapped using OpenStreetMap and machine learning to avoid unsafe areas (Lakshmi & Joseph, 2022).

2.6 Design considerations for navigation applications

To follow best practices and ground my design in established knowledge, I reviewed research on the design and usability of navigation applications, focusing on design guidelines, principles, and challenges.

Ruginski et al., (2022) proposed design principles for navigation applications based on research in cartography, cognitive psychology, and HCI. They suggest minimizing cognitive load by avoiding irrelevant or hard-to-filter information, reducing visual clutter, and including landmarks and environmental cues. Users should be able to choose between route-based or global orientation, select map alignment, and receive instructions that fit their preferences, whether landmark-based, numerical, or

directional. The principles promote flexible, user-adaptive navigation tailored to individual needs and contexts.

Delikostidis et al. (2016) highlight that pedestrian navigation differs significantly from driving. Pedestrians make flexible path choices based on context and visual-spatial understanding, rather than strictly following routes. Therefore, navigation systems should support real pedestrian behavior by aiding environmental awareness and helping users make decisions at key points. The authors also stress the need to align mobile maps with users' mental models, using meaningful landmarks, enabling heading-up orientation, and simplifying visuals to reduce cognitive load.

Dillemuth (2005) highlights that while digital maps can show unlimited information thanks to GIS technology, this creates a challenge: what information is actually useful for users on small mobile screens? The ability to show too much makes it even more important to focus only on what helps users orient themselves and navigate. This supports the need for simplified, user-relevant map content based on real navigation needs.

Roth (2015) highlights that mobile map design needs to consider the constraints of small screens, limited attention, and constant movement. He argues that mobile maps should focus on what is most relevant for the user in the moment and avoid clutter. Instead of copying designs from print or desktop maps, mobile-first cartography should adapt to the user's current situation, like their speed, location, or environment. He also emphasizes the need for accessible and inclusive design that works for different users in different conditions.

3 Theory

The section shortly describes the theory of human-centered design and design thinking, that the study is based on. While the whole project is based on human-centered design principles, and will use the design thinking process and its methods, it will be used as a guideline.

3.1 Human centered design & design thinking

According to ISO (2010), HCD is described as an approach to developing interactive systems that prioritizes usability and usefulness by focusing on users, their needs and requirements, and by applying principles from human factors, ergonomics, and usability. Some of the main principles of human centered design are, basing the design on an understanding of the users, their activities, and environments, user involvement throughout the process and users driving the design forward, taking the full user experience into account, and designing in an iterative process ISO (2010). A core principle of user-centered design is involving users throughout the design and development process to ensure that their needs, goals, and concerns guide decision-making, rather than relying solely on technical constraints. This approach

helps create systems that support and enhance user activities instead of limiting them (Preece, Sharp & Rogers 2015, Chapter 2), (Still & Crane, 2017). Understanding people, and their various contexts helps designers create interactive products that align with users needs and experiences, which can help us acknowledge that one solution does not fit all user groups (Preece, Rogers & Sharp, 2015, Chapter 1).

Design thinking is based on the principles of human-centered design, and can be described as a non-linear, creative way of identifying and solving problems. Design thinking is seen as an approach suitable for innovation, identifying customer needs and addressing wicked problems, which are problems that are "ill-defined", (Chasanidou, Gasparini, & Lee, 2015) and have no "correct" way of being solved, nor only one right solution. This was also one of the reasons for why design thinking was chosen for the project, as the problem and solution is not obvious, and could be solved in different ways.

Design thinking is seen as covering three overlapping spaces: viability, which is the business perspective, desirability, which is the users perspective, and feasibility, the technical perspective, and innovation happens when the three different perspectives are taken into account (Chasanidou, Gasparini, & Lee, 2015).

The process of design thinking

The phases of design thinking have different names depending on the literature, although the phases cover the same concepts. For this study, I am using the terms discover, define, create, evaluate (Luchs, Swan & Griffin, 2015). It is important to emphasize that the steps are iterative and non linear. In addition to process names, there are also a large number of methods that design thinking involves, that can be connected to each step (Luchs, Swan & Griffin, 2015).

Discover

(Luchs, Swan & Griffin, 2015) describes discover as understanding the customers context, behaviours and experiences, through empathising with them, which will help getting new user insights. Empathising with the users can be done in various ways, and qualitative methods are suitable to get immersed in the users context (Luchs, Swan & Griffin, 2015). In Human centered design, this phase is corresponding to the phase Understanding and specifying the context, where knowledge about context of system usage is gathered, involving both the organizational, technical, and physical environments, including the users and their behaviours and actions (ISO, 2010).

Define

The define phase is a convergent phase, where customer insights get narrowed down and defined, and problems are well framed. One should have various insights and needs at this stage, through synthesising the data. Synthesising data can be done in various ways, for example through coding, empathy maps, personas, and journey maps describing the users existing or future experience. The needs and insights are then used to define a problem statement to narrow down the focus, which is a method in design thinking where the user, need, and the insight describing the importance, is

formed (Luchs, Swan & Griffin, 2015). In Human centered design, it is in the requirements phase where the formulation of a clear defined problem happens (Preece, Sharp & Rogers, 2015, Chapter 11).

Ideate & prototype
The ideate and create modes are connected, as one creates while generating ideas and vice versa. During this phase various concepts are ideated with the aim to solve the identified problem, which later will be used to gather more insight from users to further improve the concept. The ideas are then converged to the most suitable ideas, based on criteria, which could be for example desirability, viability and feasibility. Prototype, refers to the creation of prototypes that represent the initial concepts, and can simulate the experience or part of the experience. One can choose one or several prototypes to explore with users, which are further explored with them (Luchs, Swan & Griffin, 2015).

Evaluate
Evaluate is about testing the concepts and the assumptions on the end users, to receive feedback, which then is synthesised again. The goal is to both understand what solution, or parts of a solution that works the best as well as getting more insights. This phase corresponds to the evaluate phase in ISO (2010), and there are various methods suitable for testing depending on the stage of the product, such as participatory evaluations, assisted evaluations, controlled user testing and satisfaction surveys and behavioral analytics tools (Maguire, 2001).

4 Methods

This section describes the methods of application that I plan to use for my research. In Chapter 5, it is described how the methods are used in the design process.

4.1 Methods under discover

4.1.1 Semi-Structured Interviews

Rationale for Method Choice

In order to empathise with the users and their travel contexts, I plan to conduct qualitative, semi-structured interviews with 3-6 women that have travelled alone. Qualitative research is particularly valuable for gaining in-depth insights, understanding experiences within their context, and exploring participants' perspectives and processes in detail (Bryman, 2021, Chapter 16). Semi-structured interviews offer a flexible approach to data collection, where the interviewer follows a guide of predetermined questions but can also pursue relevant topics that arise during the conversation, aiming to elicit open-ended and nuanced responses (Bryman, 2021). They combine parts of structured and unstructured interviews and could be using both closed and open ended questions (Preece, Sharp & Rogers 2015, Chapter 8). This method was considered as valuable as I was looking to understand the users thoughts and experiences in detail, while allowing them to bring up their own topics and stories at the same time.

Aim of interviews

The literature review, theory, and problem statement informed the choice of topics that I want to bring up with the users during the interviews:

- *To explore what safety concerns, needs, and considerations solo female travelers have across different moments in their journey* (planning, daytime activities, navigating at night). Although prior research highlights women's heightened safety awareness and concerns, I wanted to understand it in the context of their travelling journeys. This can help me understand in what situation the tool could provide the most value.

- *To understand what tools, strategies or actions participants currently rely on to feel safe while traveling and navigating alone, whether they support their safety needs.* This helps identify if their tools support their safety related needs and concerns, which current solutions are already working, where gaps remain, and what could be enhanced through design. I also wanted to understand what safety related features they would desired or see as useful.

- *To explore how participants perceive different types of safety data* (e.g., Crime statistics, reviews, environmental data, Some), in terms of usefulness, trustworthiness, and desirability. While the literature outlines various types of safety data, I aim to explore how solo female travelers perceive these data types, where and how it could be used to support their safety. Additionally, I wanted to explore the topic of safety data potentially leading to fear.

Interview Protocol

While I plan to allow for the participants to guide the interview, I still want to provide some structure through creating the main themes I want to cover. The interview protocol is structured into three main parts:

Introduction: Participants are asked about their previous solo travel experiences, and general fears to allow them to reflect on their experiences, and provide me with context.

Scenario-based discussion: To explore safety considerations across the travel journey, participants are asked to put themselves into three scenarios, and are prompted with giving information about safety considerations, tools, needs and actions.

- Planning where to stay: After choosing a city, how do they decide what neighborhood or area to stay in?
- Going for a daytime activity: Planning where to go and how to get there, navigating there and back.
- Going out for dinner (evening activity): Same as above, and how do their behaviors or concerns shift at night?

These scenarios are preselected to cover the full journey from choosing area to navigating and doing activities there. I considered allowing them to openly talk about their journeys but this could provide me with more structure and focus for my interest areas, while allowing for flexibility and them to add things. I intentionally excluded choice of country or city, due to concerns about being ethically risky.

Thematic exploration: After the scenario discussion, the interviews covered the following themes in more depth: tool usage, safety data, and safety vs fear, as presented in "aim of interviews".

Alternative methods considered

Alternative approaches such as using secondary user data from literature review to inform the creation of early ideas to discuss with users were considered. However, to explore the topic from a user-centered perspective and understand the full scope of needs and perceptions related to all themes, and to not start with solutions before empathising, I chose to conduct original interviews.

4.1.2 Journey mapping

I plan to use journey maps for various stages of the design process, starting from discover/empathise. The customer journey, or customer experience map, simulates and visualises a journey scenario that the customer experiences, showing how it is to be in the customers situation, through the customers perspective. It can be enriched with behaviours, preferences, events, interactions or touchpoints (Nielsen, 2024). To create a user journey map, you need to deeply engage with what users do (their actions) and understand the context around those actions (Stephanidis & Salvendy (2024). One of the benefits of a customer journey map is that it allows for

understanding and documentation of the full experience, allowing for a deep, human centered approach, which is important for innovation.

As Luchs, Swan & Griffin (2015) explains, the method of customer journey mapping can help with understanding the customer, synthesising the data, and creating insights, for the whole user journey, which goal is to help out with creating better solutions, rather than explaining the only truth. Luchs, Swan & Griffin (2015) describes the full design process the journey can be used for, as gathering data about the users, adding background information, analysing and synthesising the data iteratively using data analysis methods, identifying pain points in a step or across the journey, using the journey to define or reframe the opportunity with HMW's, and generate ideas in combination to the journey, where he calls the journey map as a "springboard for innovation". The ideas can address either one or several pain points of the journey.

As Luchs, Swan & Griffin (2015) empathises, I will use the journey map throughout the process. For discovery, the journeys worked as a way to form interview questions in a way that would allow for descriptions about the journeys and scenarios, as well as serving as an artifact for empathising with the users in the other steps of the design. For the analysis of the interviews, the journey maps will be used as a complementary tool to synthesise and organise the data. For the define phase, the journeys help with defining the main insights, as well as creating a pov that is based on a holistic understanding. It will also be used for the creation of HMW's, as well as ideating solutions, that respect, and are based on an understanding of various steps and scenarios.

4.1.3 Thematic analysis

Thematic analysis is a method to identify, analyse and describe themes from the data in rich detail, and is often used to interpret different parts of the research topic. Some advantages of TA is the way it can be used to summarize main features of a large data set in a useful way and it's ability to help create unexpected insights (Braun & Clarke 2006).

To analyse the interview data, I plan to use thematic analysis together with the journey map. When planning for the analysis method, I had the research goals and questions, as well as the goal of producing the journey maps, in mind. After having read both Luchs, Swan & Griffins (2015) literature about analysing data for the journey maps, as well as Braun & Clarke (2006, 2009) (Braun et al., 2019), literature about thematic analysis, I decided to use a two-stage thematic analysis approach, informed by Braun and Clarke's framework (2006, 2021), while allowing for involvement of user journeys (Luchs, Swan & Griffins (2015). This will allow for both a structured, journey-based synthesis, and a deeper inductive exploration of broader themes that respond to the research questions, using reflexive thematic analysis. The journey maps will serve as a way to understand where the insights are connected in the journey, whereas the thematic insights from the reflexive thematic analysis will complement

the journey through providing deeper, more nuanced information, which can help answer the why's.

I plan to code the interviews with two purposes, one of assigning them "deductive" scenario codes, for the purpose of being able to organise the data related to the different scenarios, and the other, to inductively code the full data set, including the data coded with the scenario, to create meaningful insights, which Braun and Clarke says is the core of reflexive thematic analysis.

I then plan to conduct the analysis in two rounds. For the first round, I plan to use the data coded with the journey steps, and analyse each one of them separately, for the purpose of generating the journey maps, with the various steps and insights related to different layers of interest. Instead of only organising the data, I plan to analyse them through thematic analysis as well to generate initial insights for the journey.

For the second round, I intend to analyse the full data set of the inductive codes, including the ones coded with the scenario step, to allow for the creation of insights and themes from the full data set, without being constrained and connected to a journey map, to to understand the various interest areas of my research. I then plan to follow the rest of the steps for thematic analysis from Braun & Clarke (2006) of creating and reviewing themes in an iterative way, defining, and naming them.

I then plan to revisit the journey maps, to place additional insights from the themes from the full data set, to enrich the journeys with more insights, and to help with prioritizing problems, needs that the reflexive thematic analysis allowed for as it is not only connected to one scenario.

The themes intended to be created will follow Braun and Clarke (2019) definition as "stories about patterns of shared meaning across the dataset", which they empathise are different from "domain summaries", which are simply organizing the data into "topics".

4.2 Methods under define

4.2.1 POV and HMW

Even through the journey maps will already help with defining the data, I will still have several journeys with various insights, as well as results from the reflexive thematic analysis. To help with prioritizing the pain points as Luchs, Swan & Griffins (2015) highlights in the journey mapping process, to create more focus and to converge further (Langensand (2018), I will use the method of Point Of View.

A POV helps narrow down which specific user problem to address by synthesizing and framing the insights into a focused design challenge. As Langensand (2018) explains, a common structure for this is: "[User] needs to [need] because [insight]."

This method is particularly relevant for wicked problems, where the problem itself is not initially well understood. A POV facilitates clarity by highlighting a specific tension to explore, enabling a more targeted design direction. It also serves as a way to collect and organize insights into a single, actionable framing.

4.2.2 HMW

After formulating the Point of View, I plan to use divergent thinking with How might we? (HMW) statements on various phases of the user journey, to open up for ideation. I then plan to prioritize a few of them to focus on to explore for solutions, before starting to ideate for solutions that could solve the HMW.

As Luchs, Swan & Griffins (2015) say, how might we's are a way to start opening up for opportunities and to turn a pain point or problem to a solutions and possibility. HMW's can be called innovative questionings, as they can be used to see the problem from another angle and allow for innovation.

4.3 Methods under Ideate & Prototype

Luchs, Swan & Griffins (2015) describes ideation and prototyping as an iterative process where both can be used together, to come up with and visualise the concept of ideas.

Ideation methods

Luchs, Swan & Griffins (2015) state that several ideation techniques can be used to come up with new ideas, such as brainstorming or storyboarding. (Langensand (2018) mentions scamper, a creative problem solving method that uses different things to come up with new ideas through: substitutes, combines, changes, adapts, modifies, puts into other use, eliminates or reverses. As mentioned, I plan to use Ruchs approach of the journey map, the HMW's as a springboard for new ideas, where I will use rapid brainstorming and scamper to come up with ideas.

Prioritizing ideas with impact effort matrix & criteria

Prioritizing ideas is described as a convergent step after having come up with various ideas, in order to choose the most suitable ones to move forward with for feedback Luchs, Swan & Griffins (2015). There are various ways this can be done, for example through evaluating them based on the criteria of feasibility, desirability and viability, clustering and voting (Langensand, 2018), and impact effort matrix (Sharron, 2014). The impact effort matrix helps identifying ideas, features or other things, to prioritize based on the impact it could make and the effort it would take to create it, through mapping it on "high impact low effort, or high effort", and "low impact high effort, or low effort".

Prototyping

Langensand (2018) describes prototyping as a method that can take an idea and bring it into form, so that users can experience and evaluate certain functions or solutions.

He empathizes that a prototype is not the final product, and just needs to be "good enough" to get feedback so that further changes can be made, which can be in various forms such as a paper storyboard to a programmed solution Preece, Rogers and Sharp (2019), and it can highlights certain parts and de-empathises others. The type of prototype can be chosen depending on the aim of the testing, for example, to understand how users would do something, if design supports the users goals or to explore ideas, a low fidelity paper prototype can be used, which is based on sketches that are hand-drown. In later stages of the product, high fidelity could be used. Luchs, Swan & Griffins (2015) writes that a prototype is also used to test assumptions that the designs have about the users, and get answers to questions, and that a prototype helps one to fail sooner, which saves time.

I plan to use sketching as a tool to create low-fidelity prototypes that will be used to test assumptions, explore features, and way of displaying and interacting with safety data. As the literature empathises, it will be used to test a certain part of the product in a quick way, and not for testing a completed product.

4.3 Methods under evaluate

4.3.1 Thinking out loud usability testing as a method for concept validation

Evaluations can be done in controlled or natural settings involving users, or in any settings not involving users (Preece, Sharp, & Rogers, 2019, Chapter 14). When testing with users in a qualitative way, the think-aloud method can be used to gather qualitative data about the users thoughts, concerns and expectations, through asking them to articulate their thoughts and what they are doing out loud verbally in words (Preece, Sharp, & Rogers, 2019, Chapter 15). As I am looking to gather qualitative data on the early concepts and to hear their thoughts and opinions, I plan to use qualitative usability testing with the think-aloud method. Interviews will be used as a way to gather additional information from the usability test (Preece, Sharp, & Rogers, 2019, Chapter 15).

The aspects I plan to test are: Which of the features that provide the most value for them, how it suits with their real life travelling and how they would use it, the the control, display and interaction with the safety data. As the focus of this thesis is from a design perspective rather than an engineering one, I will focus on the design while having the feasibility in mind. The plan is to test the feasibility through talking to a person with more technical knowledge, after having tested the solutions with the users.

4.3.2 *Affinity diagramming & prioritization methods*

To analyse the testing insights, the method of affinity diagramming can be used (Barnum, 2021), where findings are placed on post its, grouped, named and prioritized. Lucero (2015) describes it as a method for making large volumes of unstructured and diverse qualitative data more understandable and manageable by organizing and interpreting it in a coherent way. Barnum (2021) explains that the data can be analysed through predefined codes or categories as a to-down approach, or

through a bottom-up approach where the findings are grouped and named, or a combination. The findings can be displayed in various ways, such as reports, presentations, quotes or video clips Barnum (2021). I plan to use affinity diagramming in a combination of top down and bottom up approach, where I first approach the data with broad categories of interest, and then group them to create insights.

5 Design process / results

This section will explain the full design process, based on the methods and theory. While the methods chapter presented the methods I planned to use and why, this section describes what happened, how I used the methods, the practicalities, and the results of the methods. Similarly to the methods chapter, the process is presented under the phases of design thinking.

5.1 Discover

The literature review can be seen as the first part of the discovery phase, as I started to research the problem, existing similar applications, and the user needs. Since the literature review is presented, I will start the chapter with the interviews conducted with the users.

5.1.1 Interview procedure

The interviews were conducted with four women between the ages of 22-36. All of the women had experiences with travelling solo, in different ways. I was particularly looking for women with different types of solo-travel experiences, with a technological knowledge, to get a more nuanced picture of solo-travelling, which makes the sampling purposive, as I was looking for information-rich cases for the research aims (Bryman, 2016, Chapter 17). The sampling can also be called purposive, as I had a specific purpose for selecting the participants (Bryman, 2016, Chapter 17), being the varied solo-travel experiences of the women. The participants that were part of the interviews were: A woman that had travelled for a period alone in south east, asia, but did not prefer to travel alone in general, a woman that had travelled alone in shorter periods of time to various places in europe, as well as india, and had moved alone abroad to two countries, a woman that had travelled to many different continents such as africa, south america, and asia alone, preferred to travel alone, and had much experience in doing so, and a woman that had travelled alone in limited periods of time in europe.

A weakness of the research method is that it is not representative or generalizable to the whole population, due to both the small sample size, the qualitative nature, as well as the purposive sampling (Bryman, 2016, Chapter 17). A weakness of my sample is that all women were from Sweden, which does not allow for the differences of perspectives and experiences that a more varied sample would had given me.

The interviews were all conducted online through video-calls, and lasting between forty five minutes to an hour. The audio from the interviews were all recorded and transcribed to text. In the interviews, I was following the method of semi-structured interviews as planned, and I went through the topics I wanted to discuss. Although, there were many unexpected stories that participants told, which allowed for exploring more. Additionally, the participants were mentioning some of the topics of my interest areas in other places than expected, which made the interviews flexible.

The stories of the participants made me discover new topics, such as crisis situations which was not included in the interview protocol.

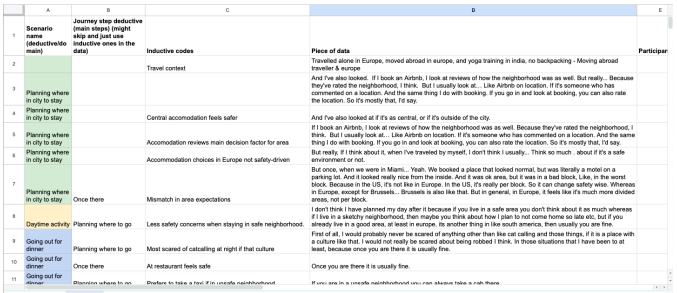
5.1.2 Interview analysis: Thematic analysis with journey mapping

The analysis of the interviews were for the larger part done as described under Chapter 5: Methods, through using the journey map for synthesising and organising data contextually (Luchs, Swan & Griffin, 2015) and thematic analysis (Braun & Clarke, 2006), for the full data set to create deeper findings and to enrich the journey maps.

The following text describes the steps taken, step by step, which led me to the findings.

Coding the transcriptions

After having read through all the interview transcripts, I started the coding process in Google docs, using the comments feature. As mentioned under methods, I coded the data with 2 purposes. The first purpose was to code the data with the names of the scenarios, and if clearly connected, to the main part of the scenario, that had been discussed in the interviews, to allow me to later organise the data that belonged to each scenario and main step, for the first round of analysis. The second purpose was to code all of the data, including the ones coded with the scenarios, inductively, meaning, I was coding the data with the meaning of what was said without applying any theoretical frameworks on it (Braun, 2016). It is important to mention, that even though I was looking for the data to guide me in the meaning making, I was biased from my research interest and literature review, as I had already decided on certain topics in the interview protocol, such as fear versus safety, the usage of navigation applications for safety, and perceptions on safety data for those applications, which, according to Braun & Clarkes description, could be connected to the “theory-driven approach”, where the researcher has interests of themes in mind from the literature. I placed all codes in a sheet, with their inductive code, scenario name and main step if used, the quote, and participant (see figure 1).

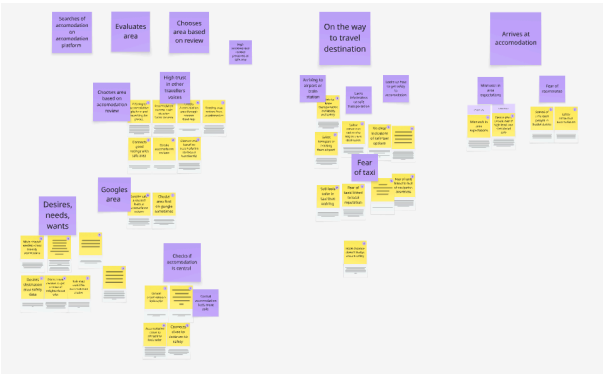


	A	B	C	D	E
1	**Scenario name (deductive/domain)**	**Journey step deductive (main steps) (might skip and just use inductive ones in the data)**	**Inductive codes**	**Piece of data**	**Participar**
2			Travel context	Travelled alone in Europe, moved abroad in europe, and yoga training in india, no backpacking - Moving abroad traveller & europe	
3	Planning where in city to stay			And I've also looked. If I book an Airbnb, I look at reviews of how the neighborhood was as well. But really... Because they've rated the neighborhood, I think. But I usually look at... Like Airbnb on location. If it's someone who has commented on a location. And the same thing I do with booking. If you go in and look at booking, you can also rate the location. So it's mostly that, I'd say.	
4	Planning where in city to stay		Central accomodation feels safer	And I've also looked at if it's as central, or if it's outside of the city.	
5	Planning where in city to stay		Accomodation reviews main decision factor for area	If I book an Airbnb, I look at reviews of how the neighborhood was as well. Because they've rated the neighborhood, I think. But I usually look at... Like Airbnb on location. If it's someone who has commented on a location. And the same thing I do with booking. If you go in and look at booking, you can also rate the location. So it's mostly that, I'd say.	
6	Planning where in city to stay		Accommodation choices in Europe not safety-driven	But really, If I think about it, when I've traveled by myself, I don't think I usually... Think so much .. about if it's a safe environment or not.	
7	Planning where in city to stay	Once there	Mismatch in area expectations	But once, when we were in Miami... Yeah. We booked a place that looked normal, but was literally a motel on a parking lot. And it looked really nice from the inside. And it was ok area, but it was in a bad block, Like, in the worst block. Because in the US, it's not like in Europe. In the US, it's really per block. So it can change safety wise. Whereas in Europe, except for Brussels... Brussels is also like that. But in general, in Europe, it feels like it's much more divided areas, not per block.	
8	Daytime activity	Planning where to go	Less safety concerns when staying in safe neighborhood.	I don't think I have planned my day after it because if you live in a safe area you don't think about it as much whereas if I live in a sketchy neighborhood, then maybe you think about how I plan to not come home so late etc, but if you already live in a good area, at least in europe, its another thing in like south america, then usually you are fine.	
9	Going out for dinner	Planning where to go	Most scared of catcalling at night if that culture	First of all, I would probably never be scared of anything other than like cat calling and those things, if it is a place with a culture like that. I would not really be scared about being robbed I think. In those situations that I have been to at least, because once you are there it is usually fine.	
10	Going out for dinner	Once there	At restaurant feels safe	Once you are there it is usually fine.	
11	Going out for	Planning where to go	Prefers to take a taxi if in unsafe neighborhood	If you are in a unsafe neighborhood you can always take a cab there.	

Figure 1 - Organisation of codes and data

Round 1 of analysis: Journey maps

The purpose of the first round of analysis was to organise the data from the scenarios into journey maps, with different layers of interests: “substeps”, “safety actions” “tools”, user insights, feelings, pain points and safety concerns, and wants and needs, which were based on the research questions and aims. I first created an empty template of the journey maps, with only the layer names listed. I then placed all the codes that were connected to a certain scenario together, as well as their inductive codes, under the empty journeys. For each code, I included the raw data and the participant number (Figure 2). Starting with the first scenario “planning where to stay”, I organised the codes in a timeline, through grouping them into main steps and substeps, and named them. I also grouped the data underneath the steps inductively, if there were any initial patterns identified, and named them (figure 3).



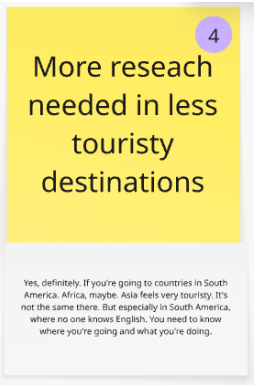


Figure 2 - One of the iterations for groupings for first scenario & Figure 3 - Codes with transcription and participant number

I then placed the themes where they belonged in the layers and steps they belonged of the map. If there were any data missing in a layer that was needed for understanding the full journey, I placed the codes belonging there from the data, which Luchs, Swan & Griffin (2015) highlights as a way to fill in important context. I marked the data that came from themes with stars, to indicate that the data came from a pattern, and to clearly see the limitations of the “thin” codes not coming from themes (figure 4). This was an iterative process, and I reorganised the groups and the steps in several rounds. At this step, the limitation of the journey maps were that the rest of the data had not been used, and the themes had not been created from across the data set, which Braun & Clarke (2016) highlights as important for the creation of themes in thematic analysis. Although, if I would have analysed the full data set from the start, I would have missed the important contextual and sequential information connected to the journeys.

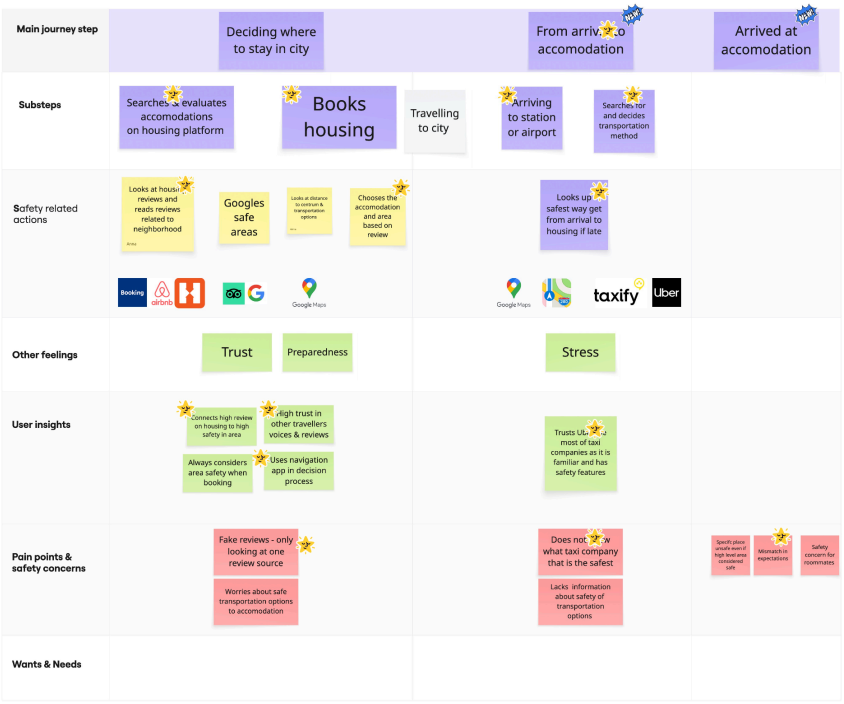


Figure 4 - first version of journey map 1: Deciding where to stay in city

I repeated this process for the rest of the journeys. Some differences between the journeys were that in the second and third journey, I had coded the data with the main steps brought up in the interview, to structure it in a logical way, while allowing for other main steps and all the inductive substeps. To indicate that a new "main" step that was data driven, I placed a sticker of "new". Another difference is the amount of data for each scenario. Scenario number 2: Daytime activity, had half of the amount of data than theme three "going out for dinner at night", which already there indicated that the participants had more to say about safety in the night. This lead the analysis to be "thinner" for the second journey, and for the third one to already at this stage have more inductive themes coming from the codes, and an analysis in more iterative steps (Figure 5).

Figure 5 - Analysis of data for journey map with grouping iterations & 3: Going out for dinner

Round 2 of analysis: Thematic analysis of full data set

For this round, I intended to follow the thematic analysis as the main steps described by Braun & Clarke (2006). I started with placing all the rest of the inductive codes from the sheet to the board, and all the codes from the journeys. As I had already identified themes earlier, I had these in mind naturally, while I still looked at the full data set again. I searched for patterns, grouped data together in themes, connected them with arrows, compared the themes with the raw data and the entire data set, named the and themes iteratively, as per Braun & Clarkes (2006) guidelines (see figure 6). I also used mind-maps, descriptions, and thematic maps (see figure 7) iteratively, which Braun & Clarke (2006) writes can help understand the full picture, connections, and the overall story. I did this for several iterations. Finally, I finalised the main themes, and organised them in four main overarching themes, with their subthemes, which are displayed in detail under results. The final themes helped me create a logical story in the report, as it was already considered throughout the analysis.

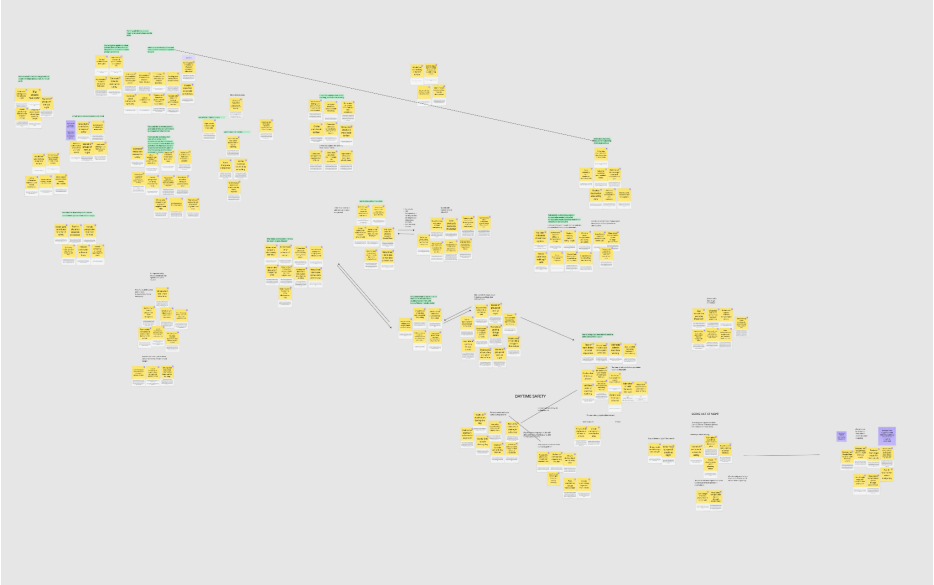


Figure 6 - thematic analysis of full data set

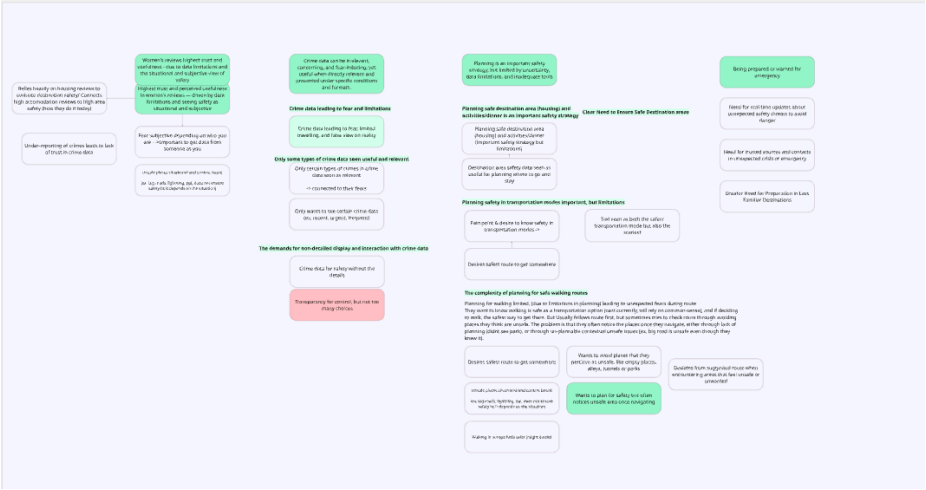


Figure 7 - Thematic map as a tool in the analysis process

Round 3 of analysis: Enriching journey maps with new insights

This part happened during the previous step, as well as after, where I revisited the journeys, now with a clearer pictures of the priorities and important parts of the data. As the participants had mentioned things that could be connected to a specific step, I could add things in the journey were they belonged. I also removed data that at this stage seemed irrelevant after having analysed the full data set. The final journey maps are presented under interview results: Journey maps.

5.1.3 Interview results

The results of the thematic analysis was three journey maps of the travel scenarios researched, enriched with data from the reflexive thematic analysis, and user insights in the form of main themes and subthemes from the reflexive thematic analysis, providing insights into the users journey and context, as well as deeper insights into attitudes about different topics. The following section will present the main themes created from the reflexive thematic analysis, followed by a description of the journey maps.

Results of reflexive thematic analysis

The outcome of the thematic analysis were 4 main overarching themes: “Highest trust and usefulness of women's reviews - due to data limitations and the situational and subjective view of safety”, “Crime data can be problematic and fear-indulging, unless directly relevant and presented under specific conditions and formats”, “Planning is a crucial safety strategy, but limited by uncertainty, data limitations, and inadequate tools”, and “Being prepared and warned for emergency”. The names of the themes were intentionally created in a descriptive way, creating an overview of the insights and making them actionable for the creation of opportunities and solutions. Each main theme consists of subthemes, each of them explaining a part of the theme and together creating a structured story. A visual presentation was created for the purpose of getting an overview of the themes and findings (see figure 8, appendix). One of the sub themes was used for two main themes, which is illustrated in the map.

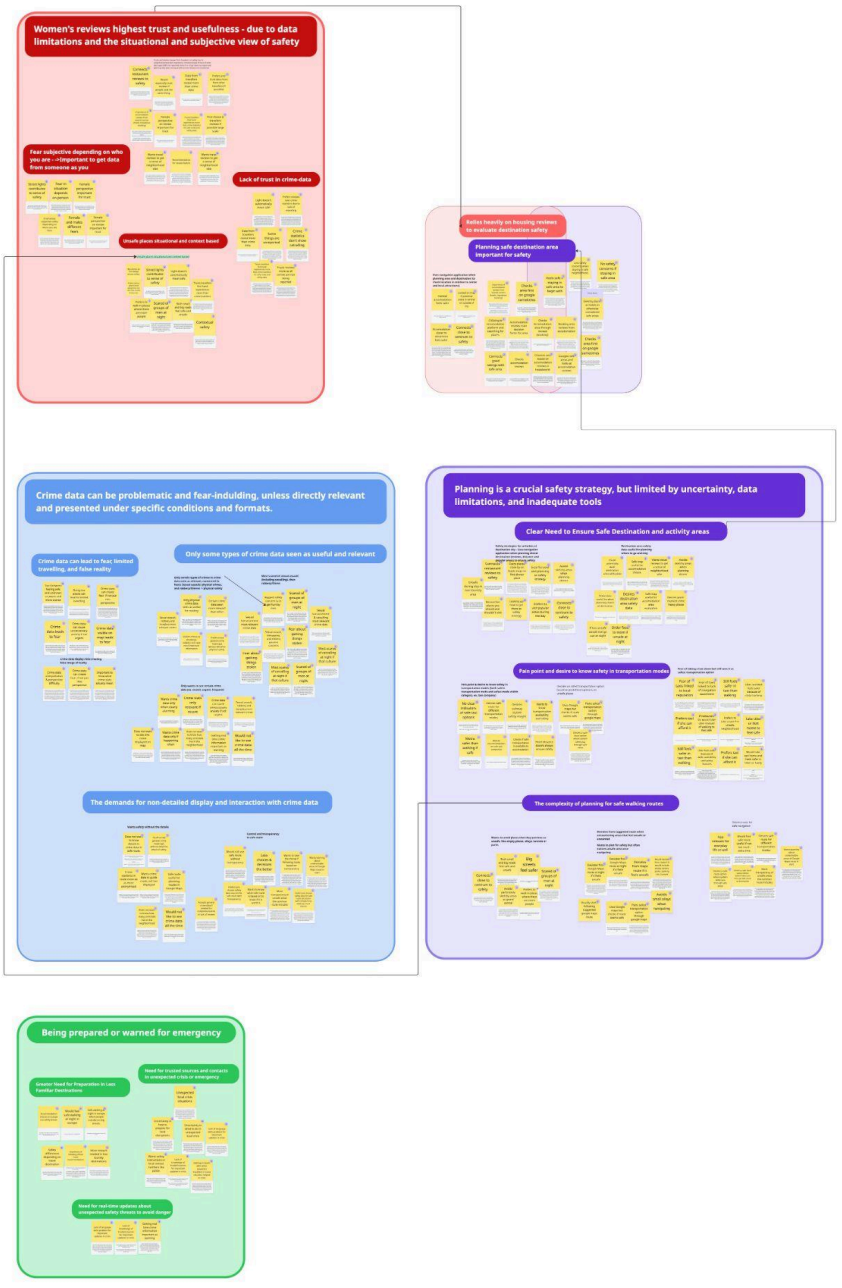


Figure 8: Presentation of themes

Theme 1: Womens reviews highest trust and usefulness - due to data limitations and the situational and subjective view of safety

This theme explains the preference, desire, and expressed need for safety data coming from real people, specifically women travellers. Across interviews, participants emphasized that reviews from other women were more trustworthy and useful than other forms of safety data. For example, when discussing different types of data that could be included in a navigation app to enhance safety, several participants said they would like to know what other solo female travellers had written about a place. One participant shared:

> "That's the first thing I would have thought about. What do other tourists write about these areas? I would have trusted that a lot if people would write the same thing."

This preference seemed linked to a lack of trust in crime data, for example, due to under-reporting of situations relevant to women, and to perceived limitations in other data, such as lighting or street size, which do not always reflect how safety is experienced in specific situations. Participants described safety as context-dependent and shaped by who you are. The theme was created through synthesising several subthemes: "relies heavily on housing reviews to evaluate destination safety," "fear subjective depending on who you are, important to get data from someone like you," "lack of trust in crime data," and "unsafe places situational and context based."

Relies heavily on housing reviews to evaluate safety

From the start of the interviews when discussing if and how users take safety into account when deciding where to stay in the travel destination, the users expressed a heavy reliability on reviews for safety, when deciding where to stay in travel destination. The users were deciding on the area simultaneously as booking their accommodation, through using the housing reviews as a way to evaluate safety and ensuring safety for both area as well as the actual accommodation. This can be seen as a sign of trust in other travellers' judgement. It also seemed like they were automatically connecting high reviews to high safety of the area. One user said:

> "If I book an Airbnb, I look at reviews of how the neighborhood was as well. Because they've rated the neighborhood, I think. But I usually look at Air bnb, if it's someone who has commented on a location. And the same thing I do with booking. If you go in and look at booking, you can also rate the location."

Fear subjective and depending on who you are

In several situations, the users expressed the importance of perspective. For example, a user expressed the importance of the app being created specifically for women as women and men have different fears, as well as the difference in perspective that a local person can have of a place versus a traveller. The common thread across these

reflections was that different identities bring different fears, but also different types of risk. As one participant expressed it:

> “Locals can be a bit home-blind. They might not see the problem in the same way. It's their world, in a way. In India, it was a bit rough. While the locals were like, this is... okay. Okay, but this is your world. I have a different point of view.”

Another user said:

> “But I would have wanted it to be created for women. From a female perspective. So that women can feel safe. Because we are afraid of completely different things than men are afraid of.”

Lack of trust in crime data:
Users expressed that reviews could reflect fears and safety threats that crime data could not. For example, the topic of catcalling was many times brought up as something making users uncomfortable, which is not reflected in crime data:

> “It's not a crime to catcall. It's not something that can be reflected in the data.”

The under-reporting of crimes was also expressed as a reason for trusting reviews more than crime data, saying that explaining that first hand-experiences reveal more than crime data sometimes can.

> “And crime statistics, even if that's also nice to know. I mean, all crimes, for example small crimes, or all crimes in general are not being reported. So it feels like first-hand experience is absolutely the most important thing.”

The users had several other concerns with crime data as the irrelevance of crime types relating to fears and threats of solo women travellers.

Unsafe places situational and context based
Participants expressed that certain characteristics, such as lighting, the number of people present, or wide roads, could contribute to feeling safe, but also that this didn't apply to all situations. For example, some participants said they feel safer when there are more people, but not if those people are only men. Another said that while lighting is nice it doesn’t necessarily mean a place is safe. One participant explained how big roads or residential areas can feel safe in one moment, and unsafe in another, leading them to change their route depending on the feeling in the situation:

> “Sometimes the big streets are sketchy, but before the big streets there are totally okay residential areas that are safe, for example. And sometimes it's

> the other way around. That it's the small streets that are sketchy, and then it's okay on the roads."

This theme may help explain why participants expressed a strong preference for human reviews. Data points like street size or number of people didn't always reflect how safe a place actually felt. In contrast, reviews, which many participants preferred, could show whether a woman traveller had experienced a place as safe or unsafe.

Theme 2: Crime data can be problematic and fear-indulging, unless directly relevant and presented under specific conditions and formats.

The theme explains the users attitudes and perceived usefulness of crime-data in navigation applications for safety, which users could see as both useful and problematic, depending on how, and which data was displayed. The participants were torn between being aware of risks to avoid unsafe areas, and being unaware to avoid unnecessary fear, or even getting a false view of reality if data was not being put into perspective. The theme consists of the subthemes "crime data leading to fear, limited travelling, and false reality", "only some types of crime data seen as useful and relevant", & "the demands for non-detailed display and interaction with crime data".

Crime data leading to fear, limited travelling and false reality

Participants expressed the risk of crime data causing unnecessary fear, anxiety and other negative feelings, as one participant put it:

> "I think I wouldn't want to know if, like, there was, like, one rape. Like, I wouldn't want to know that, because it gives you anxiety. And if it happened, like, once a year ago, then I don't know if I would like to know that."

Another participant said:

> "Because I don't think I would have liked to know... What kind of data, crime statistics and what kind of crime. You get it, it could be really awful things. You don't want to know like there are this many sex offenders living here."

While recognizing the positives of being aware, users brought up the crime data creating limited travelling:

> "Actually… I think it's good to be aware. But I think it can also contribute to the fact that you don't go there."

Several users expressed uncertainty is almost better than causing negative feelings.

> "But I personally don't want to have it. Because I feel like I would become obsessed with it. So it's almost better to live in uncertainty sometimes."

Another concern raised by participants was that crime data could create a misleading or exaggerated sense of danger if not presented with proper context. The absence of comparison, such as how one area's statistics relate to others in the same city or country, can make it difficult to assess what it actually means. One participant said:

> "Let's say I look up an area and it shows high crime statistics. Maybe that's actually low compared to other areas, but if you look at it like that, it might look like a lot. You don't know if it's high or low for that area or for the country. So I might think, 'There's a lot going on here, so it's not safe.' It can have a negative effect."

Only some types of crime data types seen as useful and relevant

Participants expressed that crime data would only be useful if it related directly to their fears and if the crimes were urgent, frequent, or recent. These fears were largely centered around the risk of being harmed by men and crimes threatening physical safety, such as rape, sexual harassment, shootings, kidnapping, or robbery. Catcalling was also mentioned several times. One participant explained:

> "But it also depends on what kind of data you're using. It's not necessary to include data about tax evasion, for example. It has to be data related to a person's physical safety. Regardless of whether it's robbery or rape or whatever."

Additionally users only saw crime data useful if it had happened recently, was occurring frequently, or was clearly alarming:

> "If there was, like, a rate showing that robberies were happening every other day in a neighborhood, then I'd want to know. But if it's something that happens just once a month, then I don't think it's very relevant information."

> "So it can have a negative effect. Yes. So maybe it's unnecessary unless it's super high. Then maybe you should know because you should avoid it."

The demands for non-detailed display and interaction preference with crime data

A common theme within the negative expressions about crime data was centered around the desire to not wanting to be too involved in the details of crime data, to avoid evoking negative emotions. Participants did not want to know specific crimes having occurred, preferred crime data to be more anonymous, and did not want to know how many criminals were living in a certain area, even if they wanted to know what safe routes were based on and wanted to understand if a neighborhood was safe or not to stay in. Users want crime data to guide without being too displayed or raw:

> “Interviewer: Okay. But how would you say that you're more okay with it when it comes to a route?[Speaker 1] Well, it's like it's anonymized. It's not like... It's not like, in this area, all of these horrible things happen.”

Another user said:

> “Actually, on a heatmap and such, it can also be... It could be okay if they're like generally displaying that it is unsafe for your physical health. It can be fine as long as they don't say what it is.”

When it comes to interacting with safety data, participants expressed a need for both transparency and some control, without having to take too many decisions and choices. They wanted to ensure the data was relevant to them and trustworthy, but they appreciated if the system could calculate a safe route automatically, but they still wanted to understand what the decision was based on in order to take a final decision. This can be seen as contradictory as they do not want to know the details but still want to know that it is based on relevant data.

Theme 3: Planning is a crucial safety strategy, but limited by uncertainty, data limitations, and inadequate tools

Planning to ensure safe destinations to stay and for their travel activities, as well as the safest way to get there, is highly important for users, which is shown both through themes reflecting current planning practices and needs for better ways. Users use different strategies for planning to ensure safety, although their methods have limitations, and there are perceived gaps both when it comes to the data available, and the tools or features to support their planning. The subthemes synthesised are “Clear need to ensure safe destination and activity locations”, “Pain point and desire to know safety in transportation modes”, and “The complexity of planning for safe walking routes”.

Clear need to plan safe destination and activity areas

The previous subtheme “Relying on reviews to plan for accommodation” highlights a strong need to ensure that both accommodation and its surrounding area feel safe. Participants primarily relied on reviews from housing platforms to assess this, but often combined them with other strategies such as checking the distance to the city center in Google Maps or doing general online searches. However, relying on a single source of information sometimes led to situations where safety expectations didn’t match reality:

> “After I made that mistake in India, I only read up on Booking.com then, but then it turned out to be a scam. I arrived and it was the worst hotel I've ever stayed in.” Interviewer: “What would you have done differently the next time to feel safe?” User: “When I am going back to India in December, I will read up on Booking.com, Hotels, and Google. To make sure that I am correct.”

Beyond accommodation, participants also put effort into planning the places they would visit, during their trip. They described trying to identify safe areas for activities, such as choosing restaurants close to the hotel, visiting only popular destinations during the day, or in some cases not going out at all at night. They used Google Maps to search for nearby places, read restaurant reviews, or sometimes tried to check unfamiliar areas in advance.

This shows that participants tried to plan for safety using the tools available to them in the best way they could. However, this often led to cautious decisions or restricted movement. Several participants expressed a need for better ways to understand the safety of areas when planning mainly accommodation as well as activities.

Pain point and desire to know safety in transportation modes

A pattern in the data was the pain point of not knowing what transportation option that was safe, which was brought up in several situations such as when having to transport to the accommodation from the airport or train station, which could at times be at uncomfortable. This was also a big part of the planning and decision making process for both choosing accommodation and places to visit, as being able to get to, and back from a destination, or housing in a safe way determines whether the user would go there or not. Current strategies to understand safety was to look at the route in google maps and check if metro is close to housing, or sticking to safe choices such as Uber when transporting.

Users expressed that the safest transportation form was Uber or other famous taxi applications, due to the familiarity and safety features of the app, and because of an uncertainty of what other taxi companies that are considered safe. Even though this was considered the safest option, it also involved a lot of fears, travelling alone with a stranger. Users often chose a taxi due to uncertainty of whether other transportation methods are safe, even if they would prefer to walk, rent a bike or take the metro. One user expressed that she knows that certain metro stations can be unsafe, and that it would be useful to get knowledge about this:

> "You could also put it on, for example, subway stations, subway lines. Some lines in Paris have such high crime statistics, so I mean, I might also had liked to point-mark some places that are specifically crime heavy."

Besides the need for more clarity in the safety of transportation modes, the users also expressed a need to know the safest route to get there for a specific transportation mode, mainly walking, but also biking.

The complexity of planning for safe walking routes

Walking was considered a challenging transportation mode to plan around in terms of safety. While participants clearly wanted to ensure that walking was a safe option, and to know the safest way to reach a destination on foot, they often lacked the tools or information to support this. Most relied on intuition — judging whether walking was

safe based on the area they were staying in and the time of day. They typically followed the default route suggested by Google Maps, occasionally checking the path in advance to avoid parks, empty streets, tunnels, or other areas they perceived as unsafe.

A common issue was that participants often noticed unsafe areas only once they were already navigating, leading them to deviate from the route in search of a safer alternative.This could be due to limited planning (e.g. not noticing a park on the map), but also due to unplannable, context-specific factors, for example, a street that looked safe might suddenly feel unsafe due to poor lighting or the presence of a group of men.

> "I follow the route, but then if it gets to the point where it's sketchy, then maybe I just have to order a taxi in the middle of the route. Or if I notice that it's sketchy, then I check. Once I checked if there were small streets close by, when I was at a very sketchy big road. So it is like you are using the map like that."

Participants expressed a need to better understand which walking routes were safe in advance, highlighting a gap in current tools for planning safe pedestrian travel.

Theme 4: Being prepared or warned for emergency:
This theme was constructed mainly based on input from a participant with experience travelling in unfamiliar and distant locations, who described a local emergency and the challenges it involved. Although such situations may be rare, they were perceived as risky and uncertain, particularly for a solo traveller, making it relevant for understanding the user groups specific safety needs in high-stress or emergency contexts, that a navigation application could potentially support. The subthemes synthesised are: "Need for trusted sources and contacts in crisis or emergency", "Need for real-time updates about safety threats to avoid danger", and "Greater need for preparation in less familiar areas".

Need for trusted sources or contacts in unexpected crisis and emergency
The theme explains the need of being certain in what sources or where to look to get reliable, updated and understandable language wise- information in a situation of emergency, as well as knowing who to reach out to when in danger or crisis. A participant explained this would make her feel more safe in general, knowing that she was prepared. Another participant mentioned:

> "But when I was in Peru, I was stuck there. I couldn't go home because there was a demonstration. So they started to fire on the streets. They tore up train tracks and stormed airports. It was a revolution. But then I was there myself. And I was like, this is not good. I don't know how long I will be there."

> “I tried my best to find reliable sources. But the second problem was that the information was in Spanish.”

Need for real-time updates about safety threats to avoid danger

The need for getting access to reliable sources and numbers also points towards getting real time updates on what it happening, that they can trust. One participant explained that she had been warned about a shooting recently happening in a bar from a taxi driver, preventing her to go there, which she had found useful. This highlights the importance of not just using safety data statically for planning but also for helping users staying aware and updated.

Greater need for safety considerations in less familiar areas

Particiapnts mentioned that they were taking lass safety considerations and actions in more familiar areas or countries, like in europe, than more unfamiliar ones. For example, they felt more comfortable walking at night in europe. The more experienced traveller also highlighted the importance of doing your research or following travel recommendations when going to a country less familiar.

> “But especially in South America, where no one knows English. You need to know where you're going and what you're doing.”

Travel journey maps

The following section shows the final journey maps with the added insights from the thematic analysis. While the themes provide deeper explanations and conceptual insights, the journey maps help identify when and where participants encounter challenges or have specific needs, including situational details that may not form full themes but are still highly relevant for design. They also support understanding of in what situations a safety-related tool could assist, helping to ground design opportunities in the real-life context of solo travel.

The images of the journey map shows all the data included, but brief descriptions of them, and their connections to the thematic analysis themes follow below.

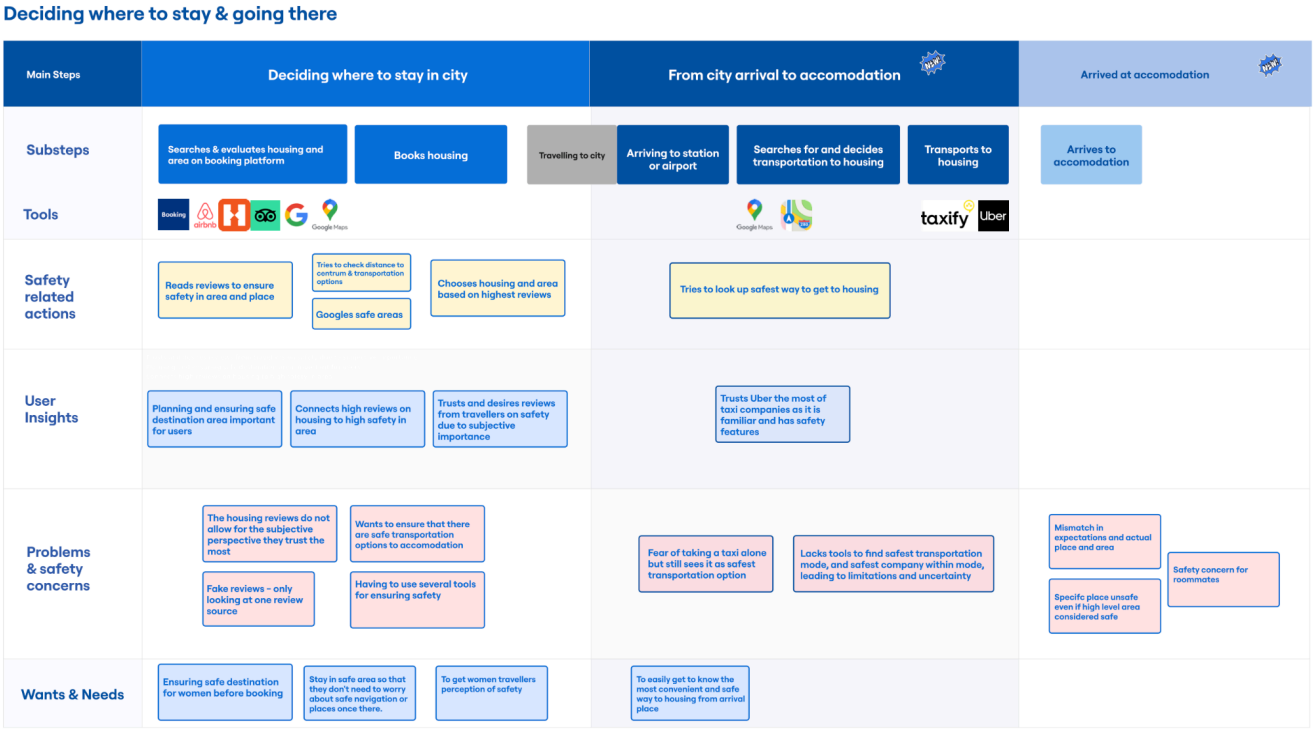


Figure 9 - journey 1

Scenario 1: Deciding where to stay and going there.

The scenario starts with that the user already has decided on the country and the city, and now they need to decide specific area to stay in the city. The users main steps of the scenario are: Deciding where to stay in city, which was the original scenario, with the added inductive steps, "from city arrival to accommodation" and "arrived at accommodation" (Figure 9) The Journey starts with the user planning and ensuring the destination area is safe, through searching and evaluating housing and areas on booking platforms, googling areas, tries to check distance of accomodation to center, and then choosing the housing based on the highest reviews. As in the first theme of the TA, the users rely heavily on general reviews of housing, as well as the reviews for neighborhood, and they trust these reviews as they are from travellers. The main concerns for this step is are having to use several tools to ensure safety, lack of subjective perspective of women, fake reviews, and lack of understanding safe transportation options, and their needs are to ensure that the destination is safe for women, ensuring they stay in a safe area so they don't need to worry about safe navigation or places there. The second step, arriving to destination, is centered around their need of trying to find the best and safest transportation option to their housing, as they might arrive to the airport or train station late, and are in a new place. This is connected to the pain point of lack of tools for looking up the safest navigation option, and the safest company within an option, such as taxi companies, and they end up

taking an uber, even though they have many fears around taxis. They then transports to their housing, where they sometimes feel that their expectations don't match reality. Other issues are that a specific place within a considered safe area can still feel unsafe, and worry about their roommates if they stay at a hostel.

Scenario 2: Travel daytime activity

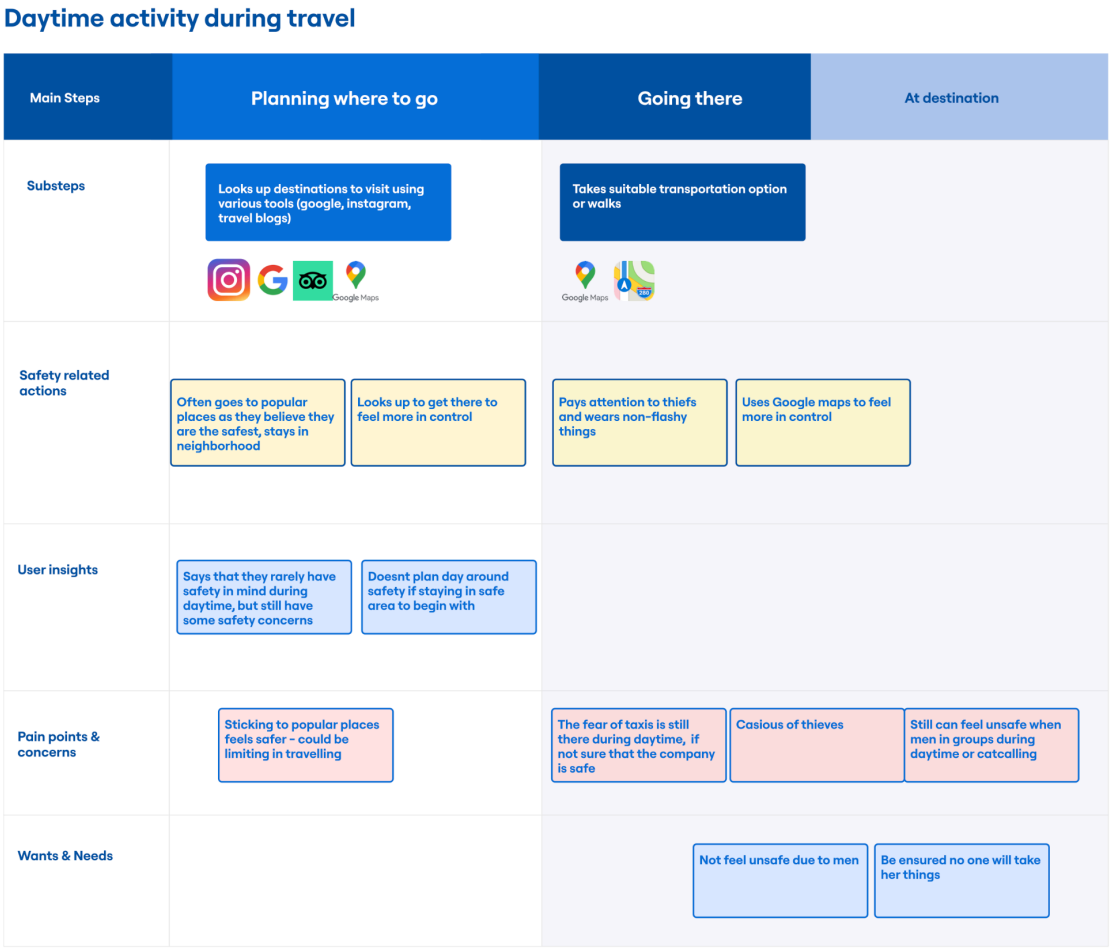


Figure 10 - journey 2

The second scenario, going for a daytime activity (figure 10), consists of the steps planning where to go, going there, and at destination, which was some of the phases asked about in the interviews for the scenarios. The participants did not have much to say about safety during day time when it was brought up, but data from other stories

and discussions still revealed they had safety concerns during the day, which they might not even be aware of. The first step they did was looking up the destination to visit using various tools such as google, instagram or travel blogs, and looked up how to get there using google maps. A theme from the data was that they often were sticking to the most popular places to ensure safety, which could be seen as limiting their travelling. They then take the suitable transportation option or walks, use google maps to feel more in control, and look out for thieves as a safety strategy. The biggest fears during daytime are to feel uncomfortable because of men for example because of catcalling, and they especially want to avoid men in groups.The fear of taxis are still present during daytime as well. It is worth mentioning that a difference between the participants was that those travelling to more unfamiliar places or other continents were more cautious in the daytime compared to those travelling in europe.

Scenario 3: Going out for dinner at night

Figure 11 - Journey 3

The main steps of the scenario of going for dinner (figure 11) were planning where to go, planning how to get there, going there, once there, and on the way back, with all steps except for at the restaurant, involving fears and concerns. The users starts with

searching for restaurants that are close to their accommodation, as they are unsure of if it is safe to navigate outside. If she is too unsure of the safety, she chooses to stay at home. She then plans how to get there in the safest way, which is an important step in the journey. Sometimes she checks the route on google maps to see if it includes places she considers as unsafe such as parks, but mostly relies on feeling when deciding to walk or not. This often limits her to take a taxi because of lack of information, even though she would prefer to walk or take the metro. If she chooses to walk, a pain point is to feel unsafe because of something contextual or a place considered as unsafe that she wanted to avoid from the start, and having to find another route. Her biggest fears are sexual harassment and crimes for her physical health.

5.2 Define

In the define phase, I synthesised the insights from the thematic analysis and journey maps further, with the aim of formulating a focused design point of view. This step helped narrow down the problem and clarify what the solution should address. Furthermore, HMW's were created to explore different solution areas across journeys, which were then prioritized to converge the focus again.

5.2.1 POV formulation

Although synthesis occurred throughout the analysis process, including while revisiting the journey maps through the lens of the TA themes, I compared the findings more deliberately to uncover cross-cutting patterns. What stood out was a recurring tension: at nearly every point in the travel journey where a pain point or safety need was identified, participants were trying to make informed, confident safety decisions, but lacked access to tools or information that felt trustworthy, context-sensitive, and relevant to them as solo female travellers.

This often resulted in two main outcomes: either they restricted their freedom of movement to avoid potential risk, for example by staying in, always booking Ubers, or only visiting popular areas, or they took uncertain actions that led to stress or fear. While these outcomes were sometimes based on deliberate caution, they often stemmed from having to rely on insufficient personal strategies like scanning reviews, checking Google Maps, or relying on intuition. Some participants even described a sense of confidence when using reviews, which later turned out to be misleading , showing the need for safety information that is not just perceived as trustworthy, but actually reliable.

This was leading to the formulation of a POV, that was summarizing the core design tension across the journey.

Point of view:

"A solo female traveller needs to make confident and informed safety decisions based on information that is trustworthy, relevant, and non-fear-inducing, because current

tools and strategies offer limited or unreliable support, which can lead her to restrict herself to stay safe or make uninformed or risky choices."

5.2.2 Design guidelines

Before starting the ideation, I read through the design guidelines from the literature review, as well as the findings, and quickly summarized some of the main points to consider in the ideas, in Miro (See appendix).

5.2.3 HMW's, ideate and sketching

With the main POV in mind, I approached the journey maps again as a "springboard for innovation", and to where in the journey that there are rooms for opportunities. I would also be able to see what specific use-cases I could focus on to cover, and what situations I could design for (Luchs, Swan & Griffin, 2015).

I went through the journey from the start, and connected pain points to design opportunities through framing HMW's. As the situations and pain points were quite specific, and as I already had much user data around it, the HMW's were more specific than normally and served as a way for me to start to create ideas. Then I connected the HMW's to ideas, which I placed with a post in a different color (figure 12).

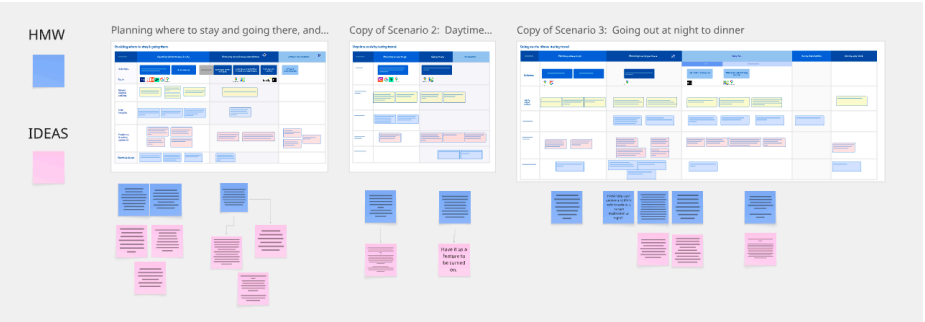


Figure 12 - opportunity identification

I also created HMW's connected to the main insights from the TA, that were important to consider non dependent of the journey (figure 13).

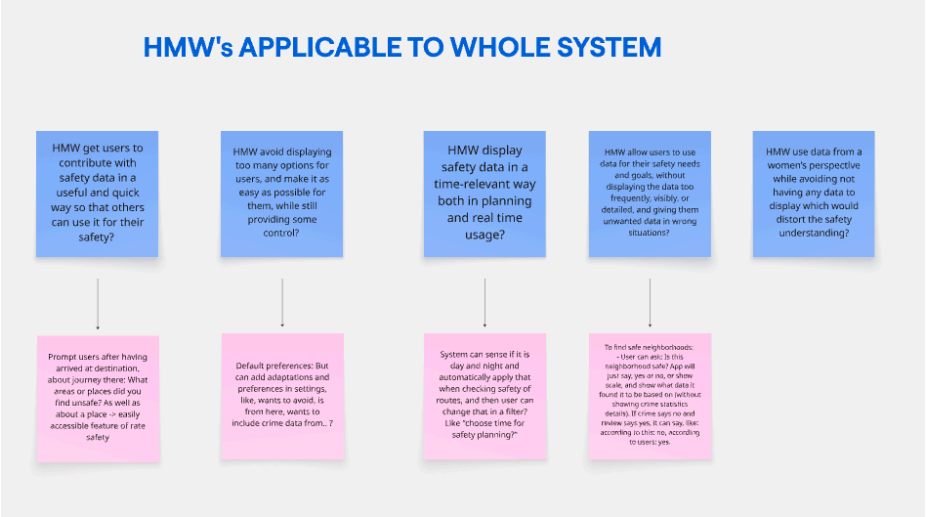


Figure 13 - HMW applicable to whole system

For the second round, I started grouping the HMW's together, to see if there were any main themes, and make it easier to prioritize. I understood that there were three main opportunity areas to explore, and how they were connected (figure 14). The main themes were "Understanding and being confident in safe destinations on map for various use cases and scenarios", where three situations of the journey were included: Understanding safe areas to stay in, understanding safe areas to explore in the city, and understanding safe areas at night", the second group of "Contributing with safety data, filtering and displaying safety data in relevant way", and the third:

Figure 14 - grouped HMW's

I chose the first group to explore, and formulated the final HMW: HMW create more freedom and confidence to visit different destinations in the city during day and night, so that she doesn't have to limit herself or take risky decisions?

I broke down what it meant to take a confident choice, in 2 steps: 1. Understand that the destination is safe, and 2. Understand that they can get to the destination safely. This showed the connections of the map display and route feature to solve the user problem. I chose to not focus on the route part of the solution, but still involving it in the structure. I also chose to not actively focus on the first situation of the solution, to helping them take decisions in finding an area to book an accommodation in for this prototype, although I also wanted to explore whether it could still be done, even if focusing on the other 2

Ideation and sketching

After having chosen the HMW and focus area, I revisited the summarised findings and the design guidelines from the literature review. I started brainstorming ideas through sketching on paper, (figure 15) while I was also brainstorming what parts of the product idea that I wanted to test with the users. I then voted on the sketches that were the most promising.

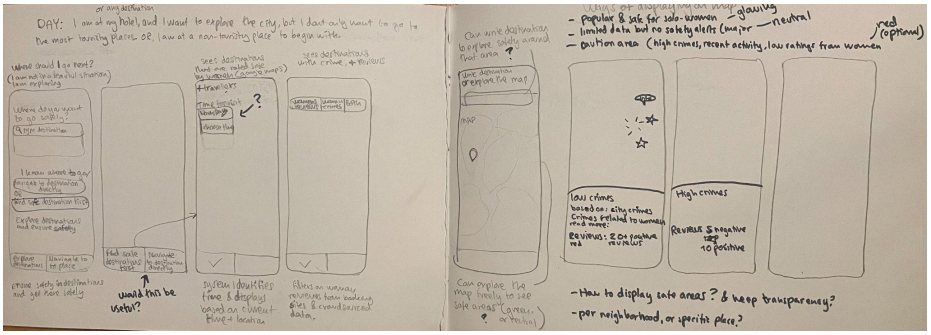


Figure 15 - sketches and ideation

5.4 Prototype & test

In this section, I will go through the chosen sketches, what they include as a concept, and what I intend to test with them. The sketches produced were a type of low fidelity prototyping of the main parts of the concepts. This is the first type of prototype that will be used for testing, to follow the principles of human centered design and design thinking of involving users often and early, without having spent too much time on finalising details. I will use the prototypes for concept testing with the think-out loud method, with participants from the chosen user group. I intend to analyse the data through affinity diagramming as presented under methods. Other input identified as useful for this stage to move the concept forward is to get feedback on the technical feasibility of certain aspects of the prototype, such as the ideas for data usage and display. As identified in the literature, the way the data can be used, also determines how the app can be designed, the possibilities and limitations.

The chosen design concept for testing

The concept created is a navigation application for the following flow (figure 16):

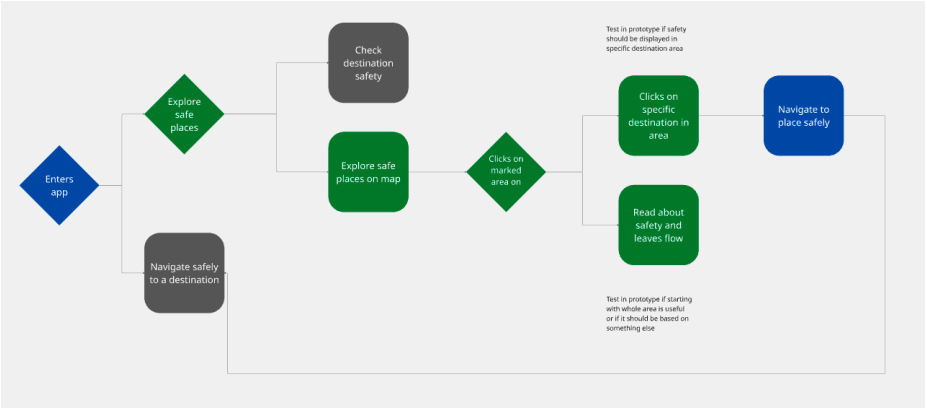


Figure 16: User flow of concept

It allows for two choices, to navigate to a destination safely, or to explore and check safe areas. The design is created for the latter, and is displayed in green in the user flow. The user gets to a map view and can see safety displayed on the map, only for the areas that are safe (no reviews, low crime, and high reviews low crime), based on the safety categories created for the idea (figure 17): The idea is that women-relevant the safety data will always be used a base for objective safety risk, while the reviews will be added as an extra layer to empathise if a place is verified by women or perceived as unsafe, in order to take both perceived and objective safety into account. The user can choose if they want the safe areas to be displayed or unsafe areas, and the sketches represent several versions (Figure 18 & 19).

Reviews/ rating	Low crime	Medium - high crime
Positive reviews	Safe & verified Show on map	High crime risk - but feels safe Not on map
Negative reviews	low crime risk - but feels unsafe -> Risks Not on map	High crime risk, neg reviews - Avoid Not on map
No reviews	Low crime risk, no reviews Neutral/ok Show on map	High crime risk, no reviews -> Risk area Not on map

Figure 17: Safety categories

The user can then select the time, which is by default the current time. When changing the time the safety is displayed for that time. Crime data is based on the criteria from users of only basing it on frequency and relevant crimes. Currently, the user can interact with a larger part of the area first, to see what the safety is based on, ex. what the crime data is based on, and where the women-reviews come from. In the tests I will explore if they would like to select smaller areas of the map and how safety could be shown on the map for that. They can then choose to see more details of both data types, which will be tested, From here, they can either click on “find safe navigation option” to see how to get there safely, or they can leave the flow and choose to visit that area. An additional feature is the display of real-time crime data, which would always be shown on the map if it is particularly relevant for the user.

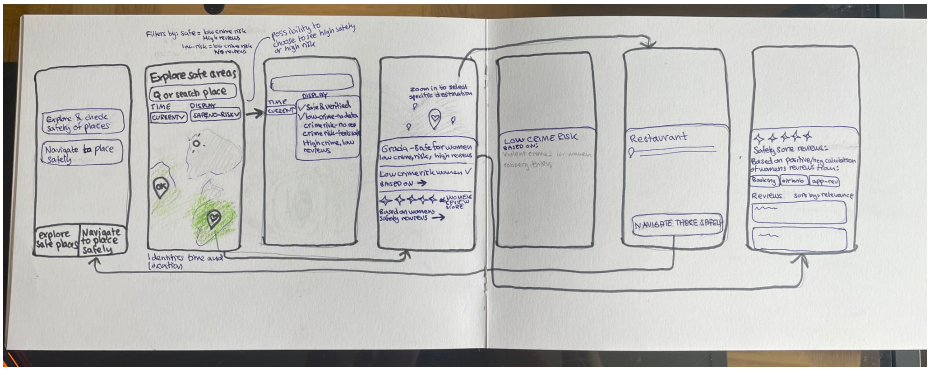


Figure 18 - Concept flow

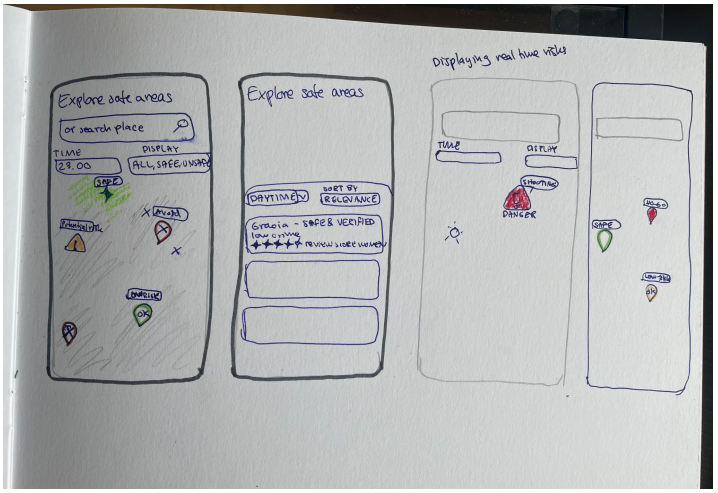


FIgure 19 - Concept screens: Displaying safety data

Testing goals:
The chosen testing aim was formulated for the sketches that were chosen:

"To understand how women want to explore safe areas or destination in the travel destination city during day and night-time"

1.Test the set of features and structure:

- How would they use the concept in searching and choosing places during the day and night?
- Would the flow support them in feeling confident in visiting a place?
- Does the flow make sense for them in achieving the goal?
- Could this be used in finding a safe area for accomodation as well?

2.Data types, presentation of crime data and human generated-reviews data, transparency and control:

- How do they want to see the way safety is based on: Women-relevant crime data as a base, and women created reviews from different sources to empathise safety or risks, and to provide more details, and a review score.
- How do they perceive the categories created for filtering safety?
- How do they prefer to see the unsafe and safe areas displayed? Filtered by safe areas, or including the unsafe areas?
- How would they want to see this on the map to not create more fear?
- How would they like to interact with the safety data, and what level of detail and transparency do they need?
- How would they like to see the real time risk data?
- What do they think of the level of control?

6 Discussion & conclusion

6.1 Answer to research questions

RQ 1.What safety concerns, needs, and strategies do solo female travelers have, in different stages of their travel journeys?

The results of the interviews from the thematic analysis and journey maps show the various types of safety concerns, needs and strategies throughout their travel journeys, already from planning where to stay, as well as navigating during the day and night, with especially high concerns during the night. The theme 3 of the thematic analysis “Planning is a crucial safety strategy, but limited by uncertainty, data limitations, and inadequate tools” as well as the formulation of the POV, showed that the need for planning for safety, both before, and in actions, and to be confident in their decisions they make, was one of the biggest needs in various stages of the travel journey, both when it came to planning for a safe area and accommodation, as well as the need for being confident in safe transportation modes and visiting safe areas. The safety fears around behind these were mainly being harmed by men in various ways, including sexual harassment and physical crimes, as well as stealing. Some of the strategies used for fulfilling these goals were to rely on reviews from the accommodation platforms and google to understand areas, and using navigation platforms in the best way they could with the limited support. This often lead them to limit themselves, as only visiting popular places, taking ubers and staying inside, or taking risky decisions causing stress or fear.

2. What types of safety-related data are considered valuable and useful by solo female travellers to support them in feeling safe, and in what situations?

From the semi-structured interviews, it became clear that users found human-created data, from individuals similar to them, preferably women travellers that they could relate to, the most trustworthy, useful and relevant. This is described by the large pattern of the data, which was created into the theme “Womens reviews highest trust and usefulness - due to data limitations and the situational and subjective view of safety “. The theme first connects the reason for their trust to their situational view of safety, which is referring to the participants bringing up the difference that a place can have in safety depending on the situation, which was seen as a weakness of environmental data like lights and crowds, as they do not ensure safety without the

surrounding situation. The other connection made to their subjective view of safety, is related to the participants empathising fear and risks being different for women and men, and different people, which makes them more relevant and trustworthy than for example crime data, as they can capture things that the crime data either miss, like crimes not being reported, as well as only showing the information relevant to them as women. Both of these reasons are interestingly highly connected to previous literature of perceived safety being identity and context based, as Williams, Cooper & Dew (2023) describe as "identity-situated". Even through the participants saw the user-generated the most valuable, they highlighted that they would see crime-data as useful to help them stay safe and avoid real danger, if it was created in a way that suited their needs.

3. What are the most important safety features for solo female travellers to feel safe yet not scared, and how can safety data be used for these in a relevant, useful and desirable way?

This question can be answered through what the participants actually said in the interviews, and through the opportunity areas identified in the journey maps based on their safety actions, needs, and concerns. When it comes to what they said in the context of a safe navigation application, the participants expressed a desire for seeing safe areas to navigate in and to choose an accomodation in, reading other womens safety reviews to support safety, and having a safe route option. Another suggestion was to be warned about where the initial route would take you.

Analysing the user journeys and the thematic analysis data, some important safety features that can be connected to the insights are tools for planning that support confident decision making, both in advance, and adjusted to the changing, unexpected and flexible nature of travelling. For example features for finding a safe area to stay and visit in the destinations, features that help them plan for the safest transportation option, and safe-routes that are based on the specific needs of them as solo women travellers. Other features that could be seen as important are features for crisis situations, like trustworthy sources and contacts.

4. How should safety data be visualized and communicated to support the travelers safety needs (in their different steps of their journey?), without increasing fear?

The thematic analysis results show that the users would like crime data to be used for guiding, without being too visualised or detailed, as that could be seen as fear-indulging or problematic. This can be connected to the perceived safety being affected by the way the risk is communicated (Karl & Schmude, 2017). Additionally they brought up the need for the data to be shown and communicated only if highly relevant, urgent, or frequent, and only in situations where they would need it, as they did not see the need of seeing the data all the time. The users preferred to not having to take all the choices by themselves, while they wanted the system to be transparent about what data sources that had been used for displaying safety, and allowing for some control for final decisions. When it comes to woman-generated reviews, they were more open for the presentation of it, and did not have as many concerns with the display of it.

6.2 Value and future work

The study and results brought up several relevant and important topics of modern safety applications, through the lens of solo-women travellers perspective, and in connection to previous literature around perceived safety and travelling, that can be useful for both the creation of travel apps as well as navigation apps. Some examples are the human perspective on data types used and the way the display, control, and

transparency matters to users and their safety perceptions and overall experiences when moving around, and the connection to the topics of situational and identity related risks and safety. These insights can be used as a starting point for guidelines to consider when designing safe navigation applications for women, and as topics to be further explored in more detail. Insights about the different concerns and needs in the journey can be used to further identify new innovative opportunities for solo-women travellers, and the other identified design opportunities in the journey. Future research can also explore various ways of exploring safety data in map and location based applications, and test them against operationalised perceived-safety criteria. The theme of “crisis” is another topic that can be explored in itself in more depth, which this study did not cover in the solution space. Moving forward, the application concept could be used as a standalone app, or certain features could be used in existing navigation applications to enhance safety for women, or to be used in travel related organisations.

The study and its findings highlighted several relevant and important topics in the design of modern safety applications, viewed through the lens of solo female travelers and connected to existing literature on perceived safety and travel. These insights are valuable for the development of both travel and navigation apps.

For example, the human perspective on data types, and how display, control, and transparency affect users' safety perceptions and overall experience when navigating, as key considerations. The study also underscored the importance of addressing situational and identity-related safety risks.

These findings can serve as a foundation for design guidelines aimed at creating safer navigation experiences for women, as well as areas for further exploration. Insights into the different concerns and needs across the travel journey can inspire new, innovative features tailored to solo female travelers and support the development of the identified design opportunities.

Future research could investigate how safety data is presented in map-based applications and evaluate different approaches using operationalized perceived-safety criteria. Additionally, the theme of "crisis"—which was not explored in the solution space of this study—offers a promising direction for future investigation.

The application concept developed in this project could either function as a standalone app or be integrated into existing navigation tools to enhance safety for women. It may also offer value to travel-related services and organizations.

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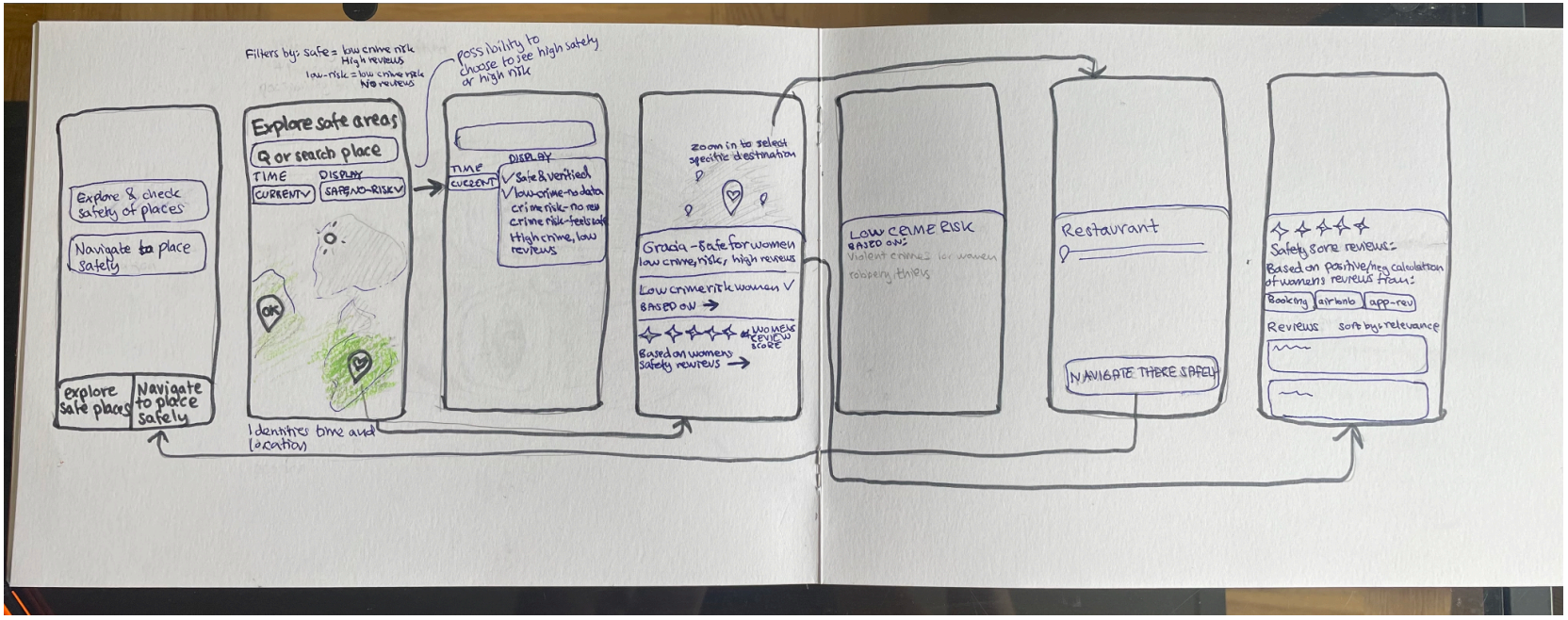
Appendixes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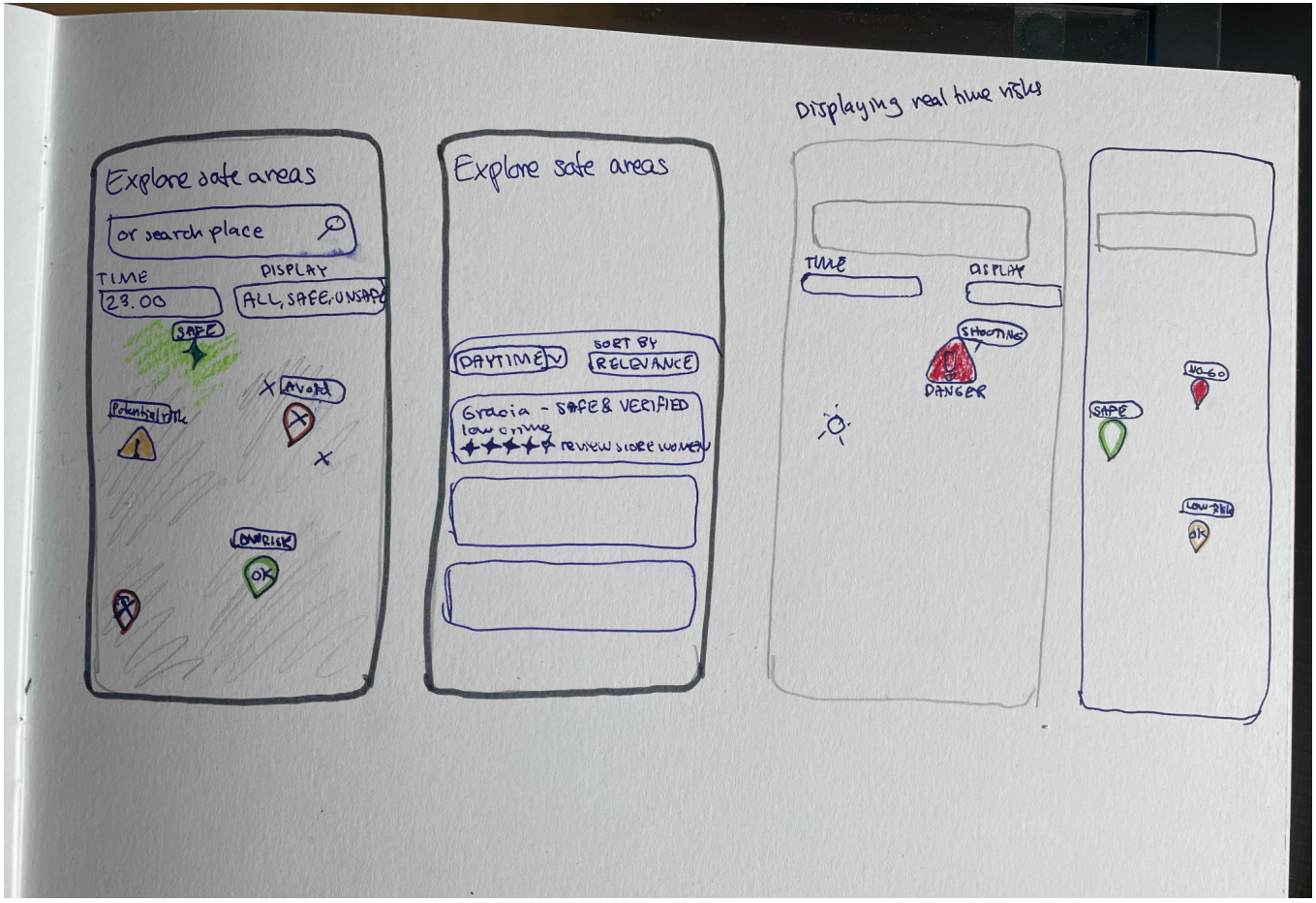
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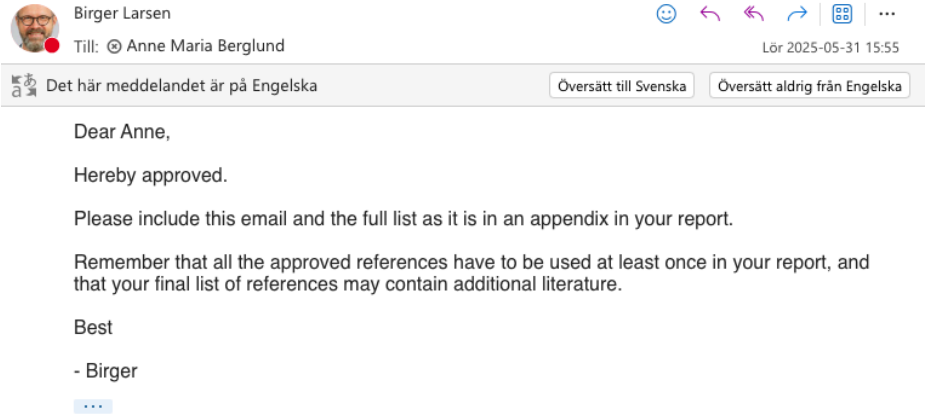

Birger Larsen

Till: Anne Maria Berglund

Lör 2025-05-31 15:55

Det här meddelandet är på Engelska

Översätt till Svenska

Översätt aldrig från Engelska

Dear Anne,

Hereby approved.

Please include this email and the full list as it is in an appendix in your report.

Remember that all the approved references have to be used at least once in your report, and that your final list of references may contain additional literature.

Best

- Birger