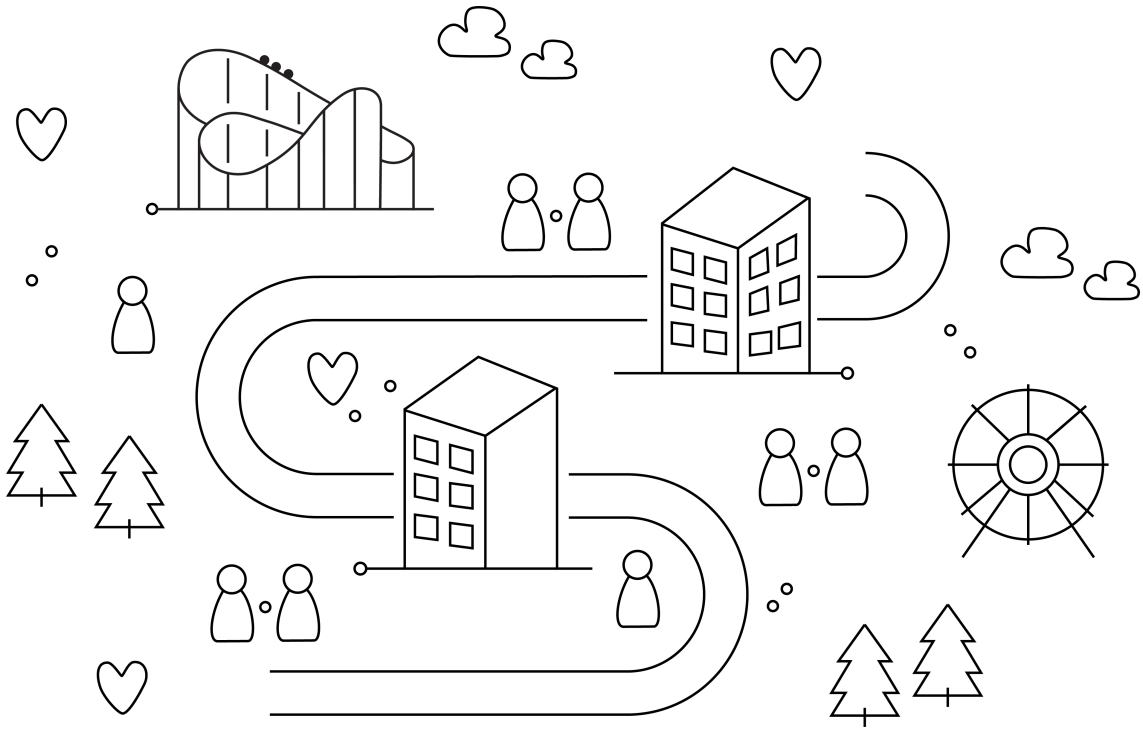

Safe in the City

Improving Perceived Safety in Public Spaces

Master's thesis in Interaction Design and Technologies

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Gothenburg, Sweden 2018

MASTER'S THESIS 2018

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Johanna Kaartinen and Christian Wickerström,
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Abstract

To feel safe is an inherent need within every human being. In the era of rapid urbanization, the topic of safety becomes very actual and should be addressed in various contexts, including design research. To find out how Interaction Design can contribute to the development of safer future cities, this master thesis explored the factors affecting perceived safety in the city of Gothenburg. Also, it investigated what role a smartphone application can have in increasing perceived safety.

The research process followed Research Through Design approach within the Double Diamond framework. The nature of the process was iterative and reflective. Additionally, a literature study, survey, and three Google Design Sprints were conducted. The research findings regarding perceived safety were divided into three categories; personal, social and physical factors. To be able to emphasize the most critical aspects of these factors, expert interviews and observation were performed.

The study resulted in empirically and theoretically grounded guidelines. They are aimed to support interaction designers in their work when designing a solution that enhances perceived safety in public places. The guidelines are supported by a conceptual model of perceived safety that visualizes the dynamic relationships between the different factors. Additionally, a lo-fi prototype of a smartphone application “Walk with Me” that aims to improve perceived safety through social connections was created and validated through user testing. The findings from the user testing resulted in design implications. The outcome of this thesis aims to contribute to further research within the field of Interaction Design regarding perceived safety in public spaces.

Keywords: perceived safety, public spaces, Research Through Design, smartphone application, guidelines, Interaction Design

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1. Introduction

A study conducted by The Swedish National Council for Crime Prevention (2017) shows that almost a third of the population in Sweden is deeply concerned about their personal safety and criminality in the society. When walking outside alone late at night, 19 % of the Swedes feel very unsafe. Perceived safety is lowest among women; 30 % of women reported to feel unsafe while walking alone late in the evening (The Swedish National Council for Crime Prevention, 2017). The statistics regarding safety in the city of Gothenburg reveal similar figures. Public Administration of Gothenburg City (Social Resursförvaltning i Göteborg, 2017) reports that the general feeling of safety among citizens of Gothenburg is decreasing. Interestingly, at the same time also the number of reported crimes is decreasing. Thus, according to statistics the city is getting safer, yet it is perceived as less safe than before (Social Resursförvaltning i Göteborg, 2017). Turning the deteriorating trend of perceived safety is important for the sake of the citizens' wellbeing, since the rapid urbanization is one of the biggest challenges for cities (Soraganvi, 2017). Knowing that Gothenburg is estimated to grow by 150 000 new residents until 2035 (Stadsutveckling Göteborg, n.d), it is essential that the public spaces in the city are designed to feel safe and empowering by every citizen.

Accordingly, perceived safety in public spaces is becoming one of the main concerns for both citizens and administrators in the future as cities are growing and more population is concentrated in smaller areas. Also, several different safety solutions which are available on the market today, point out that people are concerned about their personal safety. Prieto Curiel and Bishop (2017) assert that the perception of insecurity has negative consequences for large numbers of people and is emerging as a social problem. Fear of crime and lowered personal safety can lead to behavioral changes, including avoidance of certain areas, minimize travel and psychological stress (Ratnayake, 2017; Sayin et al., 2013).

This master thesis is carried out in collaboration with Humblebee and the scope of it is to research the factors which improve the feeling of safety in public spaces. Also, it investigates in which way a smartphone application can improve perceived safety in a physical realm. In this study, only perceived safety is concerned, i.e. there is no consideration for actual safety. As suggested by Ljungblad et. al (2015), interaction designers benefit from understanding the holistic view of the problem space, and therefore perceived safety is seen as an interconnected whole of smaller components. This is taken into consideration since the feeling of safety is built on several different factors, however, this makes it a challenging task to design a solution that improves perceived safety. To tackle a wicked problem like this, the process is carried out by applying a Research Through Design approach.

1.1 Aim and Research Question

The purpose of this thesis is to research and identify the factors affecting perceived safety in public spaces and to compile a set of guidelines that address the most essential considerations. Also, the insights gained through Research Through Design approach are used to build a broader understanding of how to improve perceived safety through a smartphone application. In this study, the assumption is being made that the actual safety is high. Thus, the study focuses only on investigating perceived safety in situations when the risk of a threat is low.

To reach these goals, the following research question has been formulated:

"Which are the important factors to consider in order to increase perceived safety in public spaces?"

And the sub-question was defined:

"What is a possible role of a smartphone application in increasing perceived safety?"

1.2 Deliverables

The outcome of this thesis aims to contribute to further research within the field of Interaction Design concerning the feeling of personal safety in public areas. For Humblebee, the results will provide knowledge regarding important considerations for a possible future product or a service. The expected deliverables are:

- A list of guidelines to consider when designing a solution that improves perceived safety
- A conceptual model of perceived safety visualizing how the experience of safety is formed
- Design implications for a safety smartphone application and a lo-fi prototype

1.3 Limitations

To ensure that the expected outcome of this thesis will be achieved within the given timeframe, the following limitations are defined:

- The assumption is made that the city is safe
- The scope is limited to public spaces in Gothenburg city.
- Safety in public transportation or privately owned public spaces such as pubs and shopping malls are not considered.
- The study does not cover how to increase actual safety, such as preventing crime and terror attacks.
- The outcome of this thesis does not include any code nor is being implemented as a user interface.
- The users of the smartphone application are assumed to be able to use such technology without any restrictions.

1.4 Authors

The nature of the thesis is cross-disciplinary as the project is carried out by students from two different master programs at Chalmers University of Technology. Johanna is a student at Industrial Design Engineering and Christian at Interaction Design. The project includes aspects and considerations from both fields. Through several years of studies in design Johanna has assimilated a broad set of design methods and internalized a holistic thinking to tackle design problems, while Christian has a firm understanding of design for experience and the interaction between the user and a product.

1.5 Stakeholders

Humblebee is a digital studio located in Gothenburg that provides product and service design. Since 2012, they have combined creativity, technology and interaction in their business to offer great user experiences for their customers (Humblebee, n.d). Their interest in this study is to gain an understanding of the current situation of perceived safety in Gothenburg and to attain deeper knowledge regarding possibilities to provide services that improve perceived safety among the citizens of Gothenburg.

Chalmers University of Technology is liable for the academic outcome of this master thesis. Their interest is the research outcome and the result of the written master thesis report.

1.6 Ethical Considerations

When carrying out this thesis, following ethical factors are taken into consideration:

Considerations during Empirical Studies

A lot of work in this thesis project will be based on interviewing private people and analyzing their subjective experiences and feelings regarding safety. The feeling of safety is highly personal and for some individuals, it can be very sensitive topic to talk about. The research participants will be treated with appropriate care and respect for their dignity should be prioritized. Bryman and Bell (2007) represent essential principles that should be applied to a thesis work. Firstly, when interviewing people, they should be provided with sufficient information regarding the purpose of the research and the implications of participation. Participation should always be voluntary and a proper agreement prior to the interview shall be made. The participants must be given a right to stop and leave the interview at any given moment. They must be able to deny the usage of their data if they prefer so. The individuals' anonymity must be ensured so that the data they deliver cannot be linked to them, unless they have given a separate permission to publish information about their answers (Bryman & Bell, 2007). Moreover, a part of the interviews will be conducted at organizations and companies which entails that also their privacy and anonymity must be secured unless anything else has been agreed on. When preparing surveys, questionnaires or interview questions a consideration should be placed on a proper language and appropriate choice of words. The analysis of the

interview data should be approached with objectivity (Bryman & Bell, 2007). However, the authors own interpretations or imaginings will affect the discussions of the results.

Academic Honesty

According to Bryman & Bell (2007), a master thesis project must be conducted according to academic integrity and honesty, which is especially important when writing the final report. All information and previous work from other authors which is mentioned in the report will be referred and acknowledged in a correct and transparent way (Bryman & Bell, 2007).

Respect for Stakeholders

Any confidential data given by Humblebee must be treated with care and not to be distributed for external parties. The work is mainly conducted at Humblebee's office hence their rules and working culture will be followed and respected under the project work. The end result of the thesis should aim for answering the research questions the best possible way and fulfil the academic requirements set by Chalmers. Additionally, Humblebee's interest in the results should be kept in mind. The authors have discussed common rules to carry out the study to ensure that the set goals will be reached. A frank and honest communication is crucial for a successful teamwork. If there should be any conflict between different stakeholders, they should be discussed through with respect and transparency.

1.7 Outline of the Thesis

This report includes eight chapters. In chapter 1, the thesis is introduced by presenting the project aim and research questions. The context and work domain in which this thesis is done is explained in chapter 2. Chapter 3 familiarizes the reader with the theoretical framework and concepts of perceived safety, followed by a description of the process and methods applied into this study in chapter 4. Chapter 5 introduces first the initial planning to carry out the research and after that, presents the actual process together with the research findings. The final results are shown in chapter 6 and discussed and concluded in chapters 7 and 8.

2. Background

This chapter presents an overview of the context in which this research was carried out. It introduces the design domains of the authors and briefly explains the differences in design practices between academia and industry. The different definitions of safety are explained, examples of solutions that improve perceived safety are presented and a general level of safety in Sweden is outlined. Lastly, the wickedness of perceived safety is discussed.

2.1 Interaction Design and Industrial Design

While Interaction Design and Industrial Design are related as both concern designing products and services that meet the user's needs, there are still certain differences between the two disciplines.

Interaction Design

Interaction design is described as the creation of user experiences to enhance and extend the work, communication, and interaction between people (Sharp et. al., 2002). Accordingly, interaction design has evolved into the focus on the interplay between computers and humans. Ljungblad et. al (2015) claims that research in interaction design field primarily seeks out to explore and understand design in its relationship with computer technology.

According to Sharp et. al (2002), the design process in Interaction Design typically includes the following activities: identifying the user's needs and establishing requirements, developing alternative design solutions that meet the requirements, building prototypes and evaluating the prototypes with the end-user (Sharp et. al, 2002). Contrary to the design of tangible products, the design process of digital products has more malleable nature that allows faster testing and a refining loop.

Industrial Design

While Interaction Design is oriented towards the understanding of how Human-Computer Interaction (HCI) design can contribute to our lives and society, Industrial Design concerns the design of physical products (Baxter, 1995). Valtonen (2005) suggests that industrial designers contribute to the design field with a holistic perspective, aiming for sustainable and innovative solutions. Accordingly, Ljungblad et. al (2015) believe that HCI research could benefit from taking influences from industrial design's holistic view in the design process, without fixating too early on a specific idea or solution.

The design process in Industrial Design involves similar activities as Interaction Design. However, physical product design entails a greater emphasis on the initial stages of a design process as it is essential to define the concept before the so-called

design freeze. This is because the late engineering changes are very costly to implement after design freeze and when the product has shipped (Eger et al., 2005; Ulrich & Eppinger, 2012).

Regardless of the different focus of design, both fields explore the humanistic needs such as empathy, the users and their needs. It is considered as advantageous that the authors of this thesis are representing two different design fields and the combination will contribute to the multifaceted reflection on the results.

2.2 Innovation at Humblebee

The thesis is carried out in collaboration with Humblebee and is done in parallel with another student project run by Humblebee, that also concerns perceived safety. That project is called Humblebee-project in this paper. The Humblebee-project is carried out by a cross-disciplinary team of five students in which the team members learn how to build products and ventures. The team ideates, conceptualizes, validates, and builds a digital service or product and the outcome is designed together with the designers and developers from Humblebee. (Humblebee, n.d.).

The authors of this thesis are also a part of the Humblebee-project, therefore the design activities which are carried out within that project and the findings of those activities are utilized in this thesis project. The goal of the Humblebee-project is to design and build a prototype of a smartphone application that enhances personal safety in public areas of Gothenburg. The role of this thesis project within Humblebee-project is to focus on providing theoretical framework regarding safety and carry out a critical reflection on how a smartphone application can improve perceived safety.

Since this thesis work is carried out under the influence from both industry and academia, the included design approaches from each field are presented.

2.2.1 The Innovation Process

In their business, Humblebee incorporates the mindset of Design Thinking which is described by Johansson-Sköldberg et. al (2013) as the best way to create and innovate in the managerial realm. Design Thinking is a design approach that combines the user's needs, possibilities of modern technology and business success (Brown, 2008). Through the strategic methodology, Design Thinking offers new forms of value by creating ideas that better meet the customer's needs and desires. This is opposite to the tactical approach to design that focuses on improving the already existing idea more attractive.

Google Design Sprints

Together with Design Thinking approach, Humblebee uses Google Design Sprint as a method to innovate fast and deliver the best customer value. Google Design Sprint is a step-by-step process to rapidly validate a concept and to answer critical business

questions. The aim is to quickly investigate if a concept provides value for the customer by creating a minimal viable product (Knapp et. al., 2016).

The length of one sprint is five days and each day, a different task is accomplished. The week starts by planning the goal of the week and getting a better understanding of the chosen problem area. Tuesday focuses on inspiration and ideating around the chosen problem area, which involves creating as many ideas as possible. By Wednesday, the team will have several various ideas on how to solve the design problem. Then the team evaluates the ideas and decides which one to take further. On Thursday, the team will turn the most promising idea into a prototype. The sprint ends with testing the prototype with potential users. (Knapp et. al, 2016).

The activities in Google Design Sprint are similar to the ones typically included in the design process within the field of Interaction Design. The main difference between them is that Google Design Sprint is focused on rapidly validating new ideas during a short period of time. Accordingly, as described by Sharp et. al (2002), in Interaction Design the concept is iterated over time and validated through more profound user testing.

2.3 Conducting Design to Gain Knowledge

Design Thinking is not to be confused with Designerly Thinking, which is based on the academic construction of professional designer's practice (Johansson-Sköldberg et. al., 2013). Designerly thinking has its roots in the academic field of design and links theory and practice from a design perspective. The main difference between Design Thinking and Designerly Thinking is that while the former can be considered as a toolbox for inspiring managers to think like designers, the latter is a design practice is used by people with a scholarly background in design (Johansson-Sköldberg et. al., 2013).

2.3.1 Research Through Design

Whereas Design Sprint is a method to learn by doing used in businesses, the related approach in academia is Research Through Design (RtD). Zimmerman et. al (2007) describes RtD as an approach in which the design process itself becomes the way to acquire new knowledge. It takes advantage of the insights learned through the design practice to build a better understanding of the problem. Accordingly, in RtD, the design artifact is the central element to generate and communicate knowledge. However, HCI field has been criticizing RtD and not acknowledging it as traditional research because the process is not replicable (Gaver, 2012). To be considered as a valid research approach, HCI research field suggests that RtD should hold standards in the process (Gaver, 2012).

As Research Through Design is used by design practitioners, the nature of it is research-oriented and involves critical thinking (Gaver, 2012). Compared with Google Design Sprint, which focuses on finding the most viable concept and deliver value to

the customer (Knapp et. al, 2016), RtD seeks to find relationships between theories, products and reflections around them (Zimmerman et. al., 2007). To build an understanding of the complex problem of perceived safety in this thesis, RtD allows us to approach the research problem through reflective practice. Even though the two methods, Research Through Design and Google Design Sprint, are being applied in different environments they share the same goal, that is to find a solution for a design problem.

2.4 About Safety

Public Administration of Gothenburg City (Social Resursförvaltning i Göteborg, 2017) states that the perceived unsafety in Gothenburg is increasing, while the reported number of crimes is decreasing. Subsequently, regardless of the lowering feeling of safety among the citizens, Gothenburg can be considered as a safe city. Therefore, when discussing the topic of safety, one must make a clear distinction between the type of safety that is being addressed. According to Alkhadim et. al (2018), safety in built environments can be divided into two categories: subjective (perceived) and objective (actual) safety. Subjective safety concerns how safe a person feels and perceives to be in a specific situation. Contrary to this, objective safety refers to how safe a person actually is and concerns the realistic risk of a negative incident occurring (Alkhadim et. al., 2018). This thesis concerns subjective safety and the term perceived safety is being used.

2.4.1 Perceived Safety in the City of Gothenburg

As this study focuses on addressing perceived safety in the city of Gothenburg and seeks to provide a solution that applies in that context, the current situation of safety is introduced. As earlier described by Soraganvi (2017), one of the greatest challenges for cities is the increasing urbanization and it is estimated that 80% of the world's population will be living in cities by 2050. The city of Gothenburg will most likely be no exception: according to Urban Development in Gothenburg City (Stadsutveckling Göteborg, n.d) the city of Gothenburg will grow by a third until 2035. This expansion will enable 150 000 more citizens to live in Gothenburg city (Stadsutveckling Göteborg, n.d).

As mentioned earlier, according to Public Administration of Gothenburg City (Social Resursförvaltning i Göteborg, 2017) perceived safety is decreasing in Gothenburg. However, at the same time also the number of reported crimes is decreasing. The trend in the rest of the country is similar; over the last five years perceived safety in public spaces is reported to be decreasing all over Sweden. In Gothenburg, most of the committed crimes occur mainly in the city center, which decreases the feeling of safety in that area. However, it does not necessarily mean that more criminals are in the city center, compared to the other regions of the city. Most of the social activities and social movement patterns occur in the city center, which makes the center a physical place that concentrates criminality (Social Resursförvaltning in Gothenburg City, 2017). The paradox of decreasing criminality and increasing unsafety can be a result of

several reasons. Public Administration of Gothenburg City (Social Resursförvaltning i Göteborg, 2017) mentions that since the summer of 2015, there has been a lot of media attention regarding refugees that could have an impact on how Swedish perceive safety. In addition to this, media has been reporting about the reorganization of the Swedish police department and their way to handle and investigate committed crimes, which could affect the feeling of safety.

2.4.2 Solutions to Improve Perceived Safety

Today, several solutions can be found in the market that aims to ensure personal safety and thus improve the quality of people's everyday life. In general, the commercial products can be divided into three categories: digital products, physical products and a combination of these. Moreover, there are installations and urban design that aim to create welcoming and safer public spaces, mostly through lighting.

There are several digital products, i.e. smartphone applications, designed to improve safety. One of these personal safety applications is Seecure, that allows the users to share their location and communicate with connected friends (see Fig. 1). In case of emergency, one can activate an alarm which will alert the defined emergency contacts, e.g. friends and family. The alarm will also alert other users close by, whom could possibly come by and help if need be. Furthermore, this application allows the user's friends to follow her or him on a map (Seecure, 2018). Other examples of smartphone applications with similar function are bSafe, Guardly, Red Panic Button and React Mobile.

Likewise, the category of physical safety products offers a broad selection of options to choose from. Generally, they are all tiny, on-the-go gadgets that are either keychains or wristbands. They are built on the same core function that is, to draw attention to the user by a loud siren when the activation button is being pressed. Examples of these products are SABRE alarm, ROBORanger and Safe by Gaia.

Figure 1: Seecure - Personal Safety Application (2018).

Figure 2: The Nimb Ring (2018).

Some of the physical products, such as ROAR and Nimb Ring, come with a smartphone application or are sold as a complementary wearable. Nimb Ring (see Fig. 2) comes with an easy access alarm button which, when being pushed, will notify friends and family, 24/7 call centers or Nimb members nearby. The Nimb Ring is connected to a smartphone application where the user can, for example, manage groups of responders and send and receive alerts (Nimb, 2018).

In Sweden there is also a smartphone application called Safeland (originally called Trygve) that aims to increase the feeling of community and build a safer society. The user can connect his or her home to Safeland, and report crimes that are committed in the city and see the crimes on a map reported by other users. Moreover, it has a personal safety alarm that can be connected to friends or family or other nearby users. Generally, the safety applications improve perceived safety by providing a solution in case something happens and by creating a feeling of connectedness.

Light design plays a significant role in improving perceived safety in physical environments. Lighting makes parks and streets more welcoming and invites people to spend time in them. Dynamic light installations can bring parks and other recreational spaces to live and by making them lively, increase the feeling of safety. Olsson and Linder are a designer duo that creates temporal lighting installations in the boundary between art and lighting design. Their aim is to make environments to be perceived as warm and welcoming (see Fig. 3). Their focus is on outdoor environments and they often utilize a participatory process.

Figure 3: Novemberljus Light Installation by Olsson and Linder (2018).

To conclude, there are various products which aim to improve the feeling of safety in public spaces. The vast number of safety products available indicates that there is a societal need for such products. However, a majority of these products are designed to be used when the user of the product is being threatened. Some of these products, such as Seecure and Nimb Ring, rely on the connection of peers to increase perceived safety. This implies that the user must have friends that are connected as well, and ready to act whenever the user is in danger. The light installations by Olsson and

Linder are focusing more on improving perceived safety in a public space and compared to the other safety solutions, they do not offer help if something bad should happen.

2.4.3 Perceived Safety as a Wicked Problem

The feeling of safety is a result of several interrelating factors, and those factors are perceived in a unique way by each individual. This equation with altering variables makes the creation of a solution for perceived safety a very challenging task to do.

Consequently, perceived safety can be considered as a wicked problem according to its definition. Rittel and Webber (1973) describe a wicked problem as a problem that is challenging or difficult to solve due to altering and inconsistent requirements. They suggest that this kind of design problems have many possible solutions, and there is no right or wrong answer to a particular problem. Originally the definition emerged within the context of social policy planning, yet several other fields have the similar elements of wickedness, including design decision making. According to Rittel and Webber (1973), the ten characteristics of wicked problems are described as follows:

1. There is no definitive formulation of a wicked problem.
2. Wicked problems have no stopping rule.
3. Solutions to wicked problems are not true-or-false, but good or bad.
4. There is no immediate and no ultimate test of a solution to a wicked problem.
5. Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly.
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan.
7. Every wicked problem is essentially unique.
8. Every wicked problem can be considered to be a symptom of another problem.
9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.
10. The planner has no right to be wrong.

Buchanan (1992) discusses the relationship between wicked problems and Design Thinking. He argues that designers visualize and plan what does not yet exist and this creation phase, before the end result is embodied, happens in the context of wicked problems. The role of design in solving wicked problems is to guide the development towards more desirable directions and outcomes (Buchanan, 1992).

Sometimes it is said that wicked problems cannot be fixed. When designing a solution for perceived safety, it is important to consider it as a wicked problem. There is no absolute solution to the problem. Additionally, the problem itself might be a symptom of another problem. So, it might entail that in order to increase the feeling of safety in the society, something else should perhaps be changed first.

3. Theory

This chapter presents the theoretical framework of this research. First, it introduces safety as a fundamental human need and its evolutionary reason why we sometimes do not feel safe. Also, possible design approaches to address the feeling of safety are presented. After that, the concept of perceived safety in public spaces is introduced. It explains the factors which affect how the experience of safety is formed and discusses the differences in perceived safety between men and women. Lastly, the limiting consequences of fear are briefly explained.

3.1 Safety - A Fundamental Human Need

To know the motivations behind a human behavior is crucial to understand why we all seek safety and security. One of the best-known theories of human motivation is the Maslow's model that describes different human motivations as a hierarchy of needs. Maslow (1943) identified and grouped a set of goals and claimed that all actions are executed to fulfill those goals, i.e. needs.

In his five-stage model of needs Maslow (1943) identifies safety needs as the second most important need after the need for sleep, food, water and air, which are called physiological needs (which are vital to existence). The two lowest levels of the hierarchy, physiological and safety needs, create so-called basic human needs that are universal among all people across the globe. This implies that humans have an innate desire to be and feel physically safe and secure. In other words, both perceived and actual safety are important for human well-being. The need to have a world in order, preference for familiar rather than unfamiliar things and the attempt to seek stability are also considered as aspects of safety. Maslow (1943) considered these needs to be important for survival, however, he points out that they are not as essential as the physiological needs. Cherry (2018) suggests that in a modern Western world these needs are, for example, steady finances, safe neighborhood and health insurance. The other needs in Maslow's theory are social needs, esteem needs and self-actualizing needs.

Criticism towards Maslow's theory has been expressed. The model suggests that the lower level needs (i.e. physiological and security needs) must be met before people can pursue fulfillment for other needs (Maslow, 1943). However, psychologists now see motivation as pluralistic behavior, whereby needs can operate simultaneously (McLeod, 2017). As for instance, some of the very creative people, such as Rembrandt and Van Gogh, lived their lives in poverty but achieved a high degree of self-actualization. Also, Maslow (1943) noted that needs are interdependent and overlapping and that there is a variation between individuals. Cherry (2018) also argues that the needs do not necessarily have to follow a certain hierarchy order.

3.1.1 Why are we afraid?

Since Darwin's evolutionary theory of emotion in 1872, it has become widely believed fact that all humans, regardless of their culture or origin, experience certain universal emotions: happiness, sadness, surprise, fear, anger, and disgust (Darwin, 1872; Ekman & Friesen, 1971). Emotion is a conscious mental reaction which oftentimes is accompanied by behavioral or physiological changes in the body (Merriam-Webster, 2018). By the definition (Merriam-Webster, 2018), fear is:

"An unpleasant, often strong emotion caused by anticipation or awareness of danger."

Thus, fear is a primary emotion that improves an organism's chances of survival as it triggers a reaction on a stimulus in the environment. For example, LeDoux (2012) describes that a feeling of fear enables us to react to danger and activates a certain kind of behavior response.

While the emotion of fear itself is the same among all humans, the reason why we experience and feel fear is not. The Two-Factor Theory suggests that there are two key components that together create an emotion (Dalgleish, 2004). The theory focuses on the interaction between physical arousal and the cognitive labeling of it. Schachter (1964) cited in Reisenzein (1983) points out that emotion is an individual's subjective interpretation of a situation or an event, meaning that the same arousal does not evoke the same emotion within all individuals. This is the essence of perceived safety which implies that there are personal differences why people feel unsafe (Dalgleish, 2004).

3.1.2 Addressing Safety Through Design

Design can be used as a tool to reveal problems, evoke feelings and provoke actions. Here, three potential approaches to consider when designing a solution to improve perceived safety are presented: Emotional Design, Critical Design and Value Sensitive Design.

Emotional Design

Norman (2004) claims that emotions change the way how humans perceive the environment and affect how we learn new tasks and that products play a significant role in it. Norman's model of Emotional Design is based on three different levels on which human brain processes emotions; visceral, behavioral and reflective level. The visceral level is the pre-wired automatic and most rapid level: what is considered good and bad, i.e. safe or dangerous. Design on visceral level concerns also product aesthetics and attractiveness. This level is relevant in the field of HCI, particularly in user-interface design since it is claimed that attractive interfaces arouses attention and are evaluated to be easier to use (Kallio, 2003). Behavioral level concerns usability and functionality of products. The third level, reflective level, makes humans being able to reflect on our actions and ourselves and it is usually related to product branding (Norman, 2004).

In contrast, to enhance the user experience by designing only pleasurable and appealing products, Fokkinga and Desmet (2013) show that also through negative emotions the product experience can be enriched and positively altered. They present a design approach that improves the user's engagement with a product and transforms a dull product experience into a meaningful interaction. Interestingly, their results show that a product which initially evokes negative emotions can lead to engaging the users in activities that they otherwise would not prefer doing, leading to positive emotions. Correspondingly, Norman (2004) discusses that in certain situations, for example in amusement parks, the fear and anxiety is needed to provide a positive experience for the customer.

The principles of Emotional Design support the human-centered design approach and can make the solution to fit better the user's needs (Desmet, 2003). In this project, Emotional Design can be used as a tool to either enhance the feeling of safety on the user's behalf or strengthen the positive emotional response. Alternatively, it can be applied to create a contradictive reaction or to elicit negative effect that leads to a positive emotion and delight at the end.

Critical Design

Critical Design attempts to raise awareness, provoke action and make people think. Malpass (2013) defines Critical Design as a way to comment on socio-technical, economic, political, cultural, or psychological concerns.

Through Critical Design, the user experience can be made a dilemma and to deliver an unpleasant experience by displaying something that people typically find disgusting. For example, critical designers Dunne and Raby have presented various hypothetical products to explore the ethical, cultural and social impact of different energy futures. For example, in their design exhibition "*Is This Your Future?"* they wanted to evoke reflection regarding the question if humans can or might be transformed from fuel consumers to energy providers. Also, they explore the idea of using child labor as a means to produce energy (Malpass 2013).

Because Critical Design criticizes existing cultural phenomenon and what exists in the society, it could be an interesting approach to perceived safety. Knowing that the actual safety in Gothenburg is fairly high and, in general, the city is safe, it could be applied to encourage citizens to reflect the reasons why they feel unsafe and if it is actually needed to feel unsafe.

Value Sensitive Design

Value Sensitive Design highlights the ethical considerations early in the design process of new technologies and concerns how society is being shaped by technology (Cummings, 2006). This design approach takes human values into consideration, of which examples are human welfare, privacy, trust, autonomy, identity, and environmental sustainability.

Furthermore, Cummings (2006) describes how this approach includes investigation of conceptual, empirical and technical aspects to a particular design. The first phase of conceptual investigation focuses on how a particular design either supports or diminishes relevant human values. The second phase is empirical investigation, which focuses on the evaluation of how the technology could both socially benefit and negatively impact stakeholders. The last phase involves the investigation of technical designs in relation to human values.

Value Sensitive Design is relevant approach when designing a solution for perceived safety. As the feeling of safety is very personal, human values should be taken into consideration in the design process and the possible implications on the society caused by the solution should be reflected on (Cummings, 2006).

3.2 Perceived Safety in Public Spaces

As mentioned earlier, Soraganvi (2017) claims that one of the biggest challenges for cities is the rapid urbanization. Therefore, cities should be designed in such way that citizens feel empowered when visiting public spaces.

3.2.1 Definition of Public Space

Public space is a platform for engagement and discussion, planned and spontaneous encounters and also a place for learning of diverse attitudes and beliefs. Back in the days, public spaces used to serve the purpose of basic survival, communication and entertainment needs. They were also important for other societal functions such as politics, commerce, and religion. Today, public spaces can be seen as an area for functional, social and leisure activities (Mehta, 2014).

According to Mehta (2014) there are various definitions for public space. A study conducted by Madanipour in 1996 (cited in Mehta, 2014) suggests that public space is "the space that is not controlled by private individuals or organizations, and hence is open to the general public". Mehta (2014) further defines public space as any space that is open to the public, regardless if the particular area qualifies as privately owned or not. A theoretical framework presented by Gehl in 1987 (cited in Mehta, 2014), mentions the features that make a good public space: accessibility, convenience, and sense of safety and control. Moreover, it should support its activities and be meaningfully designed, provide physical and environmental comfort, and offer a sensory pleasure.

For this master thesis, a public space is defined as an open space that is accessible to the public but is limited to what Ceccato (2016) exemplifies as public space: parks, pedestrian paths, tunnels, streets, interstitial spaces between buildings and transport nodes such as bus stops.

3.2.2 Perceived Threats in Public Spaces

A research conducted by Sandstig (2010) displays what people perceive as threats by studying citizens of Gothenburg (Fig. 4). The biggest fear was reported to be criminality and violence, nearly half of the respondents reporting this. Within this category, citizens are mainly concerned about being a victim of an assault in public spaces, additionally various forms of burglary and robbery are of a concern of 20% of respondents. Social problems were considered to be the second biggest threat to personal safety. This category involves unemployment, decreasing quality of healthcare and social segregation. 16 % of the citizens consider health and environment as a threat, which encompasses environmental issues such as global warming and the spread of epidemics. Society itself was not reported to be a major concern regarding personal safety. Society aspects in Sandstig's study include traffic and street environment as well as how politics affect the infrastructure of the city. Lastly, 2 % reported international threats as a concern which regards threats and risks outside of Sweden, such as internal conflicts and global threats.

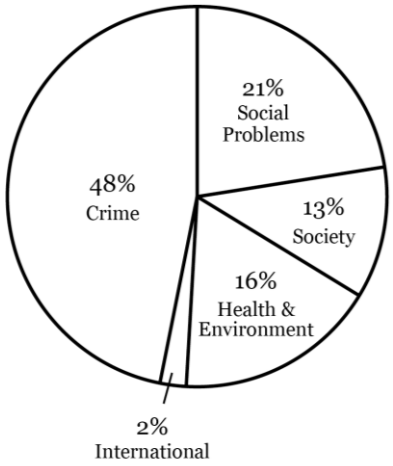

Figure 4: Perceived Threats in Public Spaces (Sandstig, 2010).

3.2.3. What Affects Perceived Safety?

There is not only one key factor that makes a space perceived as safe or unsafe, yet the feeling of safety is built on an interplay of several different aspects. However, based on various studies, there seem to be universal attributes that influence perceived safety in urban areas. Maruthaveeran and Konijnendijk van den Bosch (2014) divide the different attributes into four categories: personal factors, social factors, physical factors and other factors which are further explained below.

Personal factors

Feeling of safety is something highly personal and is dependent on the individual's characteristics such as age, gender, socioeconomic status and ethnic background (Ratnayake, 2017; Sandstig, 2010). In addition to these, personality plays a role in how people interpret environmental cues and other people. Ratnayake (2017) exemplifies

that encountering a male stranger on a quiet lane may evoke emotions of insecurity in a person who may judge that the stranger poses a threat or harm. At the same time, another individual with different prejudices can experience a sense of safety because he or she sees the stranger as a sign for a help in case of emergency. Several studies show that youngest and oldest women are the most fearful to be alone, especially late in the evening, although according to statistics, elderly are the most unlikely to be victims of a crime (Brå, 2016; Maruthaveeran & Konijnendijk van den Bosch, 2014).

People usually relate to other individuals that are similar to themselves in terms of gender, age and race. Consequently, people are generally more comfortable among people similar to themselves occupying the same physical space. This entails that also ethnicity affects the feel of safety and that ethnic minorities feel insecurity in public spaces (Maruthaveeran & Konijnendijk van den Bosch, 2014; Ratnayake, 2017).

Prieto Curiel and Bishop (2017) points out that also previous personal experiences play a key factor when individuals form a perception of safety in a certain area. A similar finding is proposed by Sandstig (2010), who claims that a previous experience of suffering a crime affects a person's perception of safety. Similarly, place-specific fear is dependent on previous experiences. Prieto Curiel and Bishop (2017) explain that if a person has been exposed to a crime in place X, that person will automatically link that particular place to fear and considers it as unsafe. Moreover, they further claim that even though a specific place is perceived as unsafe by two people, it does not necessarily mean that they fear the same thing within that area, or to the same extent (Prieto Curiel & Bishop, 2017).

According to Sandstig (2010) the most crucial factor that decreases perceived safety is the personal experience of either being a victim of a crime or witnessing someone else being a victim of a crime. The individuals with 'mixed experiences', i.e. individuals who have both experienced and witnessed a crime, are the most fearful. Sandstig also studied the role of media in perceived safety in public spaces. Her study indicates that media does not have a significant effect on perceived safety. Contrary to this, Prieto Curiel and Bishop (2017) claim that especially women are likely to get affected by the media as it oftentimes tends to give a lot of attention to female victims of cruel crimes. Nevertheless, the study of Sandstig (2010) pointed out that media may act as a reminder of past negative experiences of those that a person may hold (Sandstig, 2010).

Social factors

Social factors are considerations that involve other citizens. In this category, Maruthaveeran and Konijnendijk van den Bosch (2014) mention attributes such as the sense of community and familiarity of the area. The reason why communities strengthen the feeling of safety is explained by the sense of belonging and being familiar with both, the people and the area. Likewise, Soraganvi (2017) lists social

factors that influence citizens' feeling of safety, such as the absence of other people and the lack of a tradition of street life.

Ceccato (2016) proposes that public spaces are capable of concentrating people which offers opportunities for crime which, in turn, increases fear. Public spaces are accessible to all citizens, therefore it might be problematic to attain safety in crowded places due to different cultural backgrounds and different beliefs. Sufficient presence and responsive attitudes of police and civic authorities are therefore important in order to maintain perceived safety in areas where big crowds of people are gathering (Soraganvi, 2017).

Moreover, the research carried out by Sandstig (2010) indicates that peers and acquaintances have a significant effect on perceived safety, regardless of the environment. Her study pointed out that perceived safety is the lowest when being alone in desolate places, particularly when walking home alone from a tram/bus stop. Sandstig (2010) suggests that the reason why the company of others makes people feel safe is that in a group, the responsibility of safety is divided amongst the individuals. Correspondingly, when being alone the individual has a full responsibility for his or her own safety.

Soraganvi (2017) also points out that different cultural backgrounds as well as different ideas and beliefs about appropriate behavior effect on how the area is perceived. In general, people seek to interpret other people's behavior and when one is able to predict another's behavior, it increases trust that, in turn, increases feeling of safety. Bamberger (2010) discusses interpersonal trust which is an interaction between two people. According to him, whether a person is to be trusted by another, is highly subjective. Moreover, he suggests that personal qualities, such as honesty, caring and acceptance are essential when building interpersonal trust (Bamberger, 2010).

Physical factors

Physical factors refer to the overall physical appearance of an environment (Ratnayake, 2017). Studies show that physically disorderly surroundings evoke feelings of unsafety among people because people interpret certain environmental cues as signs of vandalism. This, in turn, may trigger fear among some individuals (Maruthaveeran & Konijnendijk van den Bosch, 2014; Prieto Curiel & Bishop, 2017). These cues are, for example, abandoned buildings, graffiti, badly maintained parks, trash and broken property. Ratnayake (2017) explains that these generate fear as they are connected to a criminal threat. Vandalism makes an area to look like it is out of control and will impact on perceived safety. Poor lighting, e.g. badly lighted streets, is one of the most significant factors that lower feeling of safety in regards physical factors (Mehta, 2014). Darkness is largely associated with danger, especially among women, yet also men perceive darkness less safe compared to daylight. Moreover, Soraganvi (2017) points out that the lack of adequate public transport and poor urban

infrastructure might lower the perceived safety among citizens. It is important to note that oftentimes, an environment is perceived as unsafe yet according to statistics the area is relatively safe (Prieto Curiel & Bishop, 2017).

Ratnayake (2017) explains a social theory paradigm called symbolic interactionism in terms of perceived safety. The theory claims that physical objects create symbolic environments in which citizens live in. People attach meanings to objects, places and buildings around them which, in turn, convey a meaning back to the person experiencing them (Norman, 2004; Ratnayake, 2017). In neighborhoods, shared symbolic meanings can emerge feeling of fear among citizens when people attach similar meanings to symbols. For example, symbolic interactionism explains that a broken window or a wall covered by graffiti can generate a common belief among citizens that a certain area is unsafe and there the risk of crime is high.

Another theory describing how people perceive safety in their surroundings is called prospect-refuge theory (Ratnayake, 2017). It is based on two environmental factors; refuge (protection) and prospect (open view). Prospect-refuge theory explains that people seek to evaluate an area in which they are at by observing it without being seen. Hence, in order to an area feel safe and meet the basic human need for safety and security, it has to offer sufficient amount of both, visibility and protection. According to the theory, an area that provides a high degree of visibility and minimal hiding places for a possible attacker is evaluated as the safest. Accordingly, spaces of high level of prospect and low visibility are experienced as less safe (Ratnayake, 2017).

Other factors

The extent to which an environment is perceived as safe, is found to be altering according to the time of day (i.e., daytime or night) and season of the year. These variables are grouped as other factors by Maruthaveeran and Konijnendijk van den Bosch (2014). Night-time has been found to be one of the most influential single factor making people feel unsafe and several studies across the world report that the absence of street lights and darkness significantly decrease perceived safety among citizens (Brå, 2016; Mehta, 2014; Maruthaveeran & Konijnendijk van den Bosch, 2014; Soraganvi, 2017).

It is also suggested that different seasons make a difference in perceived safety (Maruthaveeran & Konijnendijk van den Bosch, 2014). The seasonal changes are especially remarkable in Northern Europe, including Gothenburg, where the difference between winter- and summertime is significant because of the longer availability of daylight. This makes people spend more time outdoors and socialize more during the summer compared to the dark winter months. Maruthaveeran and Konijnendijk van den Bosch (2014) suggest that people feel safer during the summer months as there is more daylight available. However, opposing this, Gilchrist et al. (1998) claim that women are fearful at night even in summertime.

3.2.4 Fear Among Women in Public Spaces

Several researchers show that women feel significantly less safe than men when walking alone in public spaces (Brå, 2016; Gilchrist et al., 1998; Ratnayake, 2017; Sandstig, 2010). According to Ratnayake (2017) the fear of crime among women can be seen as a paradox. The paradox is that women feel unsafe in public spaces although the probability to be subjected to violence is much bigger at home or in another private place (SALAR, 2007). Similarly, Gilchrist et al. (1998) mention that the sense of safety among women is irrationally low as it does not correspond to the real threat of crime.

To explain the greater fear among women than men, Bastomski and Smith (2017) suggest that the reason lies in women's tendency to be more sensitive to certain types of behaviors. For example, when a woman and a man are exposed to a similar type of violence, the woman experiences more serious effects from it than the man does. Furthermore, the fear towards strangers is much stronger among women than men. As mentioned before, when encountering a stranger on a dark street at night women anticipate a threat and assume something bad to happen whereas men do not feel fearful to the same extent (Bastomski & Smith, 2017; Ratnayake, 2017). Greater fear can also be explained by women's weaker physics and vulnerability that decreases their possibilities to protect themselves when attacked (Gilchrist et al., 1998).

Gilchrist et al. (1998) suggest that women and men are equally worried about crime, yet the difference is that women are more fearful about sex crimes and their consequences. Based on statistics, women are more frequently a target of domestic violence, sexual offenses and harassment than men, yet in public spaces, the exposure to assault or crime is more common among men than women (Bastomski & Smith, 2017; Brå, 2016; SALAR, 2007). Generally, men are not subjected to sexual violence hence they do not hold a fear of it while among women the threat of a rape or harassment is much more probable.

Prieto Curiel and Bishop (2017) give one suggestion why women are more fearful. They claim that fear is contagious, and a fearful person is likely to make another person fearful too by altering that person's opinions. Given that women talk about their feelings of fear more than what men do, it may result in the higher rates in perceived unsafety among women.

3.2.5 Limiting Consequences of Fear

A sense of unsafety may lead to a person altering his or her behavior. Ratnayake (2017) list the effects of lowered personal safety in public spaces, such as avoiding a walk alone or in areas where other people are not available, avoid all public areas, minimize travel and feel worried when passing public spaces at night. In addition to these, Sayin et al. (2013) mention psychological stress as a symptom of fear of crime. Bastomski and Smith (2016) claim that women avoid public places or show coping behavior because of fear more frequently than men and that rude behavior has a greater negative impact on women's emotional well-being than of men. The nervous system

also changes when experiencing a provoking event, such as walking alone in an isolated area at night (Ratnayake, 2017).

However, it is important to note that the feeling of fear also carries a meaning as explained in chapter 3.1.1. Prieto Curiel and Bishop (2017) remark that fear of crime, for example, motivates us to take healthy precautions. It makes us lock the doors at home and evokes awareness and cautions in suspicious situations. However, when fear takes over and becomes excessive, it can have a severe impact on the quality of life. In the worst cases, it may lead to paranoia, anxiety and social isolation (Bastomski & Smith, 2017; Prieto Curiel & Bishop 2017).

4. Methodology

This chapter presents the methodology used in this thesis project. First, the Double Diamond framework in which this process is carried out, is presented along with its four design phases: Discover, Define, Develop and Deliver. In addition, the possible and appropriate design activities to execute during each phase are presented.

4.1 The Design Process

There are several different processes to follow in design. However, they all include more or less the same stages: defining the problem, exploring and identifying the user needs, brainstorming solutions, testing the promising concepts, and lastly evaluating and delivering the results (Brown, 2008, Sharp et. al., 2002; Ulrich & Eppinger, 2012). In this thesis, the Double Diamond model is followed due to its explorative nature. Also, it supports and goes together with the process within the Humblebee-project.

4.1.1 Double Diamond Framework

The double diamond framework was established by Design Council in 2005. Design Council, founded in 1944 in the UK, is recognized as the leading authority promoting the use of strategic design. They also address all the aspects of design from product and service design via user experience to build environments. (Design Council, n.d.).

The Double Diamond model is illustrated as a framework that has two subsequent 'diamonds' (see Fig. 5). Originally, the model emerged from the field of Industrial Design. It presents design process as a linear sequence of actions combined with a rhythmic change of altering mindset from divergent to convergent. A process that includes exchanging mindset is very common when solving design problems and Brown (2009) sees a design process as a "dance between divergent and convergent thinking". The process allows iteration which is essential when making sense of something that seems chaotic and when creating concepts that have not existed before (Brown, 2009; Cross, 2007).

The model is divided into two main stages: define strategy and execute solution. The process begins with a trigger, i.e. a question or a problem to which a designer seeks a solution. To understand the problem, exploration goes broad to obtain a lot of new information. This data is then analyzed and converged upon a vision and defined as a problem statement. After that follows an execution phase which begins with broadening the perspective again. The aim is to develop several ideas for a possible solution. The second diamond includes iteration that is conducted by building prototypes, testing and learning from them. It allows designers to quickly spot any shortcomings in the concept and to improve it. In the end, the mindset goes narrow again to eliminate options, make choices and obtain the solution. (Design Council, n.d.).

Even though the Double Diamond is presented as a linear process, the different phases do not have defined borders and the activities in them may be overlapping. Especially, the second diamond, Develop- and Deliver-phases, are considered to be very iterative by their nature. These two phases are tangled and cannot be clearly distinguished from each other. The findings from Develop-phase are reflected on and iterated constantly in order to deliver the solution that best meets the desired needs.

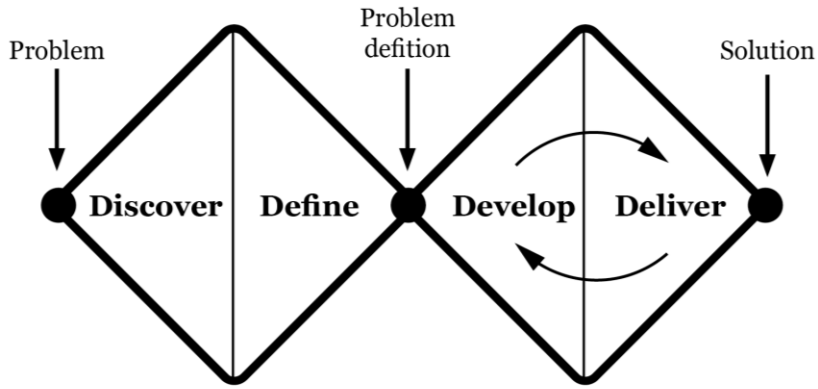

Figure 5: The Double Diamond Framework.

4.2 Design Methods

As mentioned, the Double Diamond is a framework and it does not contain any predefined methods that should be used during each phase. In an Interaction Design process, there are several commonly used design methods that can be used with the Double Diamond framework to achieve the desired outcome. The suitable methods to be applied to this project are described below.

4.2.1 Discover-Phase

The design process begins by understanding and empathizing the problem. Knowledge regarding how users behave, what they think and what they want in the given context will be gathered. The nature of the actions taken is divergent and exploratory. In addition to the activities described below, Google Design Sprints are carried out in Discover-phase to generate knowledge.

Literature Reviews & Desk Research

According to Martin and Hanington (2012) literature reviews are an integral part of any research paper but could also be beneficial in any design project. The aim of the literature review is to investigate the essence of what has been previously discovered in the research area. Internet offers various information sources and it is beneficial to not only find relevant information, but also from credible sources (Martin & Hanington, 2012).

Interviews

According to Martin and Hanington (2012) interviews are a fundamental research method in order to retrieve first-hand information, such as personal experiences, opinions, attitudes and perceptions. Interviews can be performed in person, but also using telephone or social media.

An interview can either be structured and follow a script or be totally unstructured allowing the interview to take more flexible detours. Structured interviews are perceived as impersonal and formal, but they are easier to analyze and control in terms of questions of time-keeping. On the other hand, unstructured interviews can be experienced as more comfortable by the interviewee and they can be considered more as a conversation rather than an interview. Group interviews or interviewing two persons at the same time is more time-efficient, although the interviewees might influence each other's answers (Martin & Hanington, 2012). Sharp et. al (2002) describes the advantages with interviews. They are generally beneficial when the researcher wants to explore issues and mainly gather qualitative data. Nevertheless, there are also disadvantages with interviews: they can be time-consuming and the artificial environment may intimidate the interviewee (Sharp et. al, 2002).

Survey

Martin and Hanington (2012) state that surveys can be used to collect data from large samples of respondents in a fast and usually cost-efficient way. With large enough respondent rate, the answers could also be analyzed statistically. However, like any self-report instrument, answers provided by a survey might not be accurate and be satisfying considering true thoughts, feelings, perceptions and even behaviors of the respondents. Therefore, the survey results must be interpreted carefully and one has to be aware of potential survey bias. A survey bias may result if the respondent is being influenced by, for example, leading questions, question-wording or the order of the questions. It is usually beneficial to complement a survey with interviews or observations to gain more qualitative insights (Martin & Hanington, 2012).

Observation

As described by Martin and Hanington (2012), the observation method is used as means to gather information through immersion in a specific situation or environment. The researcher can have a set of questions prepared before the actual observation or just bring an open mind. Despite the informal structure of the observation method, the observation session should be documented in any form, such as by taking notes, drawing sketches, taking photographs or video footage) (Martin & Hanington, 2012).

4.2.2 Define-Phase

The second phase is about moving from the problem space into an opportunity space and converging on a vision. The activities carried out in this phase aim to reveal what the problem is really about. To establish the underlying design problem, the findings

and insights from the previous phase are analyzed. The aim is to synthesize understanding into knowledge in order to establish the desired outcome.

Dot voting

Media Lab Amsterdam (n.d) describes how dot voting can be used to collectively prioritize and decide which design solution is feasible to develop further when having too many ideas to choose from. The first step of dot voting is to gather between 4 to 20 persons to a dot voting session. All the possible design solutions are listed, and each session attendee is given 2-3 post it dots to assign to the ideas they appreciate the most. After the voting is finished, the votes are counted, and ideas are arranged in popularity. This is followed by a discussion within the session attendees to decide for which idea or ideas to take further (Media Lab Amsterdam, n.d).

KJ Technique

Martin and Hanington (2012) describe KJ Technique as an exercise for a team to organize a complicated and a vast range of data. By externalizing the team's ideas and information, the data can be organized in a way that builds a group consensus. The KJ technique is silent, and it starts out by letting the team writing down their thoughts and ideas on post-it notes. This gives everyone an opportunity to express their ideas without getting biased by the opinions of the others. After writing down the ideas, the post-its are placed on a whiteboard. While still in silence, the team organizes the post-its in categories. The KJ Technique offers an equal representation of the ideas of the whole team and offers a way to make a democratic decision (Martin & Hanington, 2012).

4.2.3 Develop-Phase

In the first phase of the second diamond, Develop-phase, the ideation goes broad again by creating alternatives, merging ideas and taking different perspectives. The process is non-linear, iterative and the different ideas are compared with each other to create the best concept. In addition to the design methods described below, also observation, survey and interviews that were introduced above, are considered to be carried out in this phase.

Sketching

Within both fields of interaction and Industrial Design, sketching is most often the very first ideation tool and it plays a significant role in concept development. Kumar (2013) argues that by using concept sketching, an abstract idea takes a more concrete form which makes it easier to understand, discuss and evaluate. Also, a sketch communicates the idea better than an abstract idea described in words. It also allows for further development of the idea, since it is concrete and invites to further exploration. Iteration of a sketch usually leads to further development and new ideas (Kumar, 2013).

Brainstorming

During a brainstorming session, Kelly (2000) suggests creating as many ideas as possible in a certain amount of time. The participants of a brainstorming session should aim to generate a large number of ideas, however, only a small percentage of them will be solid leads. A brainstorming session should not be a place for critique, rather encouraging all kinds of ideas. A brainstorming session should be initiated by stating a narrow but not leading question to ideate around. If the question is too narrow, there is no need for a brainstorming session since the answer lies in the question itself. On the other hand, if the question is too vague, it is difficult to find the right focus (Kelly, 2000).

Crazy 8

Knapp et. al (2016) describes the Crazy 8 as a rapid pace ideation method. Each person during the ideation phase writes and sketch eight variations of ideas on a paper under eight minutes. The word "crazy" does not necessarily imply that the generated ideas should be crazy. It implies that the pace of this ideation method is fast and "crazy". To perform this exercise, each person folds a paper until it is split into eight squares. When a timer of 60 seconds starts, and each person starts sketching in the first square. When the timer stops, the procedure is repeated until all eight squares are filled with ideas. This method should be performed individually but the final eight ideas are presented within the group (Knapp et. al, 2016).

Personas

Martin and Hanington (2012) describe personas as a tool to help designers to humanize results of empirical studies such as interviews and surveys. Personas can also be used as an aid to communicate design and to validate various scenarios. When performing field research, it is hard to empathize with plain gathered information. Therefore, personas play a significant role in human-centered design. They help the designers to stay connected with the persons behind the gathered information. The personas are built around the traits of the persons encountered in the field research.

Personas are typically presented with a name and a brief description. This description usually involves the life situation and goals of the persona. Personas are helpful in throughout all phases of the design process, since they are used as a human reference to the designers to design for in the ideation phase, as well as to validate in the development phase. Personas should be limited to three to five in any given project, in order to maintain a design focus and avoid targeting outliers (Martin & Hanington, 2012).

Storyboard and Scenario

Sharp et. al (2002) describes storyboarding as a low-fidelity prototype: a storyboard is a series of sketches to show how a user might process throughout a certain task using the product being developed. A storyboard allows the stakeholders to get a more

detailed view of the interaction between the system and user compared to reading a written scenario (Sharp et. al, 2002).

Like storyboards, scenarios are a way to communicate the user's perspective (Martin & Hanington, 2012). Scenarios help the designers to empathize with what the user is feeling, seeing, hearing and thinking through a narrative. It is generally used to describe a potential user using a product or a service in the future. While a scenario can offer a lot of insights into the design, it is also limited to only one perspective (Sharp et al., 2002).

Prototyping

Prototyping is a key activity in Interaction Design to transform an abstract thought into a more tangible artifact, which is a basis for discussion, iteration, and testing ideas. Houde and Hill (1997) suggest that a prototype is a representation of an idea and is used to examine the problems and evaluate the idea. A prototype of efficient nature produces rapid answers to the most urgent questions of the designer, in the least amount of time. A prototype consists of three different dimensions: role, look and feel and implementation. The role describes in what particular context the prototype could be useful. The look and feel represent how well prototype creates a sensory experience, i.e. how it looks and feels. The last dimension is implementation, which describes the feasibility of a certain prototype and how it works. A prototype can have all three dimensions (Houde and Hill, 1997).

Martin and Hanington (2012) describe two types of prototypes: low-fidelity prototypes and high-fidelity prototypes. Lo-fi prototypes are commonly represented in paper form, which is usually utilized in the initial stages of the design process. For software design and interfaces, lo-fi prototypes are used to validate the interactions between the different screens, to evaluate the usability of the product. Sharp et. al (2002) discusses the advantages and disadvantages of lo-fi prototypes. According to them, a lo-fi prototype is a useful communication device of a concept, although its simple nature limits its use in usability tests.

Houde and Hill (1997) argue that depending on the background of the designer, the definition of what a prototype actually is can vary. Hi-fi prototypes are a more refined version of the design and represents the final product in terms of look and feel. They are more useful in the latter part of the design process, which represent the final product in terms of aesthetics, form, interaction and usability (Martin & Hanington, 2012). According to Houde and Hill (1997), a hi-fi prototype takes a lot of time and is expensive to construct and such prototype might be perceived as more complete than it actually is.

4.2.4 Deliver-Phase

At the last stage of the design process, the mindset goes narrow. There are several decision-making techniques that can be applied to make the decision regarding the

best concept. In this process, the last phase does not lead to a market launch as the outcome of the project is not a real product. However, the methods are applied to evaluate the most essential factors affecting perceived safety in order to establish the guidelines.

Think-aloud Protocol

According to Martin and Hanington (2012) think-aloud protocol is one of the most common evaluation methods in the usability community. While evaluating a product or a service, the person evaluating is asked to perform a task while articulating thoughts, opinions and experiences. When performing a think-aloud session, the person evaluating is usually asked to perform a specific task rather than test the whole product at once (Martin & Hanington, 2012).

Usability testing

Martin and Hanington (2012) describe usability testing as an evaluative method that allows observation of an individual's experience with a product, while the individual is asked to perform a certain number of tasks. This is beneficial in the development process, since the usability testing will reveal elements in the product that confuse or irritate the user. The users' feedback is used to further improve the product. The number of persons evaluating the product will affect the numbers of problems that will be revealed. The greater the number of evaluators, the more problems will be detected (Martin & Hanington, 2012). By utilizing comprehensive usability testing the whole concept and the value that it provides to the user can be evaluated and improved.

Nielsen (2000) claims that using extensive user testing is a waste of resources. According to Nielsen (2000), no more than five users are needed to retrieve the best results from user testing since 85% of the usability problems are discovered after validating a concept with five users. However, Nielsen (2000) advices that a design should be tested in three different sessions which all include five users, i.e. in order to capture 100% of the usability problems and to get the most valuable feedback, a design should be validated by 15 users in total. The concept will most likely to be changed between each session, therefore it is not recommended to carry out one validation session with 15 users at once (Nielsen, 2000).

5. Execution

The chapter introduces first the initial plan to carry out this thesis project and after that explains how the project was actually executed. The process is presented within the framework of the Double Diamond model and its four phases: Discover, Define, Develop and Deliver. At the end of each phase, the most important findings, changes occurred, and the major outcomes are summarized.

5.1 Initial Planning

The extent of this master thesis project was 30 ECTS. The first five weeks were to be spent on research (Discover), followed by Develop- and Define-phases when executing the plan. The last four weeks were planned to be used for summarizing the results, reporting and delivering the findings (Deliver). During these weeks Humblebee offered a workspace at their office.

The thesis work was planned to follow the progress of the Humblebee-project as some material and insights gathered through that project were aimed to be utilized in this research. A suggested time plan for Humblebee-project was given by the company and this thesis project was to be adjusted accordingly. The project was planned to be carried out within the Double Diamond framework that consists of two 'diamonds'. During the first diamond Google Design Sprint process is followed and in the second diamond, Research Through Design approach will be applied.

The initial plan was to investigate the factors that affect especially female citizens' feeling of safety in public spaces. The outcome of the project was aimed to be a concept that evokes reflection through Critical Design approach around the paradox of women feeling unsafe. The type of the concept to be developed in the thesis was not defined in the beginning of the process and could be, for example, a digital product, interactive environment or board game. In addition to the concept, guidelines for a solution that aims to improve personal safety was about to be developed. It was planned to create a high-fidelity prototype to test the concept and the guidelines.

The initial time plan to carry out the project with corresponding activities in each phase were as follows (Fig. 6):

Discover (late-January / late-Feb)

- Literature research
- Google Design Sprints
- Survey

Define (March / late-March)

- KJ analysis
- Evaluation

Develop (late-March / early-May)

- Brainstorming
- Prototyping & User Testing
- Iteration
- Expert interviews
- Evaluation

Deliver (May)

- Reporting the findings

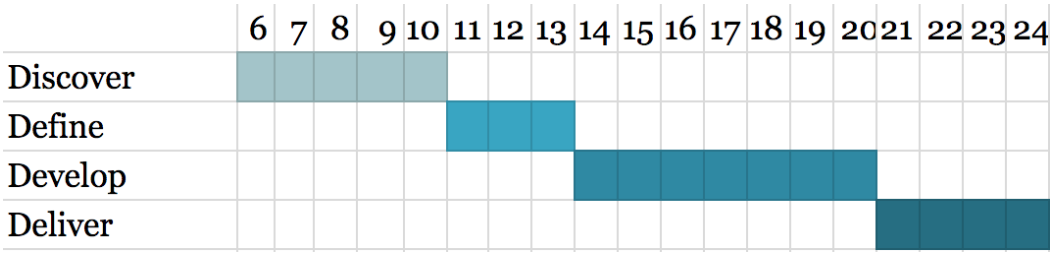

Figure 6: Initial Time Plan.

5.2 Discover-Phase

During the first quarter of the Double Diamond, the aim was to get a comprehensive overview of the topic of perceived safety in public spaces. The broader perspective was developed through literature research, a survey and developing three concepts together with the designers from Humblebee following Google Design Sprint method. The activities in the first quarter were seen as a reflective practice as the final outcome of the project was not yet defined when the project started.

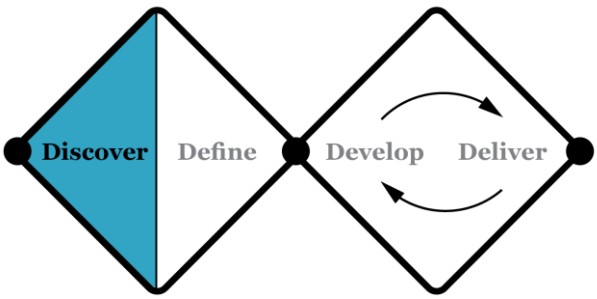

Figure 7: The Double Diamond Framework: Discover-phase.

5.2.1. Defining the scope with the stakeholder

In the beginning of the project, Humblebee had not yet decided what do they wish to gain through this research. Since this study was running parallel with the Humblebee-project and planned to be utilizing the material generated in that project, it was beneficial to define the deliverable in a way that it was aligned with the Humblebee-project. After the project started, Humblebee expressed that their interest in this thesis project is to attain deeper knowledge regarding the possibilities to establish a

venture in the field of personal safety solutions. To do this, they suggested possible questions to investigate, for example how perceived safety in the city of Gothenburg has changed during the past few years, what is the actual value that a safety solution delivers to the users and whether people would be willing to pay for a safety solution. To make the outcome of this research beneficial for the company, the approach to it was adjusted to answer the wishes of Humblebee.

5.2.2 Literature Research

Literature research was performed to gain deeper insights into the topic of perceived safety in public spaces. To retrieve online papers about the topic, online services such as Google Scholar and Chalmers Library were used.

When searching information through online services, the following web search queries were used: *perceived safety in public spaces, women + perceived safety, how to improve safety in public areas, trygghet i Göteborg, human emotions, theory of human motivation, emotional design, basic human needs, personal safety + smartphone application, personal safety alarm, Research Through Design. Apart from studying online papers, various books were reviewed.*

The literature research of perceived safety showed that a lot of research has been conducted in this topic. It was found out that among all humans, certain universal factors which either improve or decrease the feeling of safety can be identified and grouped. The factors that affect perceived safety fall into four categories: personal (gender, age, previous experiences, etc.), social (sense of community, presence of other people, etc.), physical (appearance of the environment, darkness, etc.) and other factors (seasonal changes, time of the day) (Maruthaveeran & Konijnendijk van den Bosch, 2014). The findings showed that personal safety is not built on only one category but is a result of a cooperative action of them all. Consequently, the degree to which an area is perceived as safe is affected by the person experiencing it. Therefore, perceived safety can be identified as a wicked problem to which there is no only one right solution.

To investigate possible approaches and methodologies to this research, previous course literature from both author's programs, Interaction Design and Industrial Design Engineering, were reviewed. In this study, a holistic approach is taken in order to emphasize and internalize the interrelating factors that together create the experience of safety. The approaches to tackle wicked design problems were analyzed. To build an understanding of how to possibly evoke reflection regarding the underlying reasons of safety or the societal problem regarding perceived safety, principles of Critical Design and Value Sensitive Design were studied. Emotional design was studied to reflect the diverse ways how to target perceived safety through emotions.

As a part of the literature review, the existing products and related solutions that improve perceived safety were reviewed. It provided an understanding of the diverse ways the how the feeling of safety can be delivered through a product.

5.2.3 Additional Research

Apart from the literature study, the subject was investigated further by carrying out additional research. The initial plan for Discover-phase included only literature research, survey and Google Design Sprints. However, when carrying out literature study it was noted that to better grasp what is currently happening in the city of Gothenburg, a field research is needed. This research is called Additional Research, as it was carried out to supplement and support the research carried out in the beginning of the process.

Älvrummet

To gain more hands-on knowledge regarding the future development of the city of Gothenburg, an exhibition called Älvrummet was visited. Älvrummet (Göteborgs Stad, n.d.) provides information regarding the ongoing development of Gothenburg. The purpose was to retrieve deeper information of the plans for how the city will grow and how the potential problems that rapid urbanization might cause to perceived safety in public areas are addressed. Nevertheless, the field trip did not yield the expected results since the focus of the exhibition was mainly to show how the urban development affects the landscape of the city and not to discuss societal aspects, such as safety in urban spaces. Yet, it pointed out the rapid growth of the city of Gothenburg in the near future. This made it clear that personal safety is a current topic to address in order to ensure citizen's wellbeing.

#metoo-hackathon

By the definition of a wicked problem, oftentimes there is another problem behind the actual wicked problem at hand (Rittel & Webber, 1973). As the initial plan of this thesis was to study perceived safety in public spaces particularly from women's perspective, it was chosen to investigate media's effect on how women perceive safety. At the time when this project was carried out, there was so-called Me Too (or #metoo on social media) movement going on. It aimed to unmask and evoke discussion regarding sexual harassment experienced by women (Nationalencyklopedin, n.d). To explore the societal implications of Me Too-campaign and its possible consequences on perceived safety, the initiator of the Me Too-hackathon in Gothenburg was interviewed. Unfortunately, the interview with the initiator did not give the expected information regarding the research question. Instead, it turned out to be a general discussion about the existing gender roles in the society and how men are expected to behave towards women.

VÅGA

As mentioned above, the existing gender inequality and harassment that women are facing in the society were considered as a possible cause of the low perceived safety

among women. To understand what other actions, besides #metoo-hackathon, are being taken in Gothenburg to solve the social problem a campaign called VÅGA was studied and contacted. VÅGA works towards eliminating the problem showing in the nightclubs and bars. It aims to establish a certificate system that would identify a nightclub or a bar as safe where there is educated staff who knows how to handle assault and sexual harassment (VÅGA, n.d.). Contacting VÅGA did not give any direct input on our study and it did not point out any direct implications on perceived safety in public spaces. However, it further pointed out that there is a societal problem and it has been acknowledged by the authors. After discussing with the representatives of #metoo-hackathon and VÅGA, it was realized that focusing only on women's perception of safety would take the study too far away from its primary focus, which is to investigate the experience of safety. Also, focusing only on women was seen as a risk to create a bigger gap between genders and segregation in the society.

5.2.4 Survey

To gather substantial amounts of data in the initial part of the project, an online survey was conducted. To build this online survey Google Forms was used. It was distributed on Facebook to reach people across locations and it was online for 10 days resulting in total 280 responses. The survey was directed towards citizens of Gothenburg and the aim was to gain an initial deeper understanding of their relationship towards the topic of perceived safety in public spaces in Gothenburg. The research objective was to find out what situations and areas of Gothenburg are perceived the most unsafe, what items or factors are linked to safety and how the time of day effects on the feeling of safety. Additionally, the purpose was to find out whether the feeling of safety has changed over the past 5 years. For the full list of survey questions, see Appendix I: Survey Questions.

When compiling the survey questions, the considerations presented by Martin and Hannington (2012) were reviewed. The survey was anonymous and contained questions with rating scales of seven points and multiple-choice questions with predefined answers. Besides the questions regarding perceived safety, the survey included demographic questions. The questions were written in a neutral way to avoid influencing the results. The respondents were able to choose one or more items in each question. The length of the questionnaire was kept short to increase the number of responses. The questionnaire was written in English and this may have affected the results. The target group for the survey was all citizens of Gothenburg and not only Swedish speaking citizens, therefore the language was chosen to be English. In general, the level of English language skills among Swedish people can be considered to be high, therefore the language was not seen as a problem. Before publishing the survey online, it was tested among potential respondents to get feedback and to validate it.

Survey Results

The major findings from the survey were:

- Street lights and company of other people, especially a good friend, improve the feeling of safety the most
- People feel the most unsafe when walking home from a bus stop late at night
- Top 3 items that improve perceived safety: smartphone, pepper spray and personal alarm
- Top 3 most unsafe areas: City Center, Norra Hisingen, Västra Hisingen
- More than two third of women feel unsafe in public spaces
- A third of men occasionally feel unsafe in public spaces
- There is a marginal decreased perceived feeling of safety over the last years

In general, the results supported the findings from literature study. For example, the findings pointed out that the absence of street lights and darkness significantly decrease perceived safety (Mehta, 2014; Maruthaveeran & Konijnendijk van den Bosch, 2014; Soraganvi, 2017), (2010), walking home from a bus or tram stop is the situation that people consider the most unsafe in public spaces (Sandstig, 2010), presence of other people has a major effect on perceived safety in public spaces (Sandstig, 2010), and that the general feeling of safety in Gothenburg is decreasing (Social Resursförvaltning i Göteborg, 2017). Also, the survey results were aligned with the Swedish Crime Survey conducted in 2016 (Brå, 2016), that reported that the absence of street lights, badly lighted streets and darkness decrease perceived safety. Likewise, both our survey and Brå reported a higher level of fear among women than men when alone in public spaces (Brå, 2016).

5.2.5 Carrying out the Google Design Sprints

Along with the survey, Google Design Sprints were used as a means to gather data. To utilize Google Design Sprints was a suggestion from the stakeholder and a part of the Humblebee-project, as presented in chapter 2.2 Project Framing and Approach. It is a rapid method to explore the user value and to build deeper understanding through user validation.

A duration of each sprint was five days and they were carried out together with the designers and developers of Humblebee. They were based on the findings from the literature study and the survey. The nature of the sprints was iterative and the learnings from one sprint were taken along into the development of another. The outcome of the sprints was not tied to any particular solution, i.e. a digital application, yet they aimed to create any possible solution that would improve the feeling of safety for a citizen. Exploring diverse types of solutions was of an interest to Humblebee since they wanted to investigate business opportunities within the field of perceived safety. Through the concepts, the team aimed to learn more about how individuals think, what are their concerns and pain points regarding safety in public spaces and what is needed in order to improve the general safeness in the society. In other words, the purpose was to build knowledge through exploration and discovery. This perspective was aligned with Research Through Design approach, that also retrieves knowledge through designed artifacts.

Each sprint included the same five phases: understand, ideate, decide, prototype and test. The activities carried out in each phase are described below and the result of each sprint is presented in chapter 5.2.6 The Google Design Sprint Concepts.

Figure 8: A Google Design Sprint Workshop.

Understand

During the sprints, the team created personas in order to take the user's perspective and identify the worst pain points. According to Martin & Hanington (2012) a persona is a typical way to make collected information about the user group and to keep the human perspective through the design process. However, in the Humblebee-project, personas were created rather freely and not following the persona design guidelines. The purpose of personas in this sprint was to empathize with the potential user and to create a collective understanding of the user among the design team. Thus, the personas were not based on any former study, yet they were mainly used as an inspirational tool for design.

Ideate

The ideation phase was performed in collaboration with designers at Humblebee as an ideation workshop to generate several diverse ideas. During two sprints, Crazy 8 ideation method was used. After each workshop attendee had created eight ideas of their own, the ideas were presented for rest of the group. The results were discussed and some of the ideas were combined to create even better ideas. In one sprint a more experimental way of brainstorming was used. During a limited time of 10 minutes, any

random idea related to the topic, without any criticism towards its feasibility, was written down on post-its. After that, the post-its were placed on a wall and grouped by using the KJ method.

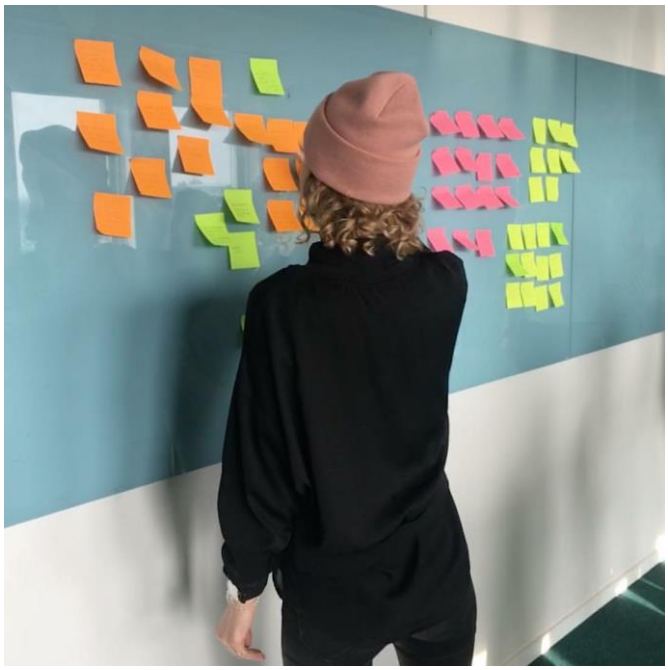

Figure 9: KJ Method.

Decide

After each ideation phase, dot voting was used to decide on what idea to proceed with. All the ideas were written down on a separate post-it and put on a wall. Each member of the workshop got a limited number of votes, in shape of small dots. These dots were placed by the workshop participants on the ideas they appreciated the most. The idea with most votes was transformed into a prototype.

Prototype

To conceptualize the ideas into prototypes as rapidly as possible, they were presented in form of posters in order to convey the idea to the participants of the user testings. The posters visualized the key characteristic of the concept, demonstrated with images and additional description of it. The posters were used as a basis for discussion during the user testings, since a descriptive poster would feel more tangible and relatable to the interviewees.

Test & Evaluate

To validate the concepts, semi-structured interviews were carried out with at least five interviewees to get rapid feedback on the prototype. The aim was to interview and demonstrate the prototypes for persons within the potential user group of each concept. The interviews started with a brief presentation of the concept and the purpose of the team. After the initial presentation, a semi-structured interview followed of which aim was to get feedback on the prototype. The results from the user

testings were written on post-its and grouped by using KJ analysis. After the KJ analysis, the feedback of the prototypes was summarized and reflected upon.

5.2.6 The Google Design Sprint Concepts

In this section, the result of each Google Design Sprint is presented. It involves descriptions of a persona, the concept and the result of the user testing.

Concept 1: #GetOff

Persona: Ebba, 25

Ebba is a social and outgoing young woman. She lives outside the city center of Gothenburg and enjoys long walks in the forest with her dog. During the winter she is a bit worried about her safety when in the woods. On the weekends she likes to meet up with the friends in the city center and getting home late in the evenings concerns her sometimes. She does not own a car, so she is using public transportation to commute.

#GetOff is a smart safety bracelet with an automatic alarm, a product targeted towards young women, like Ebba (see Fig. 10). The concept has a built-in gyroscope and heart rate monitoring, which will detect when the user is in a panic situation and will activate the alarm automatically in case of emergency. Also, it has an option to activate the alarm function manually. The alarm is connected to security guards and police in the nearby area. The bracelet comes with a glowing light feature that communicates to others that the person is 'connected' to the authorities. The use case of this product is when the user is walking home alone in the dark late at night, which the survey results reported to be perceived as the least safe situation. Additionally, both the literature research and survey results emphasized that women feel significantly more unsafe than men, which is the motivation to target young women with this concept.

The concept was tested by interviewing five potential female users of age 20 to 25. Participants in the interviews said that the concept would add their feeling of safety. They liked that the product was tangible, and the connecting function was seen as a very good function as well. However, the respondents thought that the concept might victimize them. This was due to its glowing function that was evaluated as least attractive part of the concept. It was said that the glow makes the user visible that, in turn, would show a possible attacker that the user is afraid and therefore an easy target. Even so, a preventive property itself was considered to be beneficial as it would minimize the risk of being attacked. Many of the interviewees said that they hope there was no need for them to have a personal safety alarm and they hoped that men were more aware of how they feel. Additionally, some of the respondents said they would prefer a manual function only for calling help, because they wanted to estimate themselves when there is a need to use such product. Thus, the reliability of the technical aspects was suspected.

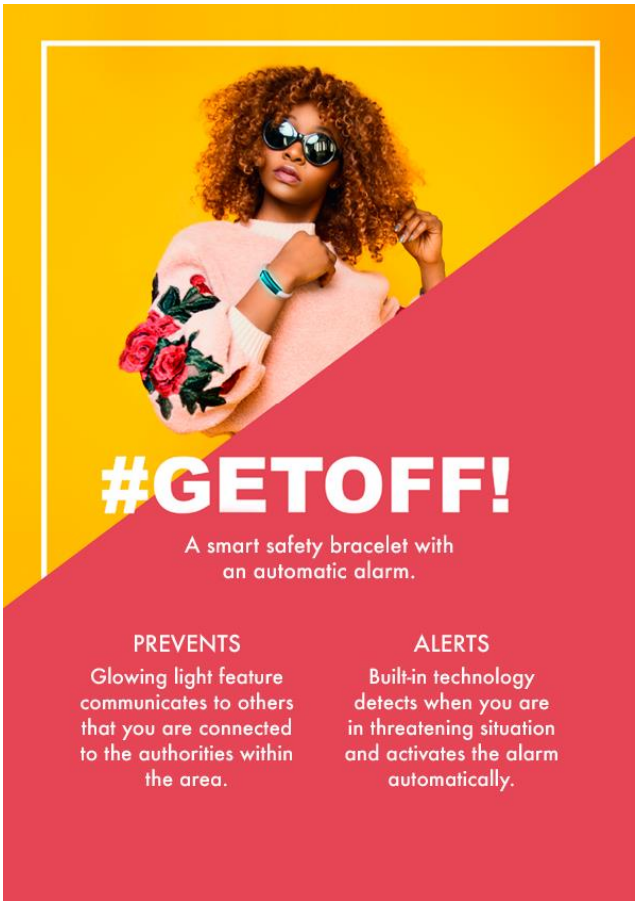

Figure 10: The Prototype of the First Concept: GetOff.

Concept 2: Experience Another Reality

Persona: Oscar, 23

Oscar is a friendly young guy who loves team sports. He is very popular among his friends and on a typical Saturday night, Oscar can be found at a nightclub having an enjoyable time. On the weekdays, he likes to play video games. Sometimes he gets affected by the peer pressure and is thinking about what other people think about him.

Experience Another Reality is a concept directed toward young men like Oscar that offers the user a possibility to experience certain situations by other people's perspective in a virtual reality (VR) (see Fig. 11). The inspiration for developing this concept was taken from the women's interview responses. That is, they hope that such a situation did not exist in the first place that they would need a safety alarm, i.e. they wish to change the behavior of the persons making them feel unsafe. Hence, the use case of this concept is to increase the user's understanding of how a woman might feel when walking home alone late at night, i.e. it translates situations that women experience as intimidating. It works as an empathy tool by providing a sense of how it seems when some stranger approaches in the scary environment, i.e. in a dark and empty alley, for example.

Figure 11: The Prototype of the Second Concept: Experience Another Reality.

The concept was tested by interviewing five young men between the ages of 20-25. The interviewees considered the idea interesting and exciting and they all said they would be willing to try it in reality. However, when asking their opinions regarding what type of a situation or 'another reality' they would like to test, most of the respondents did not want to experience anything scary. The user testing revealed a lot of questions regarding the quality of the VR experience and the purpose of it. Additionally, the respondents considered the concept as something that they would use only once; hence it would be more suitable as an educational tool, for example for schools, than to be sold as a consumer product. All things considered, it was realized that the need for this concept is not of the target group's own.

Concept 3: Nightfellows

For the third concept, the team decided not to create a persona. The reason for this was that a persona was seen to be too restricting and presenting only one characteristic of all potential users. Instead, the team defined a target group which was formed by merging the two previous personas, Ebba and Oscar, together. Hence, the target group of the third concept was young adults who socialize with their friends and like going out on the weekends.

Nightfellows is a smartphone application that improves the feeling of safety when walking home alone late at night, which according to Sandstig (2010) and the survey is the situation when people feel the most unsafe. To target this situation, the concept uses a similar idea as the existing Swedish concept of Nattvandrarna. Nattvandrarna are volunteering people who walk on the streets in several cities around Sweden

during nights aiming to increase safety by being present and talking with people. (Nattvandrarna, 2017) However, the problem with their organization is that Nattvandrarna are visible to citizens only when encountering them. Taking inspiration from this, the concept makes the location of 'Nightfellows' visible by showing them on a map. In the concept, Nightfellows are trusted people who either work or are volunteering in the service. Besides seeing their location, the user can connect to them by messaging or calling, and request them to walk you home, for example, from a bus stop. The core idea of how this concept improves perceived safety is that it creates a sense of not being alone on the streets. The prototype can be seen in Figure 12.

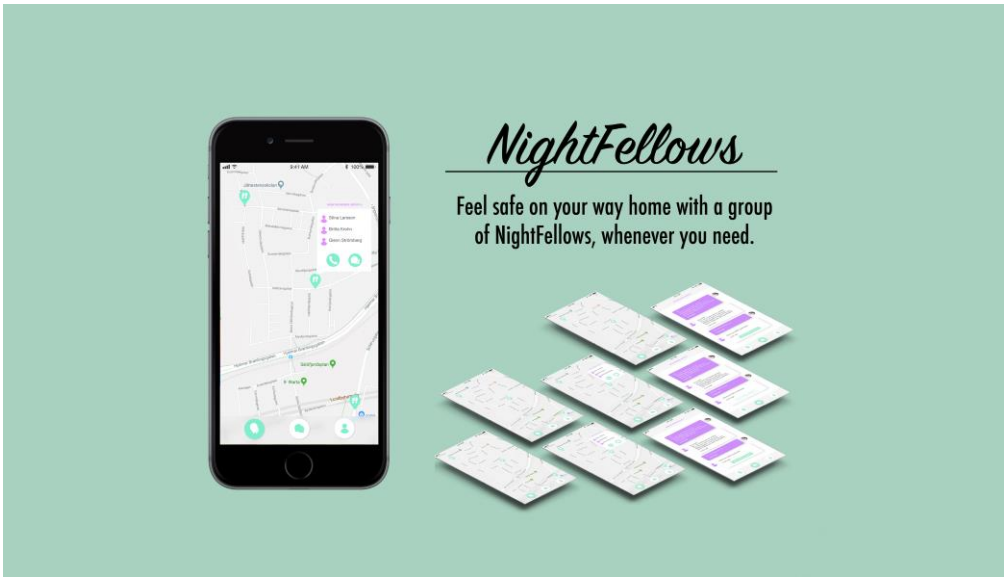

Figure 12: The Prototype of the Third Concept: Nightfellows.

The ideation of the concept also took inspiration from the literature results that pointed out that people feel unsafe in the desolate areas outside of the city center, and the survey results that suggested that a smartphone is an item that improves the feeling of safety the most. Moreover, it aims to provide a solution for people feeling unsafe especially during the night time. In contrast to the previous concept, this concept is not targeted towards a specific gender but can be used by anyone who wants to feel safer. This was done since the survey results revealed that not only women's perception of safety, but also men's, is decreased during the night time.

As the target group of the concept was not targeted to a specific gender, it was tested by interviewing both female and men. Overall, the interviewees evaluated the concept to be a promising idea which would increase their perceived safety. This was mainly because it would provide them someone to walk home with. However, men said that they would not use the service as they are not afraid and do not need anyone to walk them home. Also, the responses indicated that there would be issues regarding trust. It was questioned whether the user can trust that the Nightfellows actually are good people.

5.2.7 Summary of Discover-Phase

Discover-phase was about building knowledge through exploration and discovery. The beginning of the project included literature study, survey and three Google Design Sprints to create a comprehensive understanding of the topic and the interdependence of different factors that affect perceived safety.

The initial plan was to address perceived safety from Critical Design perspective. Also, it aimed to highlight the paradox of women feeling unsafe in public spaces. It was understood that the feeling of safety is interpreted through each individual's perception of the surroundings and can be a highly sensitive topic. Another reason to switch the approach appeared after further discussing with the stakeholder. Since Humblebee wanted to gain insights of possibilities to create business opportunities around personal safety solutions, the project approach was altered to be 'less radical' and make the concept proposal in such a way that it could possibly be commercialized.

Regarding the aim of this research, it seemed to be a too narrow approach to focus only on the women's perceived safety and the paradox of fear among women in public spaces. Thus, the topic was decided to be studied from gender-neutral perspective instead of focusing only on women's perceived safety in public spaces. By taking a gender-neutral approach the idea was to place a greater emphasis on the actual feeling of safety and the overall reasons that create it, not on the person who is experiencing the feeling. It was comprehended that the gender inequality is a significant societal issue and understanding its sensitive nature, the gender-neutral approach was taken. Moreover, the survey results indicated that a third of male respondents and two-thirds of female respondents feel unsafe in public spaces. This finding supported the decision to not focus only on women's perceived safety but to follow more gender-neutral approach.

Due to the decision to leave Critical Design and woman-centered approach, the research question no longer described the focus of this research. Therefore, in this stage, the research question was rephrased to be more general.

5.3 Define-Phase

After conducting the background study in the Discover-phase, the project moved on to making sense of all the gathered data. During Define-phase, the outcome of this

project was further clarified, and a clear brief established. The activities in the second phase included, for example, reflective evaluation, further discussions with the stakeholder and clustering the quantitative findings.

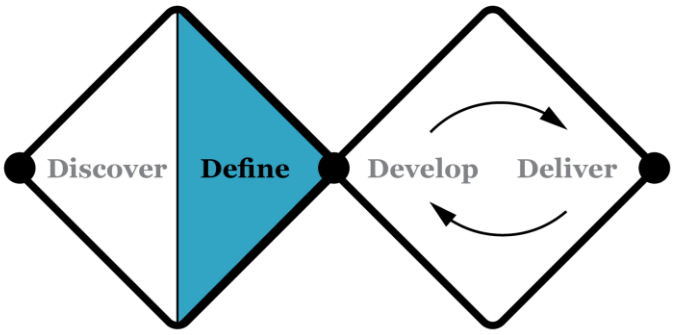

Figure 13: The Double Diamond Framework: Define-phase.

5.3.1 Refining the Project Plan

In the beginning of this phase, the time plan was adjusted and decisions regarding the project outcome were made.

New Time Plan

The extent to which the Discover-phase went, was broader than expected hence it also took a longer time to execute than what was planned. According to the initial plan, the length of Discovery-phase was to be five weeks but ended up to eight weeks. However, the information gathered during the first phase was needed to learn and internalize the fundamentals of how the experience of safety is formed. Also, the knowledge was processed throughout the Discover-phase which accelerated the execution of the rest of the project. Anew time plan to carry out the rest of the project within the given time frame was done. The actual schedule of how the study proceeded is visualized in figure 14.

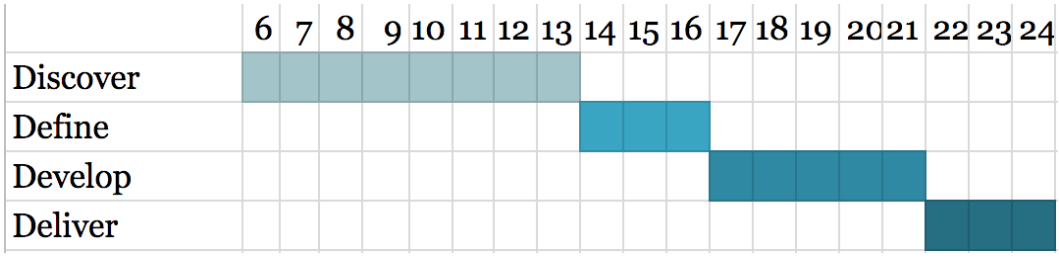

Figure 14: The New Time Plan.

Separation from the Humblebee-project

In this phase, it was decided to separate from the Humblebee-project. In the beginning of this thesis, the plan was to possibly utilize the concept developed within that project also in this study. However, the new time plan of this thesis project did not match with

the schedule of the Humblebee-project. Moreover, the concept that was decided to be further developed in that project did not suit the purposes of this research. As such, the early qualitative research in this thesis project carried out in collaboration with the Humblebee-project but the further concept development and evaluation is done separately.

Defining the Concept

At this stage, it was decided that the concept to be created in this thesis project is a smartphone application. The decision was based on two reasons. Firstly, since Humblebee is a digital design agency, it was a reasonable choice to focus on exploring the possibilities of a digital product. Secondly, the survey results supported the decision to create a smartphone application since a smartphone was reported to be the most popular item that improves the feeling of safety. When the type of the solution was clarified, also its role in this research was re-evaluated. In the beginning of this project, it was defined that one of the deliverables will be an interactive high-fidelity prototype. Nevertheless, now the concept was decided to be only a secondary deliverable which evaluates and exemplifies a role of a smartphone application in improving perceived safety. Additionally, design implications for that specific concept were decided to be generated. The concept is seen as a by-product of the research and for the purpose of this study, it was considered to be unnecessary to build a hi-fi prototype.

5.3.2 Synthesis of the Literature Study and Survey

To analyze and transfer the findings from the research phase into the guidelines, a systematic classification of the data was required. The findings from the quantitative research were analyzed by using KJ-method. Answers from the survey were written down in order to get a good overview of them and to notice the interconnecting factors. From the survey, information regarding the situations and places that were perceived as not safe were extracted. Also, as mentioned earlier, the results gave insights regarding the items that the respondents associated with an improved feeling of safety. After grouping the results, it was noted that the four categories discovered in the literature study were the most applicable and suitable to be used as a frame to map the factors that affect perceived safety. These categories are ‘personal factors’, ‘social factors’, ‘physical factors’ and ‘other factors’, earlier described by Maruthaveeran and Konijnendijk van den Bosch (2014).

To simplify the investigation, it was decided to merge ‘other factors’ and ‘physical factors’. This was done because both categories include considerations for the effect of light, hence the attributes in them were seen to be overlapping. Moreover, seasonal changes have a significant effect on the amount of daylight in Scandinavia, therefore they were linked together. As such, in this thesis project the following categories are used as a basis for the further study:

Personal factors regard an individual's characteristics, i.e. age, gender, personal interpretation of surroundings and previous experiences.

Social factors regard the sense of community, the presence of acquaintances or strangers, the familiarity of the area, and isolation of neighborhood.

Physical factors regard the appearance of the environment, darkness, the time of the day, and seasonal changes.

Since a deeper understanding of these domains was required to continue this study, experts within the fields of social sciences, urban planning and architecture were contacted and invited for an interview. Additionally, efforts were made to set up an interview with a psychologist to get insights into how human behavior and mind can be addressed in this context. This would have been a major benefit to understand the role of personal factors in experiencing safety and to strengthen the holistic approach in the study. However, regardless of the efforts, an interview with a psychologist could not be arranged due to clashing schedules.

5.3.3 Drafting the Guidelines

The main outcome of this thesis is the guidelines for improving safety in public spaces. The guidelines were decided to be descriptive. The study which was carried out during the Discover-phase and the synthesis of the findings was used as the basis for formulating the first version of the guidelines. The first draft was only some keywords and based on the authors' own infers and conceptions about issues that were considered as important to address when improving the feeling of safety. The first draft of the guidelines was as follows:

- Company & other people
- Sense of community
- Calling someone makes people feel safer when they are alone
- Street lights and darkness
- Clean and organized environments support safety
- Support perceived safety especially outside of the city center
- Open spaces are perceived as less safe than closed spaces
- The atmosphere in society affects the overall safety
- If people think they are seen being scared it decreases personal safety
- Individuals with similar characteristics relate to each other
- Try to prevent an attack if possible but don't victimize

5.3.4 Approach to the Concept Development

Based on the research of related work, it was realized that the safety applications on the market today are relatively similar to each other and they provide functions of the same kind (panic button, location tracking, connection to authorities). In a way, these can be seen as functions that help when personal safety is in fact threatened, and these

applications offer a solution to deal with the consequences of an attack. Instead of evaluating what are the best features that help when a person has been subjected to a crime and analyzing why it is so, a different approach was taken into this study. It was decided to study what possible role a smartphone application can take in order to improve perceived safety without focusing on the solutions for coping with emergency situations.

The aim of the concept was to evaluate how a smartphone application can enhance the experience of safety in terms of the three different factors (personal, social and physical) and to identify a suitable role to do it. Also, the aim was to generate design implications that suggest the important aspects to consider in that particular application. The core idea of the concept was aimed to be rather simple. Since the question of perceived safety is very wicked, it was understood that there are several applicable solutions and approaches to take, and the concept itself did not aim to be a comprehensive solution that covers everything.

5.3.5 Summary of Define-Phase

During the Define-phase, the remaining uncertainties were removed, and the final goal of the study was established by synthesizing the information gathered. It was decided to separate this thesis project from the Humblebee-project, also the time plan of the thesis was also adjusted to meet the deadline since the Discover-phase lasted 3 weeks longer than what was initially planned. Moreover, it was decided to develop a smartphone application that explores what role a digital solution can take in order to improve perceived safety.

Based on the refinements done in this phase, the research question was now divided into two questions. The main research question concerns mapping out the important factors to consider in order to increase perceived safety, while the sub-research question concerns what possible role a smartphone application can have in improving perceived safety.

5.4 Develop-Phase

Once the aim of the study was established, the process moved on to the second diamond of the Double Diamond framework. The goal of this phase was to further develop the guidelines, create a smartphone application concept and to generate design implications for the concept. Develop-phase began by interviewing experts in different fields which relate to perceived safety and would support the guideline development. After that the project proceeded by ideating the concept, building a lo-fi prototype and conducting user testings. The activities in the third quarter were very iterative and the findings were continuously reflected.

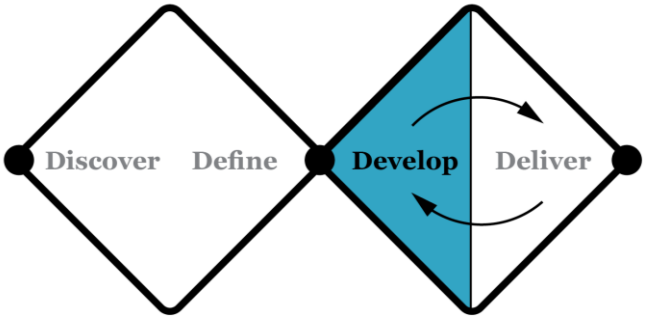

Figure 15: The Double Diamond Framework: Develop-phase.

5.4.1 Expert interviews

As mentioned in the previous chapter, four expert interviews were carried out with experts whom could, with their knowledge, contribute to the study of personal, social and physical factors which affect perceived safety in public spaces. This was done in order to get first-hand information of different perspectives about the topic. The interviews were carried out with following experts:

- Architect with Expertise in Lighting design (White Architects)
- Researcher in Urban Planning with a Background in Social Sciences (RISE Research Institutes of Sweden)
- Senior lecturer at the Department of Journalism, Media and Communication with 15 years of experience of researching safety and security (Gothenburg University)
- A representative of Nattvandrarna Gothenburg, with 27 years of experience of being an active Nattvandrare

Before the interviews, it was considered what was the expected outcome of each interview that would support us in answering the research questions. Each interview aimed to cover the same questions but from each expert's point of view. The interviews were conducted in English in a semi-structured way, e.g. if there was a need for clarification from the interviewee, follow-up questions were asked. The questions are presented in Appendix II: Expert Interview Guides.

All interviews were recorded, after getting verbal permission from each interviewee before the interview. Each interview recording was transcribed and later analyzed. To understand the answers and to see the connections between each interview, the answers of each question were gathered and divided into the following categories: Personal Factors, Social Factors, Personal Factors and Technology and Perceived Safety. Each section starts with a concise summary of the main findings.

Empirical Perspectives on Personal Factors

Perceived safety is a highly personal experience and is affected by personal characteristics, the level of emotional stability and the trust one holds towards

others. Media has no direct effect on perceived safety but might affect the awareness of societal problems, which in turn, decreases perceived safety. Gothenburg is a generally a very safe city and the risk of something bad happening is low. Many areas in Gothenburg are perceived as unsafe but statistically, they are safer than what citizens perceive them to be. Also, fear is primarily stemming from the idea of the possible negative consequences of a crime, not the actual crime itself.

The representative of Nattvandrarna, the researcher in safety and the researcher in urban planning all agreed that there are public conceptions regarding the safety in certain areas of Gothenburg. The representative of Nattvandrarna claimed that media gives an unfair picture of certain areas of Gothenburg. Likewise, the researcher in urban planning said that there are certain areas in Gothenburg such as Bergsjön, Kortedala and Kviberg that are perceived as unsafe but statistically they are safer than what citizens perceive them to be. These areas are considered as low-status areas and the population in these areas generally has the income below the average compared to other Gothenburg citizens. The researcher in urban planning mentioned that the low-status areas are perceived as unsafe all around the world. He pointed out that compared to other cities in the world, Gothenburg is a generally a very safe city. The representative of Nattvandrarna also said that the risk of something happening is minimal.

On the contrary, the researcher in safety claimed that the media on its own has no effect on perceived safety in public spaces. Instead, she described media as an amplifier. She exemplified that if a person has negative experiences or has seen someone else being a victim of an unpleasant event, media can amplify and remind that person about his or her own negative event. She also added that the way media reports about crimes have become more dramatized with shocking pictures, yet the actual number of crimes have not increased. Furthermore, she mentioned that media affects the awareness of the public regarding societal problems. It has been noted that the gang-related crimes reported in Gothenburg have increased the citizens' anxiety about gang-related crimes and their effect on their safety.

Furthermore, through the interviews it came clear that there is a difference between what a person assumes to happen and what actually will happen. The researcher in safety described that the level of emotional stability has a significant effect on how individuals perceive different situations and other people. In general, people feel the safest when they are in a closed space with acquaintances, where there is social control. Accordingly, people with low levels of emotional stability may perceive any space as unsafe whereas higher levels of emotional stability create a safer experience. Moreover, the researcher in safety explained that people who generally hold a firm trust towards life, are also more confident when it comes to their personal safety. That can be explained by the underlying trust that those people have in life. The influence of personality was confirmed by the representative of Nattvandrarna who stated: "There is a difference between FEELING unsafe and BEING unsafe".

The representative of Nattvandrarna claimed that through his observations and discussions with people, gender is a major factor affecting perceived safety. On the other hand, when being with peers, age plays a significant role. The most unsafe group, according to him, were young people regardless if they are with peers or not. The representative of Nattvandrarna also highlighted the feeling of safety among elderly people. He believes that they feel unsafe when walking outside alone and are influenced by the media. He explained that the news about crimes affect their perception of safety since the media is usually reporting about the negative aspects of the society.

The researcher in safety believed that the general public perception of safety and the absolute safety correlates. In general, the citizens of Gothenburg are very aware of the risks and the probability of something happening. She pointed out that typically, people are not concerned about the actual negative event, instead, they are worried about the consequences of it. Accordingly, fear is primarily stemming from the idea of the possible negative consequences of a crime.

Empirical Perspectives on Social Factors

To increase perceived safety in an area, the physical environment should be welcoming, warm, friendly and well-maintained. Also, people are exposed to a well-maintained area for a longer time, their perception concerning perceived safety will increase. Furthermore, a sense of community and trust among people within an area also increases the feeling of safety. Signaling trust by not having high barricades around buildings will also affect perceived safety in the area. Lastly, a living area with a lot of people on the move will also increase perceived safety.

The interviews with both the researcher in urban planning and the researcher in safety emphasized the importance of the sense of community for perceived safety. Humans are social creatures and everything that signals community will improve perceived safety. Thus, it is clear that the human need for belonging and being able to trust the people around us is crucial in order to feel safe. Moreover, it was stressed that a daily human interaction is a fundamental aspect to consider within the context of social factors. It was explained that the events that occur daily have a bigger impact on how we think since they act as frequent reminders, whereas an event that occurs more rarely does not have that much of an effect.

If people perceive the physical environment as welcoming, warm and friendly, it will increase the positive experience of that environment. Also, if people spend long periods of time in a welcoming environment which is signaling trust, they start to form a positive perception of the people in that area. This was explained that the trust signaled by the atmosphere in the area improves perceived safety because the person feels that she or he is a trusted person. Accordingly, a massive fence or a wall around a house can be interpreted as a signal of mistrust towards the neighborhood which in turn, decreases the overall perceived safety within that area.

The researcher in safety mentioned that people find it hard to trust people whose behavior they cannot predict. Young women are often claimed to experience anxiety regarding safety in public spaces, however, if they are familiar with the neighborhood and can predict other people's by using social queues, their feeling of safety increases. The researcher in urban planning also emphasized that a living city improves perceived safety. For example, providing several types of social functions (e.g. kindergartens, cafés and cultural centers) in the same area and building active ground floors improve the public life. A new trend in city planning is to connect different districts of a city to increase the number of people visiting different areas. However, this might affect the feeling of safety in a negative way, since there are a lot of strangers visiting the area. Additionally, not having a homogenous society will also increase safety. Studies have shown that children being in a kindergarten with other children from mixed cultures are more likely to trust strangers as adults. Being able to trust other people is an indicator to feel safe.

The researcher in urban planning also described the author Jane Jacobs' theory called 'Eyes on the Street'. This theory explains that citizens watch after each other and considers that people on the streets are being watched by other residents through the windows. In other words, the theory suggests that neighborhood safety is improved when people care for each other. Also, this theory supports the understanding that a sense of community and familiarity of the neighborhood increases perceived safety.

Empirical Perspectives on Physical Factors

The physical environment in public space should be well-maintained and structured to strengthen the feeling of safety. In parks, bushes and trees should be maintained, and any signs of vandalism in surroundings should be removed, such as graffiti. The environment should be designed to be welcoming and support spatial orientation. A way to provide an understanding of how an area is structured is to use lighting, for example street lights and vertical illumination of buildings.

In order to improve the feeling of safety in public spaces, the researcher in urban planning suggested that areas should be well-maintained and structured. He claimed that human's biological heritage and the subconscious mind might affect how safe we perceive the environment. For example, an adequate number of potential places to hide in case someone attacks will improve perceived safety. Additionally, clear routes that enable sudden escaping from the area in case of a potential threat is crucial for feeling safe. The lighting designer mentioned similar cases; providing sufficient visibility by cutting overgrown bushes or trees will support the feeling of safety. From an evolutionary standpoint, darkness, trees and bushes are considered as a hiding place for predators to attack and will therefore decrease the feeling of safety.

The lighting designer recommended to increasing the feeling of safety in public spaces by vertically illuminating the walls of buildings. This creates a feeling of 'closed room' in the public space which supports understanding of how the surrounding is

structured. Furthermore, illuminating essential elements in the environment, such as pathways and entrances, help people to orientate and make sense of the dark area around them.

The representative of Nattvandrarna claimed that fully functional street lights are crucial for high perceived safety in public spaces. Especially, if within a small area several lights are broken, it will dramatically decrease the feeling of safety because of the darkness. Additionally, various adjustments in the environment can be done that improve perceived safety. Pedestrian tunnels could be designed to be more inviting, signs of vandalism, such as graffiti and broken property, should be repaired and any litter on the ground should be cleaned.

Empirical Perspectives on Technology and Perceived Safety

Technology can be applied in numerous ways to improve perceived safety. A smartphone application could, for example, provide data for city planners, architects or government to create a safer society. Citizens could report unsafe areas or broken property for the authorities which then would get direct feedback regarding what actions to take. Also, a smartphone application could be used as a tool to improve the sense of community or to provide insights into the trends of how citizens move in certain areas.

The interviews with the experts gave insights on the possible ways how different smartphone applications could be used by city planners, architects or government to create a safer society. An application in which citizens could report crimes and that would create a visualization of the crime statistics is considered as an interesting opportunity by the researcher in urban planning in order to better design the society. Additionally, information about the different types of committed crimes would be helpful in his work. Similarly, the lighting designer stated that data regarding areas that are perceived as unsafe by the citizens would be beneficial. Nevertheless, it was also discussed how liable this data would be as the experience of perceived safety is very subjective. As the lighting designer stated, data about perceived safety is hard to measure.

Problems such as glare, graffiti and destroyed street lights are less subjective and would therefore be less problematic to be reported through a smartphone application. Additionally, data about how citizens move in a certain area could be helpful to improve perceived safety in that area. For example, this data could point out reasons why people are avoiding certain pathways or places. The technological solution must be applied in a constructive way. It is worth of considering that an application that reports crimes or other unsafe events, might in fact decrease the general feeling of safety in that area. If the solution is about reporting broken property, then it is important that the person reporting will get a feedback when actions have been taken.

Apart from using technology as a channel between the citizens and authorities, an application can directly improve perceived safety. The representative of Nattvandrarna claimed that technological solutions are definitely a way to increase perceived safety, as there is a growing interest to utilize technology and its possibilities. The researcher in urban planning stated that smartphone application can change the societal trends as technology enabled shared economy to grow. As an example, a smartphone application could be used as a tool to increase the sense of community which, in turn, increases perceived safety. However, technology might set certain limitations for who can use those services as not all citizens have access to smartphones. Additionally, the researcher in safety claimed that the fewer citizens use safety smartphone applications, the better. This means that someone is making a profit out of other people's fear about their personal safety is threatened.

5.4.2. Observation

During the interview with the representative of Nattvandrarna, we were invited to observe their work and their working environment (see Fig. 16). The observation was not included in the initial planning but later in the process, it was realized that this activity is crucial in order to internalize and empathize with potential users. The aim with this observation was to get a first-hand experience of how it seems on the streets of Gothenburg on late weekend evenings in the environments which, in the survey, were reported to be perceived unsafe.

The areas visited during the observation were Biskopsgården in Hisingen and the city center of Gothenburg on a Friday evening from 09.00 pm to 00.30 am. These were chosen based on the survey results that suggested that those areas are perceived as least safe. During the observation at Hisingen, various tram stops and places in between them were visited. This was done to get understanding why many of the survey respondents reported to feeling unsafe during night time when walking home alone from a bus or tram stop.

Figure 16: Observation in Biskopsgården.

Figure 17 shows a recently renovated pedestrian tunnel in Biskopsgården. Lights, mirrors and colors have been placed in the tunnel to create an inviting atmosphere.

Figure 17: A Pedestrian Tunnel in Biskopsgården.

The impression of Biskopsgården was very peaceful. Not many people were seen on the streets or hanging out in the parks. Occasionally, there were some groups of young men standing and talking, but in general the environment was quiet. Some of the street lights were not functioning, which became prominent in the late evening when it was getting dark.

Whereas Biskopsgården was calm and quiet, the atmosphere in Brunnsparken was populous and lively. It was fairly crowded, and the street lights and shop windows made the environment lit. In the city center we felt safer than in Biskopsgården, though also there we were not scared. The reason for this might be that we were familiar with the city center whereas Biskopsgården was unfamiliar to us. This reflection correlates with the literature findings regarding the link between perceived safety and the familiarity of the area (Maruthaveeran & Konijnendijk van den Bosch, 2014). Moreover, as the literature study pointed out, the absence of people can decrease perceived safety, which explains why Biskopsgården is considered less safe compared to the city center (Sandstig, 2010). On the other hand, while there were many people in the city center, it increases the probability of a crime. However, the presence of other people compensates the fear because other people can be seen as a source of help in case of something happening.

During the observations we were not walking alone, which might affect our own perceived safety, making us feel safe. To find out a more realistic experience of the safety in those areas, the observation should perhaps be carried out individually, and not in a group of four people. To conclude, observations did not provide any additional information to the study, yet they supported the holistic approach in this study and reinforced understanding of the previous findings.

5.4.3 Concept ideation

As mentioned before, the purpose of creating a concept was to discover what possible role a smartphone application can take to increase perceived safety. Concept ideation started by brainstorming possible ways how the experience of safety could be improved through a digital solution and was approached from the three categories' perspective. All previous findings that were gathered throughout this study, including the guideline draft, were considered in the concept ideation.

When ideating around the category of personal factors, it was realized that addressing this domain through a smartphone application is very challenging and a possible role which an application could take was not identified. Also, since an expert interview with a psychologist was not carried out, it felt to be difficult to focus on personal factors. However, during this research, it had come clear that personal characteristics are the basis for how the factors in the other two categories affect perceived safety. To approach the issue from physical factors' perspective, it came to the realization that the experience of safety can be mainly improved indirectly through an application. Additionally, elements in the environment are generally bounded to a specific area and only those people who are within that area can benefit from them.

After brainstorming suitable roles for a smartphone application to improve perceived safety, it was decided to approach the concept development from one perspective only. This was decided in order to create a solid concept with a clear core function. It was noted that the experience of safety is created by the factors that are in the physical

environment, therefore the approach to tackle physical issues with a digital solution seemed hard. To provide a physical solution with a digital tool, it was decided to focus on social factors and use other people as a support to enhance perceived safety. Furthermore, since the original purpose of a smartphone is to connect people, in that sense the social factors felt the most natural approach to take, too. Hence, it was chosen to develop a safety application of which role is to create social connections in order to increase perceived safety.

Based on these reasons it was chosen to focus on studying how attributes in the category of social factors can be incorporated in a smartphone application. Since the main benefit and the original purpose of a smartphone is to connect people, social factors felt the most natural approach to take.

User group & Storyboard

Simultaneously with ideating around the possible role and core functions of the concept, the user to whom it is to be designed was considered. It was decided to not limit the possible user of the concept to a certain persona. The reason for this was that it was considered to be too narrow to focus on a specific gender only. As the previous findings showed, a man and woman can feel equally unsafe in public space. Instead, a user group was defined which was decided to be young adults. This was loosely based on the Nightfellows-concept ideation. Moreover, young adults were considered to be the biggest age group that spend time out in the weekend evenings, which was the scenario that the concept targeted. The scenario was defined according to the survey and literature results, which pointed out that people feel especially unsafe in the evenings when walking home alone from a bus/tram stop. Based on these factors, the scenario was defined:

***Walking home alone** in **public space** with a **smartphone** when it's **dark**.*

Several findings showed that the company of other people is the main factor that increases the feeling of safety. Therefore, the role of the application was defined to be connecting people to share the way home. Based on this, the following storyboard was created to visualize the interaction between the user and the concept (see Fig. 18):

A person is out with friends, it's late evening. It is time to go home, but the friends live in different directions. A person has a smartphone application that shows other people going in the same direction. A person finds a walking buddy to share the journey and connects by a chat. They set up a meeting point, meet up and keep each other company during the journey. The person gets home and goes to sleep safe and sound.

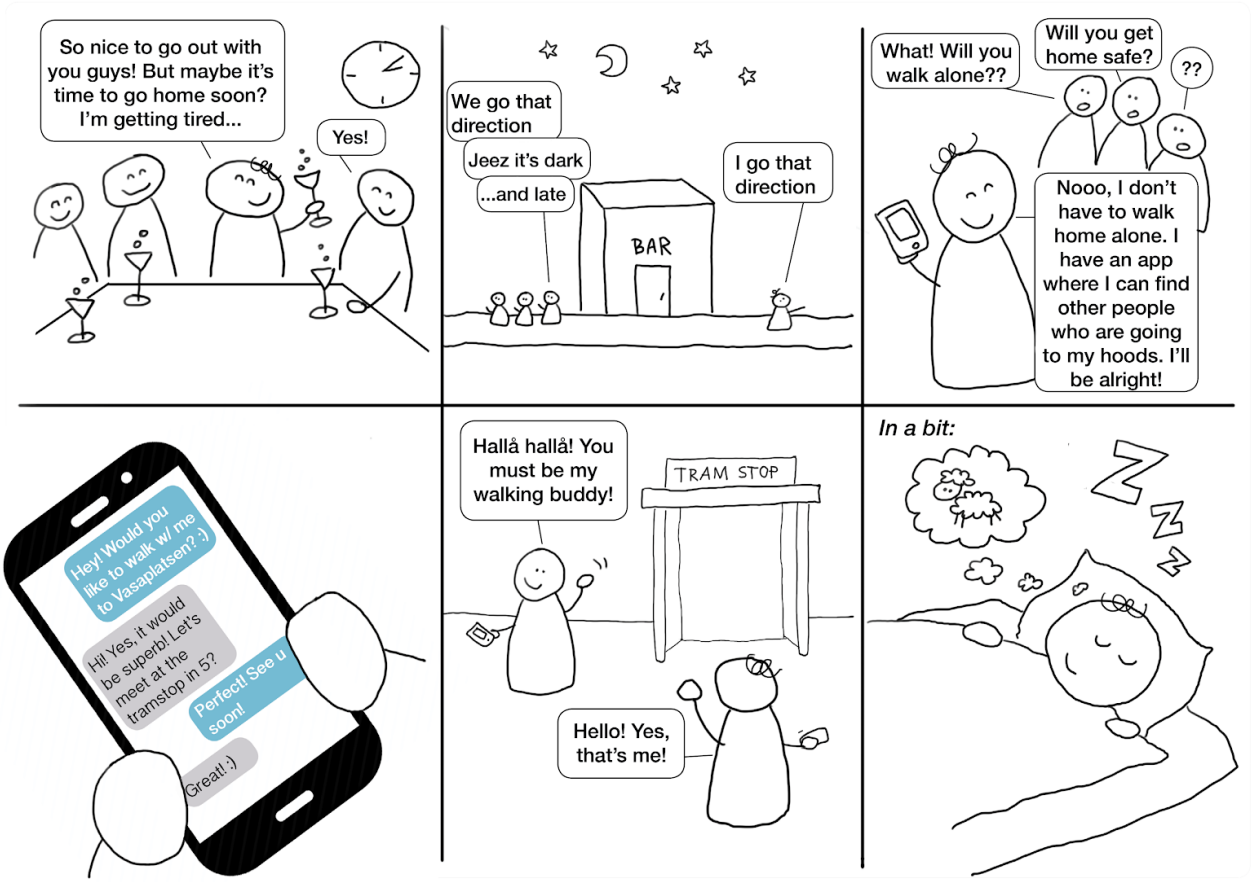

Figure 18: Storyboard.

The concept: "Walk with Me"

After ideation session, the concept to be tested with users was established. The core features are:

- Use BankID to verify your identity
- Create a profile with a brief description of yourself
- Search for users by specific terms, e.g. age and gender
- Connect with like-minded people in your proximity
- Share the way home

To see the full description of the concept "Walk with Me", see chapter 6.3.1 "Walk With Me" - Concept.

5.4.4 Concept Prototyping

The concept was first rapidly sketched on a paper to create a common vision of the application. Each screen of the smartphone application and the transition between them was further developed and discussed while sketching. During this rapid prototyping, the functions of the concept were being evolved. The first sketch is shown in Fig. 19 below.

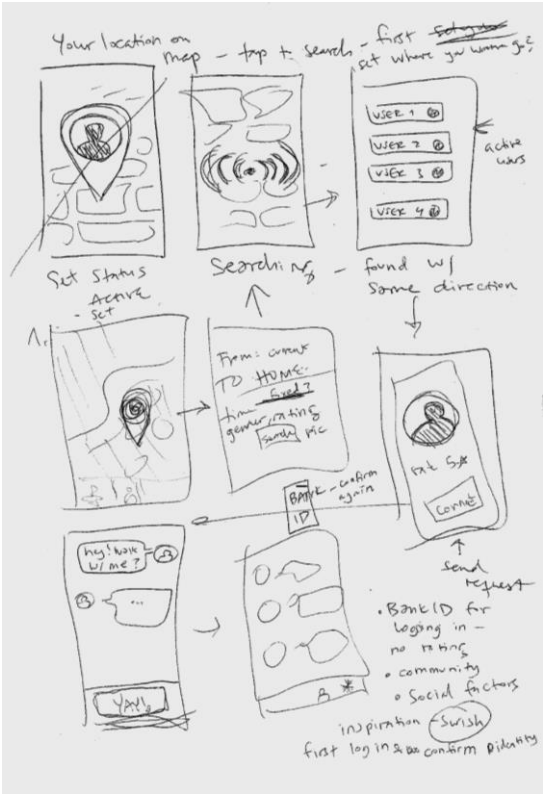

Figure 19: First Iteration of the Concept.

To deliver a more realistic feeling of the concept during the user testing, a refined prototype was made. To do this, POP by Marvel was used. POP by Marvel is a tool that translates a paper prototype into an interactive mobile experience (Marvel, n.d). This was made by taking pictures of the screens and importing them into the software and linking them together. This prototype can be seen in chapter 6.3.1 "*Walk with Me"-Concept*.

5.4.5 User testing of the Concept

The concept was tested with 10 users between 23 to 43 years old, of which 3 were men and 7 were women. The aim of the user testing was to find out if and why a smartphone application in this specific role would enhance the feeling of safety and to identify the eventual challenges in it. The user testings started by shortly introducing the concept to the participants and presenting the scenario which the concept is based on. The participants were asked open-ended questions regarding the functions of the concept and their general opinions, see Appendix III: Interview Guide for Concept Testing. The aim was not to receive feedback of the user interface as the focus in the concept development was to study in which role a smartphone application can improve perceived safety. The results of the user testings were analyzed and grouped using KJ method and were as follows:

Positive Feedback

Generally, all participants considered the core idea to find company to share a way home as a good idea that improves the feeling of safety. Similarly, the identification

method by using BankID was seen as a good feature that improves trust between the users. It was explained that the trust increases because both users who connect, must identify themselves and no one in the system is anonymous.

Negative Feedback

Some participants suspected that they would not use the service since it entails meeting up with people whom they do not know before. Despite the feature of BankID, some respondents would not trust the concept. Also, one respondent pointed out that it will exclude some potential users who do not have BankID. In order to get BankID, one must have a Swedish personal number which some foreigners might not have. One participant was concerned about strangers finding out where she lives if she shared a way home with them. Additionally, if the service is used late on weekend nights, there is a risk that the users are intoxicated.

General Feedback and Suggestions

Some of the respondents questioned why they would use the service to meet a stranger, instead of simply calling a friend while walking home. Also, usually people go home at the same time and way with his or her friends. One of the respondents would only connect with other women since it was considered to be safer. It was suggested that in the search settings, a preferred way of transportation should be good to include. One could set suitable alternatives to go home; a tram, bus, shared taxi, or alternatively by foot. Furthermore, suggestions were received regarding implementing a rating system, which would improve reliability towards other users. Some feedback concerned about what happens when there are no other users to match with?

Regarding the situations in which the service would be used, varying results were received. Some of the respondents stated that they would use it when it is dark outside and when they have missed the last bus. One respondent said that she would use it in an area that she is unfamiliar with, another would not use it for short distances and a third stated she would use it during daytime as well. Some of the respondents would use it to find people to share an Uber or taxi with.

The feedback from user testing was reflected on and translated into design implications. A second iteration of the concept was not carried out. This was due to the plan, according to which the purpose of the concept creation was not to develop a comprehensive concept. Instead, the aim was to find out which of the factors that improve safety could be implemented in a smartphone application and what is the possible role of a smartphone application in this context. Thereby, the design applications of the smartphone application are fairly specific and only creating a vision for the future.

5.4.6 First Iteration of the Guidelines

As shown in chapter 5.3.3 *Drafting the Guidelines*, the first draft of guidelines was a simple list of keywords that was compiled rather freely. They were aspects that were found during the background study. In the first iteration, the guidelines were reflected on and elaborated based on the expert interviews, observation and user testing. Yet, still in this stage, the guidelines were considered on a general level and the descriptions of them were fairly rough. To organize the guidelines and to better understand their domains, they were divided into the three categories: personal, social and physical factors. Some of the guidelines were rephrased and merged. For example, from the list of draft guidelines, '*Atmosphere in society affects overall safety*' and '*Sense of Community*' were merged and changed to '*Create Communities*'. Guidelines that were not relevant in terms of the scope of this research were removed, such as '*GPS tracking to see where friends are on a map*'. Some new guidelines were added based on the expert interviews such as '*Promote day-to-day positive interaction*'.

5.4.7 Summary of Develop-Phase

During this phase, the ideation went broader again to reveal the most essential aspects that affect perceived safety. To do this, four expert interviews, observation and concept ideation, prototyping and user testing were carried out. The nature of this phase was iterative and non-linear to construct the best possible outcome.

The expert interviews resulted in stressing the essential elements to consider in this context. A concept 'Walk with Me' was developed to explore a possible role of a smartphone application in order to enhance the feeling of safety. The concept development resulted in a smartphone application that improves the experience of safety by creating social connections. The results of user testings were analyzed and used as a basis for compiling design implications for that specific smartphone application.

During this phase, the first iteration of the guidelines was done. The results of the expert interviews, observation and user testing were compiled and compared against the guidelines created. They were rephrased to be descriptive guidelines and the core meaning of each guideline started to evolve, however in this stage they were still rather rough.

5.5 Deliver-Phase

In the last quarter of the project the final outcome of this thesis, the guidelines were further iterated. Moreover, a conceptual model of perceived safety and the interrelating factors that affect the feeling of safety was created. At the end of the process, the final guidelines were established.

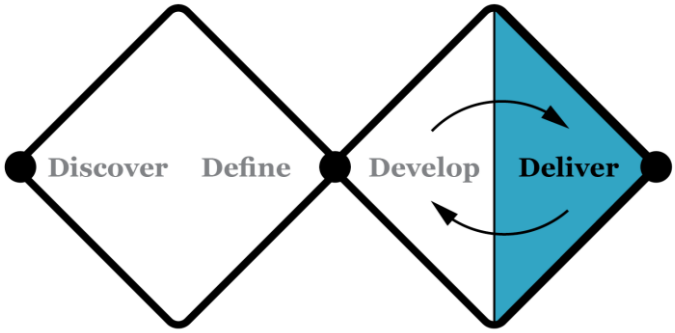

Figure 20: The Double Diamond Framework: Deliver-phase.

5.5.1 Second Iteration of the Guidelines

The second iteration of the guidelines focused on elaborating the descriptions of each guideline and defining the headings. After the second iteration, examples of the guideline headings in each category were:

- Acknowledge personality differences (Personal Factors)
- Create Living Public Spaces (Social Factors)
- Support Maintenance of the Environment (Physical Factors)

5.5.2 Third Iteration of the Guidelines

The third iteration of the guidelines focused on reviewing them and making sure they are easily understandable. Some headings were changed or defined to be more descriptive and correspond to their meaning. Following examples shows such changes:

Acknowledge personality differences was changed to
Consider different personality traits

Enhance Communities was changed to
Enhance the sense of community

The full list of the final guidelines is presented in chapter 6.2 *Guidelines to Improve Perceived Safety*.

5.5.3 Creating a Conceptual Model of Perceived Safety

When developing the guidelines and analyzing their effect on perceived safety, it came to the realization that the three categories of safety are easier to understand through a visual representation. Therefore, a conceptual model of perceived safety was created.

It demonstrates the different factors which influence the feeling of safety. These factors are illustrated as dimensions to emphasize that the experience is created in a physical reality. Since perceived safety is an experience that is an interplay between

several factors, the dynamic interaction of them is also illustrated. Moreover, it includes a discussion of what role a smartphone application can play in each dimension. The model is based on the research carried out within this study and is a result of the author's personal interpretation, exploration but also an intuitive judgement of the research findings.

5.5.4 Summary of Deliver-Phase

During this phase, the guidelines were iterated twice. The first iteration elaborated the content of each guideline and the headings were further defined to be more descriptive. The second iteration focused on only defining some of the headings by rephrasing them and resulted in the final list of guidelines. In this stage also, a conceptual model of factors that affect safety was created. Since perceived safety involves several different factors and is a result of the interplay of them all, it was considered to be beneficial to communicate the concept also visually. The model acts as a supporting element to the guidelines. The final results of this thesis are presented in its entirety in chapter 6 *Results*.

6. Results

This chapter presents the results of this master thesis which answer the research questions. The guidelines for safety along with the conceptual model of perceived safety answer to the research question: "*Which are the important factors to consider in order to increase perceived safety in public spaces?*". The design implications for a safety smartphone application together with a lo-fi prototype answer the sub-research question: "*What is a possible role of a smartphone application in increasing perceived safety*?".

6.1 The Conceptual Model of Perceived Safety

The conceptual model of perceived safety demonstrates how different factors together create the experience of safety from an individual's perspective (Fig. 21). The model is based on the research carried out during this thesis and is aimed to provide an overall picture of perceived safety and support to understand the guidelines. It includes the factors that were identified to be affecting perceived safety. What is new in this presentation is that the model includes the individual's role in creating and also affecting his or her own experience of safety.

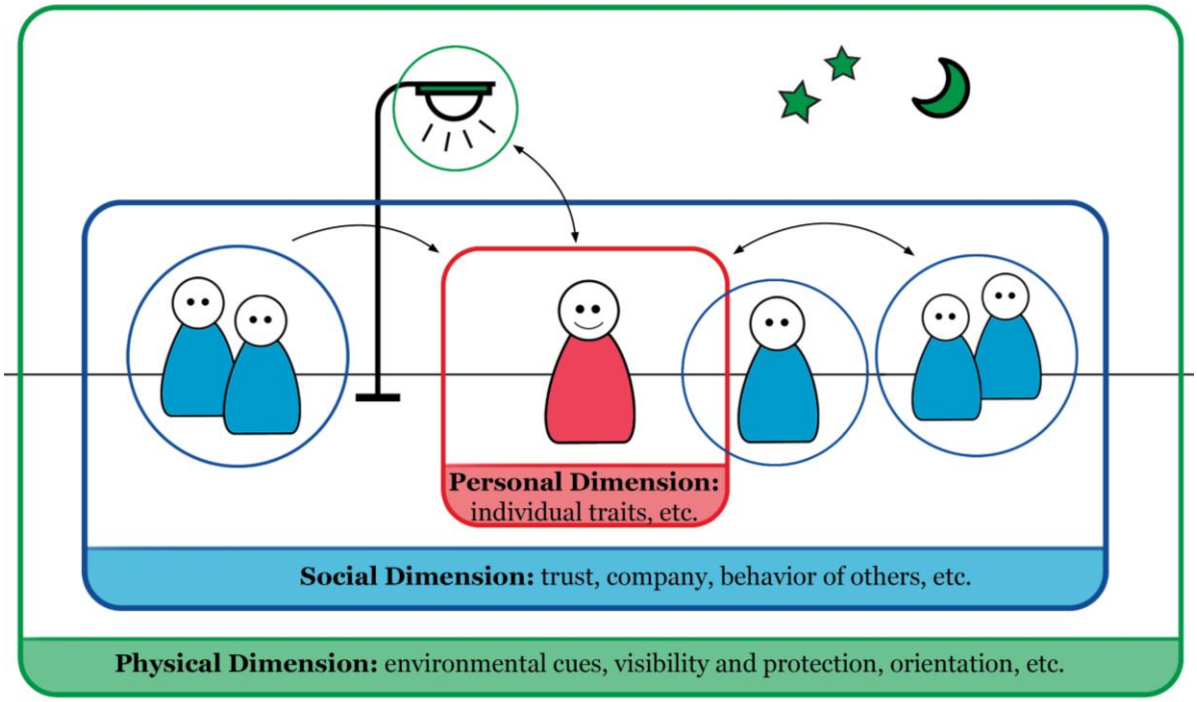

Figure 21: Conceptual Model of Perceived Safety in Public Spaces.

The factors and the way how they influence an individual's perception of safety are represented within three dimensions: personal, social and physical dimensions. The

conceptual model visualizes the dynamic relationship between an individual and the physical and social dimensions.

The *personal dimension* includes aspects such as an individual's personal characteristics, prejudices and previous experiences. This implies that the feeling of safety is an individual's subjective interpretation of the situation that is formed by a physical arousal and the individual's cognitive labeling of it. This means that not all individuals feel the same in the exact same setting. Accordingly, the individual is able to alter his or her own personal dimension, i.e. the experience of safety, as it is created by the individual's own thoughts.

The aspects in the *social dimension* are, for example street life, the presence of other people and the sense of community. The way how an individual relates to the other people in the environment or how other people behave towards the individual has a different effect on perceived safety, depending on the type of interaction they have and the individual's interpretation of the situation. Also, the individual influences the other people in the environment, hence there is an interaction that goes both ways between the individual and the social dimension. It also demonstrates how social and personal dimensions can connect through the feeling of shared responsibility of safety.

The *physical dimension* consists of aspects such as environmental cues i.e. trash and broken property, physically disordered surroundings, time of day, familiarity of the area, visibility and protection. The aspects of physical dimension affect only the personal dimension as the physical dimension does not experience fear. However, it is worth noticing that the individual can affect perceived safety through physical dimension by for example, maintaining the environment and creating welcoming areas.

Considering the role of a smartphone application within this context, it can play a role in all three dimensions, depending on its nature. In personal dimension, a smartphone can provide courage through a digital connection that the individual gets with his or her friends. Also, a smartphone application can be a way to escape the physical realm into a digital world. Within the social dimension, a smartphone application can be used as a tool to connect people or to enhance social life and the sense of community. The physical environment can be altered and maintained through an application, or it can provide a communication channel between the authorities and citizens.

The model aims to explain that perceived safety is an interplay between several aspects, and by focusing only on one aspect there will still be other elements that affect the holistic perception of safety. It is based on the research carried out within this study and is a result of the author's personal interpretation, exploration but also the intuitive judgement of the research findings.

6.2 Guidelines to Improve Perceived Safety

The guidelines are compiled for interaction designers to support their work that concerns designing solutions that aim to improve perceived safety in public spaces. Moreover, the guidelines can be useful for city planners when developing urban areas that support the feeling of safety. The guidelines are beneficial to consider during the early stages of a design process to get an overview of the different factors that play a role in this context. The guidelines are grouped and presented according to the three factors that have been used as a framework throughout this study, i.e., personal, social and physical factors.

Personal Factors

Consider Different Personality Traits

Each individual experience the world through their own personal interpretations, prejudices and beliefs. Accordingly, also the feeling of safety is highly personal and is affected also by the individual's characteristics such as age, gender and socioeconomic status (Ratnayake, 2017; Sandstig, 2010). Also, previous personal experiences play a key role when individuals form a perception of safety. This entails that a certain area which is perceived as unsafe by two people might fear different things within that area (Prieto Curiel & Bishop, 2017). A low level of emotional stability typically decreases the feeling of safety whereas higher levels increase it (Sandstig, 2010). Moreover, the researcher in safety explained that people who have trust towards life, are more confident regarding their personal safety. The representative of Nattvandrarna concluded this by stating "there is a difference between feeling unsafe and being unsafe". This was noted during the user testing as some respondents claimed to not feel unsafe at all whereas others reported being highly concerned about their personal safety. Similarly, the differences in survey results pointed out how the experience of safety varies between people. In a design process, this could be considered by, for example, testing the concept with a sufficient number of users.

Empathize the Holistic Perspective

To understand the factors that affect perceived safety is crucial when designing a solution that aims to improve it. There is no particular part of it that by fixing it, could translate the entire experience safer. Yet, one must be aware of the interplay between personal, social and physical factors within the given environment. Acknowledging that perceived safety as a wicked problem, one must approach it from various viewpoints and be aware of the deeper reasons, too, on which the perceived safety is built on. This implies that only one solution is not necessarily enough to improve the overall feeling of safety in a specific area.

The importance of this guideline came to the realization through the author's personal reflections on the user feedback, expert interviews and during the observation. Also, this recommendation is supported by Ljungblad et. al (2015). According to them, HCI research field would benefit from approaching design problems from a more holistic perspective and not only focusing on the technology-driven solutions. This could be

considered when approaching a topic such as perceived safety. An interaction designer needs to understand the whole problem space in order to design a suitable solution.

Social Factors

Create Living Public Spaces

A living public space is perceived as a safe public space. During the interview with the researcher in urban planning, it was suggested to increase the number of people visiting a certain area by adding different social functions such as kindergartens, cafés and cultural centers in an area to improve the public life. Additionally, when designing new buildings, it is important to consider living ground levels with social activities to increase the social life in the building which in turn, increases perceived safety. This guideline is supported by the survey results, but also by Soraganvi (2017) and Mehta (2014) who state that the absence of other people and the lack of a tradition of street life decreases the perceived safety.

Enhance the Sense of Community

Maslow (1943) identified social needs as one of the most essential human needs which enhance the feeling of safety. Also, as a part of the need for safety, Maslow (1943) mentions that humans seek familiar over unfamiliar and want stability in their lives. As such, perceived safety can be improved by supporting an individual's feeling of belonging and being familiar with both, the people and the area. Similarly, Maruthaveeran and Konijnendijk van den Bosch (2014) mention that the sense of community, familiarity of the area and presence of other people are important in order to feel safe. This was supported also by the interview with the senior lecturer that suggested that everything that signals community will increase perceived safety in an area. If people experience that the environment as warm and friendly, the feeling of safety will increase through the positive experiences. Moreover, as studied in this thesis, the sense of community can be supported through a smartphone application that connects people within the same residential area.

Foster Trust

It is important to consider what kind of signals the elements and actions in our daily interaction are sending. The interview with the researcher in safety revealed that events that occur daily have a great, yet indirect impact on the way how we think as those events act as frequent reminders. Hence, the nature of the events that occur daily should be positive. For example, encountering friendly people in the neighborhood is subconsciously strengthening the feeling of safety in that area. According to Soraganvi (2017) and the researcher in safety, being able to predict other people's behavior creates trust, which in turn, increases perceived safety. It is important to notice that trust can be signaled also through environmental cues hence it is not limited to social factors. For example, a high fence around a house may be interpreted as an environmental cue of mistrust that decreases the feeling of safety.

Physical Factors

Support Spatial Perception of the Environment

In physical environments, it is important to provide a sense of orientation, especially when it is dark. This came to the realization through the observation and the expert interview with the lighting designer. Orientation and understanding of how the environment is structured are important as humans have innate need to perceive potential escape routes and spot places to hide. In darkness when visibility is lowered, people feel the most unsafe hence in the night time it becomes more crucial to provide orientation by lighting. Vertical lighting can be used to illuminate facades of buildings to help the citizen to orientate. The consideration to support the understanding of the environment is also suggested by Ratnayake (2017) who claims that a safe environment should provide sufficient amount of both, protection and visibility. Furthermore, Sandstig (2010) discusses how the spatial perception of an area is affecting the perceived safety in public spaces. In general, people feel safer in closed spaces with social control and company, such as in restaurants. Contrary to this, people feel significantly less safe in a desolate open place, where there is no way to perceive the structure of the environment (Sandstig, 2010).

Support Maintenance of the Environment

The research revealed that certain environmental cues, such as physically disorderly surroundings, evoke feelings of unsafety among people. This is because some people interpret them as signs of negligence which may trigger fear (Maruthaveeran & Konijnendijk van den Bosch, 2014; Prieto Curiel & Bishop, 2017). Therefore, maintenance of environments is essential, and it also includes considerations for creating an environment that is aesthetically pleasing. This was also emphasized in the interviews with the lighting designer, the researcher in urban planning and the representative of Nattvandrarna. It is suggested to design environments welcoming by, for example, light installations as exemplified by Olsson and Linder (2018) and keeping greenery maintained. As mentioned by the researcher in urban planning, maintenance of the environment could be supported through a smartphone application where citizens can, for example, report broken property.

Ensure Adequate Lighting

Badly lighted streets were found out to be the most critical physical factor decreasing perceived safety in public spaces (Brå, 2016; Mehta, 2014; Maruthaveeran & Konijnendijk van den Bosch, 2014; Soraganvi, 2017). Similarly, the observation and survey results pointed out that fully functional street lights are one of the most important factors that increase the perceived safety and that people generally feel slightly more unsafe during nighttime than daytime. Additionally, the importance of adequate street lights was validated through the interviews with the representative from Nattvandrarna who claimed that when walking home at night, fully functional street lights are a major single thing affecting perceived safety.

6.3 Improving Perceived Safety by a Smartphone Application

The Research through Design activities resulted in a smartphone application concept and design implications. Due to the specific scenario which the concept is built on, the design implications provide very specific design knowledge. In this case, the role of the smartphone application is to act as a social connector that delivers a feeling of shared responsibility of safety. It is designed to increase only the feeling of safety, hence does not aim to improve the actual safety.

6.3.1 "Walk with me" - Concept

The "Walk with Me"-concept aims to improve perceived safety by connecting people (Fig. 22). The narrative of the storyboard used in the concept creation was as follows:

> *A person is out with friends, it's late evening. It is time to go home, but the friends live in different directions. A person has a smartphone application that shows other people going in the same direction. A person finds a walking buddy to share the journey and connects by a chat. They set up a meeting point, meet up and keep each other company during the journey. The person gets home and goes to sleep safe and sound.*

Figure 22: Walk with Me: Splash Screen.

<u>Description of the Concept</u>

The core idea of the concept is to find and connect with like-minded people in one's proximity to share the way home at the specified time span. It has a search filter that allows the user to specify the age range and gender for the people that one wishes to connect with. This is motivated by the research findings which showed that people

most often relate to individuals that are similar to themselves in terms of their characteristics, i.e. age and gender. Being able to find and perhaps learn to know other people within the same residential area was thought to strengthen the sense of community which in turn, according to the literature study, strengthens perceived safety within that area. When installing the application, one must identify personality through BankID. In Sweden, BankID is the leading electronic identification service. It was developed by several large banks to provide electronic identification for the public, authorities and companies. On a regular basis, BankID is used by 7.5 million people for private and public services. A bank is responsible for issuing the BankID and is responsible for the customer's identification. BankID is available on various devices such as smart card, computers, smartphones and tablet devices (BankID, 2018). BankID identification was included to enhance the reliability of the concept. Based on the feedback received during the Google Design Sprint testing, it is crucial that the user can trust the people in the system. Also, the users will not see other users' addresses, date of birth or other sensitive data for the sake of integrity.

How Does it Work?

The user can search for potential people to share the way home. The user can select where to and from where they are going to, at what time, with age group and gender they prefer to walk with (Fig. 23). The application shows people who match to the search criteria and allows the user to connect to them by messaging. Their name is shown as well as their distance to the user measured in kilometers. The user can load more potential users to walk with or tap to choose any of the suggested users (Fig. 24)

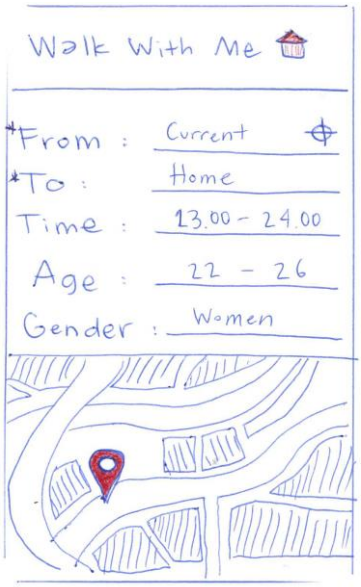

Figure 23: Walk with Me: Search Screen.

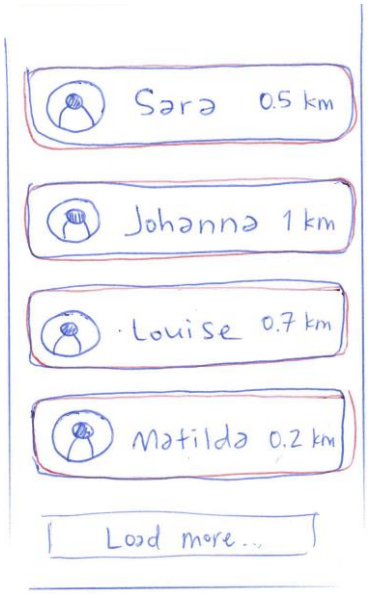

Figure 24: Walk with Me: List of Matches.

Each user is able to create a profile with a picture and a description of themselves. The user can view more specific information about his or her matches, such as profile picture and a brief description. By having a personal profile, the users get a sense

about the other users in the application. This feature aims to reduce the feeling of meeting up with a stranger. If the user wants to connect with a match, the user taps the “Walk with Me”-button (Fig. 25).

Figure 25: Walk With Me: Show Other User Profile.

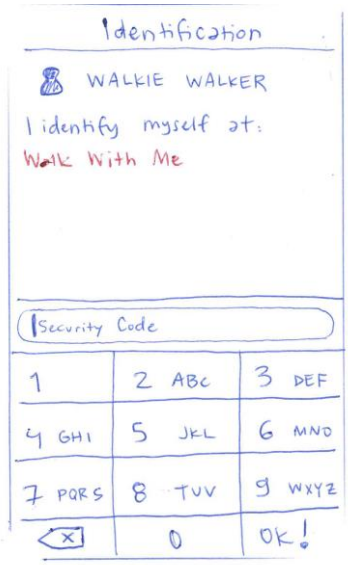

Figure 26: Walk with Me: BankID.

Before sending the first message, one must reconfirm personality through BankID to ensure that she or he is actually the person approaching another. Also, the responder has to reconfirm his or her identity before answering to the first message (Fig. 26). After successful identification, the chat window opens, and the user is able to start chatting (Fig. 27).

Figure 27: Walk with Me: Chat Screen.

There is no rating system included as it was seen to be a function that could possibly place the users in unfair positions. Assessments are always highly subjective and a pleasant experience for one person can be rather the opposite to the other, therefore rating another person was not considered to be ethically correct. After connecting to the other user by a message, it is up to them to decide when and where to meet and start their safe journey together.

6.3.2 Design Implications

The design implications are based on the user testing of the "Walk with Me"-concept. Accordingly, these considerations are not exclusive and there are several other aspects to be considered, as well. They are best to be used as inspiration and as a basis for reflection. They are primarily directed towards digital agencies when exploring the possibilities of a smartphone application to increase perceived safety through social factors, i.e. connecting people.

Support Social Connections

Since the experience of safety is mainly formed through the elements that are perceived in the *physical* environment, it is challenging to influence those elements by a *digital* solution only. The user testings emphasized the importance of company of other people when feeling unsafe. Thus, the most essential factor that increases the feeling of safety is the company of others. This can be supported by the literature findings which revealed that the responsibility of safety will be shared in groups (Sandstig, 2010). In other words, people rely on others when seeking safety.

Support Identification

The interview with the researcher in safety pointed out that in order to feel safe, one must be able to trust. This was also observed during the user testing of Nightfellow-concept as the participants expressed concerns regarding reliability. Therefore, it is one of the key elements to incorporate in a safety application. Through the user testing of "Walk with Me"-concept it was discovered that by electronic identification, the trust towards strangers can be notably increased, which in turn increases safety. The users considered that the risk of the other users misusing the application will decrease because no one is anonymous.

Support User Recommendations

Another way to improve trust among users of a smartphone application is to provide a rating system through which the users can give feedback of other users that they have met. The feedback from the user testing suggested that it would be good to know whether the profiles are 'real' as there were concerns about the creation of fake profiles. Also, some participants were concerned if the concept would be used for negative purposes. However, the interview with the researcher in safety pointed out that rating other people is very subjective as different individuals consider different things as 'good'. Instead of implementing a 'five-star' rating system, it would be worth

of ideating other ways to give feedback. As an example, trustworthiness could be given in written text or in a color scale. To conclude, one should consider the possible negative implications that a rating system can cause to the individual to be rated.

Support the connection of individuals with similar characteristics

Both Maruthaveeran and Konijnendijk van den Bosch (2014) and Ratnayake (2017) suggests that people usually relate to other individuals that are similar to themselves in terms of gender, age and race. This was supported through the user test results of the "Walk with Me"-concept, as it was requested to be able to choose what kind of people the users wish to connect with in the application. For example, generally women do not perceive other women as a threat to their own personal safety. Hence, people are generally more comfortable when among people similar to themselves. This might also encourage people to use the app and meet people whom they do not know from before.

7. Discussion

This chapter discusses the results of this thesis, the methodology and approach used. It reflects how the design methods applied contributed to the outcome and how the result can be generalized. Lastly, recommendations for future work are given together with proposals about appropriate ethical considerations within the context of perceived safety.

7.1 Analysis of Results

The results of this thesis aim to provide a supportive canvas for interaction designers when designing a solution that enhances perceived safety in urban places. They are not all-encompassing but rather mirrors the many-sidedness of the topic and encourages designers for deeper exploration.

7.1.1 Guidelines and the Conceptual Model of Perceived Safety

This section presents the most important reflections on the guidelines and conceptual model.

Reliability

The results provide a viewpoint to the topic from three different angles. Most of the findings from this master thesis correlate with the former research in the field of perceived safety, based on which the guidelines are compiled. What was done in this study is only a scratch on the surface as there is much more to research within this area. To validate the guidelines can be problematic since perceived safety is not measurable yet it is highly subjective. Also, the guidelines can be influenced by the authors' subjective interpretation and evaluation of the research findings.

Coverage

There is no perfect solution for all citizens, although these guidelines can be viewed as general recommendations to improve perceived safety in public spaces. In cities, there are endless amounts of different types of public spaces, and as previously mentioned, all individuals have different opinions of what safety is. Therefore, it is nearly impossible to cover all of them in one set of guidelines and it is fairly challenging to establish strong guidelines within a short period of time.

The Conceptual Model

The conceptual model is a visual presentation of the guidelines. It aims to give a rapid and clear overview of the interrelated nature of the factors that affect perceived safety. Furthermore, it highlights the dynamics between an individual and the different surrounding aspects. The model can be seen as a simplified illustration of perceived safety as the concept of it is so complex. For instance, an element such as familiarity is hard to categorize as it is based on the physical environment but is also related to

social factors. To make it more descriptive, a conceptual model of each factor could be created.

7.1.2 "Walk with Me"-Concept and the Design Implications

Here, the smartphone application and the design implications are discussed.

Reliability

The concept is hypothetically valid since it is based on a scenario in which majority of people feel the most unsafe and the features of it are supported by theoretical and empirical studies. The aim of the concept was to target the most unsafe situation, i.e. walking home alone in public space when it's dark. Ideating around a scenario like this can be both inspirational and limiting. In this case, we limited ourselves to this kind of static scenario, which resulted in a solution that is very specific. Since the evaluation of "Walk with Me" lacked a realistic setting during the user testing, the results of it might not be completely reliable. To meet up with a stranger and share a journey home is a quite untypical action, after all. Therefore, the users may evaluate it as a good idea but in reality, they would not dare to do it. To be fully functional, "Walk with Me" requires a critical mass of users as it is based on crowdsourcing. In Gothenburg setting, there might not be enough users traveling to the same direction at the same time. Without any users, this smartphone application would not provide any value. Additionally, it is beyond our power to guarantee that someone would not use it for wrong purposes.

The Role in Perceived Safety

The concept can be considered as one part of the puzzle, but not the ultimate solution. It takes a role as a creator of social connections, which increase perceived safety. Further research is required to see if it is possible to create a smartphone application that focuses on the physical or personal factors. There are alternative ways to enhance perceived safety through a smartphone application yet to be discovered. One of the ideas that was discussed during expert interviews and brainstorming sessions was to use a smartphone application as a communication channel between citizens and the city planners, through which the citizens could report where they perceive the safety to be low. In that case, the role of the application would be to act as a communication tool between different parties. Furthermore, regarding the personal factors, a smartphone application could possibly act as an empowering tool that supports an individual's image of self. However, since in this study a psychologist was not interviewed, this suggestion is only the author's own inference.

Digital Solution for Physical Problem?

It is debatable if a smartphone solution is the ultimate way to improve perceived safety in public spaces. According to the survey results, smartphones are one of the most popular items that increase perceived safety in public spaces. In this thesis, the underlying reason why a smartphone is actually providing safety was not further researched. However, as one of the basic functions of a smartphone is to call someone,

i.e. connecting people, this might be the reason why people associate a smartphone to safety. Nevertheless, technology such as a smartphone application might not be enough to offer the ultimate solution for perceived safety regardless of its connection capabilities.

Design Implications

The design implications of the safety application are fairly specific and only focusing on the social aspects of perceived safety. For example, the first design implication recommends creating social connections that is directly linked to human interaction. Also, the design implication regarding electronic identification is not necessarily important if the solution is not about meeting new people and sharing the responsibility of trust. Similarly, the third and fourth design implication of rating system and similar characteristics are very precise and do hardly apply to other cases. All things considered, the design implications are hardly applicable in an application that aims to improve perceived safety by focusing on, for example physical factors.

7.1.3 Methodology Considerations

This section presents the reflections of the overarching approaches that were utilized during this master thesis.

The Double Diamond Framework

The process was carried out within Double Diamond framework that entails changing between divergent and convergent mindsets (Design Council, n.d.), which is a very typical process in various design fields (Cross, 2007). This was an applicable approach to make sense of such a multifaceted topic as perceived safety is and was chosen for its explorative nature. Its holistic approach to design problems allowed us to delve into the topic from various viewpoints. The Double Diamond was beneficial as it allowed us to reflect, compare and iterate the research findings along the way while keeping the human in the center of the focus.

Google Design Sprints

The first diamond within the Double Diamond framework was influenced by the stakeholder's design practices. Humblebee uses Design Thinking and Google Design Sprints in their business which became a part of the approach also in this thesis work. Also, as these approaches are adjusted to the needs of the industry, they put emphasis on evaluating the value which the concept provides for the business early in the design process. This thesis was not focusing on studying the business value of a safety solution but rather to deliver value for the research. Hence, Google Design Sprints were helpful in retrieving rapid insights but from the research point of view, the outcome was somewhat shallow as there is no room for proper reflection. This suggests that one should place sufficient considerations for the validation of the concept.

Research Through Design

When moving on to the second diamond of Double Diamond, the approach was changed to Research Through Design. In our research, RtD gave the advantage to use the three concepts created during the sprints as a means to build a better understanding of the problem. Also, Gaver (2012) argues that the design research community should focus on being explorative and speculative to result in the form of new, conceptually rich artifacts. For us, it allowed iterative practice in the process which was beneficial as there were so many different aspects to safety to consider.

Interaction Design & Industrial Design

The different backgrounds of the authors gave a refreshing addition to this project. The perspective of Industrial Design underlined the broad, holistic approach while Interaction Design focused on the interaction between the digital artifact and the user. These both aspects were helpful in the development of the "Walk with Me"- concept. Taking the holistic approach helped us to see the whole picture of the aspects affecting perceived safety. This relates to what is suggested by Ljungblad et. al (2015): interaction designers should take a step back to view the whole spectrum and not only consider the interaction between digital artifact and user. Additionally, representatives from two different design fields allowed more critical reflection towards the design practices of the other, as one may become blind to his or her own habits.

Design Approach Considerations

Early in this process, Critical Design and Value Sensitive Design approaches were considered in order to achieve an alternative solution which would evoke reflections of the underlying societal reasons of perceived safety. Also, Emotional Design was considered to be incorporated into the design of the final solution. The idea behind this was to study how a design approach could enhance the feeling of safety. The design in visceral level is about product aesthetics and attractiveness and is said to be the most relevant in regards user interface design (Kallio, 2003). In this thesis, a realistic prototype was not created which resulted that at the end, any particular design approach was not used as a tool to shape the outcome. Accordingly, as this research was dealing mainly with theory, a place where to apply this design approach was not identified.

7.1.4 Method Considerations

In this section, the methods that had the most influence on shaping the result are discussed.

Survey

The survey was carried out during the early stage of the process, which generated a lot of insights which were used as a starting point for ideating concepts. However, the way how the survey was conducted and how the results were analyzed might have

affected how the rest of this research went on. For example, the phrasing of the questions was not completely neutral, and they almost assumed that the respondent is feeling unsafe. Also, predefined answers might have affected the outcome, since it is more convenient to select a readymade answer than writing a custom one. A survey has its limitations but is a cheap and fast way to gather vast amounts of data. Using extensive amounts of interviews might be more applicable for a subjective topic such as perceived safety but was not considered due to the time constraint of this master thesis.

User Testing

The number of participants in the user tests of each Google Design Sprint and the final concept was quite low, as the average of participants was five per test. Using the feedback of only five persons might have given somewhat unilateral insights. We were following Nielsen's suggestion (2000) that claimed that 85% of the most common usability problems will be found by five users. However, Nielsen (2000) also suggested to run three rounds of user tests which we did not do. For a proper concept validation, more extensive user testing is required.

Observation

Observations were done only while walking in a group of other people and did not yield to any ground-breaking insights. From the concept scenario's point of view, it could have been interesting to focus only on that situation, i.e. observing a tram/bus stop late in the evening. Also, whilst observing we could have interviewed people in the realistic setting. Additionally, the observation was performed in a group of people. That might have affected our feeling of safety as well since perceived safety is increased by being surrounded by peers.

Expert Interviews

The four expert interviews gave us an understanding of several various perspectives to perceived safety in public spaces. Since perceived safety is strongly influenced by personal factors, it would be beneficial for the research to perform an interview with a psychologist to gain deeper knowledge regarding the mental processes in unsafe situations. The expert interviews validated our findings from the literature study, but also emphasized the most important considerations to focus on.

7.1.5 Generalization

The generalization of the results is discussed below.

For Safe Places Only

Since the assumption was made that in a public space the actual safety is high, that sets certain limitations to the generalization of the result. How well they are translatable is depending on the context in which they are to be applied. The first two guidelines that encourage to empathize with the individual and the full experience are perhaps the most important of all and should be considered in all cases when

improving perceived safety. The guidelines considering aspects in the physical environment are more difficult to adapt to other cases as they are geographically limited. Likewise, the guidelines about social factors are dependent on the area in which they are to be applied since it is considering humans.

Different Perceptions of Safety

Apart from the location, generalization is also affected by who is the individual whose perceived safety is about to be enhanced. Perceived safety is considered as highly personal experience which means that the guidelines do not guarantee a perfectly safe experience. In other words, regardless of the best attempts to increase perceived safety, some individuals may still do not feel safer. However, as mentioned earlier, it is crucial to note that guidelines are limited to places where the actual safety is high as they do not prevent any threatful event from occurring.

"Walk with Me"-concept

The success of the "Walk with Me"-concept is dependent on the city in which is it to be used. The user base has to be sufficient enough as its main function is based on other users, i.e. crowdsourcing. Similarly, personality traits affect how well it would work. For example, it could be successful for people who are used to a social lifestyle, are outgoing and used to meeting new people.

7.2 Future work

The results of this master thesis should not be considered as a complete solution, but rather a starting point for parties that are interested in continuing researching the topic of perceived safety. The following suggestions are made.

Guideline Development

The guidelines can be seen as a basis for a design toolbox, that in the future, has more elaborated and refined content in each category. For instance, this study was based around the city of Gothenburg and it would be interesting to see if the findings are applicable to other cities in Sweden, or around the world, as well. However, some places are safer than others, which could make the transition of these guidelines to other cities quite problematic.

Further Development of the Concept

If the development was to be continued, observations combined with user testing in a real context is recommended. However, the ethical considerations have to be addressed in the user testing as it requires the users to be potentially scared. It is suggested to further research what it is in the concept actually delivers the users the improved feeling of safety. In further development, also hi-fi prototyping and implementation of the principles of Emotional Design are suggested to be carried out. For example, the user interface could be designed to signal safety through colors, shapes and robustness. Furthermore, the possibilities to include features regarding actual safety into the concept development would be interesting. Perhaps an

application could recommend a user to be more aware within certain areas at certain times when the risk of crime is actually higher according to the statistics. Apart from the continuation of the concept development, further research regarding the role of a smartphone in the context of perceived safety is needed. It is recommended to further investigate why a smartphone is associated with the increased feeling of safety.

Exploring Other Approaches

During the research, several interesting suggestions about functions to be incorporated in a safety application emerged. For example, an application to be used for reporting places that are perceived unsafe was suggested by the interviewees. This feature was not considered in our research, together with many other interesting ideas. Thus, it would be interesting to explore a solution that takes the physical and personal factors into consideration, since the concept created during this master thesis emphasized the social aspects.

7.3 Ethical considerations

Regarding ethics in the context of this research in perceived safety there are certain ethical aspects that are worth of reflecting on, of which three major ones are discussed.

The Need for Feeling Unsafe

When improving the feeling of safety, it is important to note that the feeling of fear carries a meaning (Prieto Curiel & Bishop, 2017). As Darwin presented (1971), all humans experience certain universal emotions of which fear is one of them. These emotions trigger a reaction and increase an organism's chances of survival. Therefore, perceived safety should not be viewed solely as a negative trait since it has been the reason why mankind has survived from an evolutionary standpoint. It is an innate reaction in all humans and is actually beneficial in our everyday life. Therefore, it should be reflected upon whether it is ethically correct to design a digital artifact that enhances perceived safety and numbs this primal feeling. Likewise, it should be considered if perceived safety should be improved in areas where the actual safety is low.

Consider the Actual Effect

A product that is designed to improve perceived safety might actually create the opposite effect to what intended, if used in areas where in fact the actual safety is high. This is because the product can remind the user of the potential threat, which is not there, and decrease the feeling of safety. As the research findings showed, oftentimes the fear does not correlate to the risk of something bad happening.

At What Cost Do We Design Solutions for Perceived Safety?

From the business perspective, there are certain ethical considerations to be considered, as well. In order to generate revenue by safety products, there has to be a customer need for them, i.e. fearful citizens and potential threats in society to generate the fear. In general, one could reflect at what expense perceived safety is enhanced,

and if it would be better to focus on the cause that decreases perceived safety. As it came up during the expert interviews, there is an industry making money of individuals being worried about their personal safety. After all, in the ideal society, everybody should feel safe in public spaces and would not have the need for safety products.

8. Conclusion

The aim of this master thesis project was to answer the research questions:

"Which are the important factors to consider in order to increase perceived safety in public spaces?"

"What is a possible role of a smartphone application in increasing perceived safety?"

To answer the first research question, guidelines and conceptual model of perceived safety have been created. The answer for the second research question has been delivered in a form of design implications and a lo-fi prototype of a smartphone application.

The project investigated and approached the topic through theoretical and empirical research. To build a solid foundation for the project and attain an understanding of perceived safety, literature study, survey and three Google Design Sprints were carried out. To be able to translate the findings into guidelines and emphasize the most essential factors, expert interviews and observation were performed. The guidelines to consider in order to increase perceived safety in public spaces are:

- Consider Different Personality Traits
- Empathize the Holistic Perspective
- Create Living Public Spaces
- Enhance a Sense of Community
- Support Spatial Perception of the Environment
- Support Maintenance of the Environment
- Ensure Adequate Lighting

The guidelines are aimed to be used as a support in interaction designers' work when designing a solution that enhances perceived safety in public places. They are not comprehensive but provides a starting point for further exploration.

In order to answer the second research question, a smartphone application was created. The role of the application is to enhance perceived safety by providing social connections that create a feeling of shared responsibility of safety. The feedback from user testing was translated into design implications. The established design implications for a smartphone application are as follows:

- Support Social Connections
- Support Identification
- Support User Recommendations

- Support the Connection of Individuals with Similar Characteristics

These design implications are aimed to be used in the development of a smartphone application that focuses on social factors to increase perceived safety.

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Appendix I: Survey Questions

Aim: To gather initial insights into the topic of perceived safety in a Gothenburg City context, to complement the literature studies.

*** = Mandatory Question**

Age *
- 0-15 years
- 16-24 years
- 25-34 years
- 35-44 years
- 45-54 years
- 55-64 years
- 65-74 years
- 75-84 years
- 85+ years

Gender *
- Woman
- Man
- Other (defined by respondent)

Where do you live? *
- Gothenburg
- Not in Gothenburg

What is your occupation? *
- Student
- Employed
- Unemployed
- On a parental leave
- Retired
- Other (defined by respondent)

Where are you from? *
- Sweden
- Outside of Sweden

Where in Gothenburg do you live? *

- Angered
- Askim-Frölunda-Högsbo
- Centrum
- Lundby
- Majorna-Linné
- Norra Hisingen
- Västra Göteborg
- Västra Hisingen
- Öregryte-Härlanda
- Östra Göteborg
- Don't know / Don't live in Gothenburg

Do you feel safe in public spaces in Gothenburg during the daytime? *
The respondent could choose on a scale from one (No, never) to seven (Yes, always).

Do you feel safe in public spaces in Gothenburg at night? *
The respondent could choose on a scale from one (No, never) to seven (Yes, always).

How safe do you feel in public spaces in Gothenburg today? *
The respondent could choose on a scale from one (Not Safe) to seven (Completely safe).

How safe did you feel in public spaces in Gothenburg 5 years ago? *
The respondent could choose on a scale from one (Not Safe) to seven (Completely safe).

In which of the following occasions do you feel unsafe? You can select multiple choices. *

- When traveling by tram
- When traveling by bus
- When walking home from a tram/bus stop
- On the streets of the city center
- On the streets outside the city center
- When the street lights are off
- When I'm alone in public spaces
- Around people who I don't know
- Other (defined by respondent)
- Add your own choice (defined by respondent)

Which area(s) of Gothenburg do you think are unsafe? *

- Angered
- Askim-Frölunda-Högsbo

- Centrum
- Lundby
- Majorna-Linné
- Norra Hisingen
- Västra Göteborg
- Västra Hisingen
- Örgryte-Härlanda
- Östra Göteborg
- Other (defined by respondent)
- Add your own choice (defined by respondent)

What item(s) would increase your feeling of safety? *
- Personal Security Alarm
- Safety App
- Smartphone
- Pepper Spray
- Flashlight
- Keys
- None
- I'm not afraid
- Other (defined by respondent)
- Add your own choice (defined by respondent)

Have you experienced a situation in public spaces in Gothenburg when your personal safety has been threatened by another person? *
- Yes
- No
- I don't know

Please, feel free to share any additional comments or thoughts regarding safety!
- Open question, the respondent could write text input

Appendix II: Expert Interview Guides

Aim: To retrieve empirical perspectives on the factors that affect perceived safety

Architect with Expertise in Lighting design (White Architects)

- Tell your background
- How do you aim to design safe and welcoming environments and how do you message that to the citizen?
- What do you do to convey safety to people in public spaces?
- How make an environment to be perceived as safe?
- How can the physical realm be connected to a digital application?
- How do you think a smartphone application can improve safety in public spaces?
- In what way perceived safety could be improved in public spaces?
- How could technology improve perceived safety?
- How would you use a smartphone application in your work to improve perceived safety in the city environment?
- How could physical environment and a smartphone application be connected?

Researcher in Urban Planning with a Background in Social Sciences (RISE Research Institutes of Sweden)

- Tell your background
- What is your experience in safety in Gothenburg city?
- What is safety for you?
- What do you do to convey safety to people in public spaces?
- What has been done to improve safety in Gothenburg City?
- How make an environment to be perceived as safe? What factors affect safety?
- How could technology improve perceived safety?
- How do you think a smartphone application can improve safety in public spaces?

Senior lecturer at the Department of Journalism, Media and Communication

- Tell your background
- What do you consider as perceived safety?
- What is your experience of perceived safety in Gothenburg city?
- What is, in your opinion, the biggest issue regarding perceived safety? How do you think perceived safety in public spaces can be increased?
- From social factors (sense of community, the presence of acquaintances or strangers, the familiarity of the area, and isolation of neighborhood) point of view?
- What do you think about media's role of perceived safety in public spaces?
- How can social problems that threaten safety be addressed?

- How do you think a smartphone application can improve safety in public spaces?

The representative of Nattvandrarna Gothenburg, with 27 years of experience of being an active Nattvandrare

- Tell your background
- What do you consider as perceived safety?
- In what way could perceived safety be improved in public spaces?
- What have you observed in your work?
- When do people feel unsafe?
- Why are they unsafe?
- What do you do to convey safety to other people, i.e. how do you act to be perceived as a safe person?
- How do you think a smartphone application can improve safety in public spaces?

Appendix III: Interview Guide for Concept Testing

Aim: Find what features improve perceived safety and what do not. Evaluate what aspects are of concern regarding this concept.

Introduction: This concept involves being able to meet up with people through a smartphone application when going from one point to another. First, you set up the app with your personal information and use BankId to confirm your identity.

Following scenario was presented: It's late in the evening and you are in a bar in Gothenburg. You are about to leave home, but there's no one to share the journey with.

This was followed by a demonstration of the smartphone application concept and these questions were asked:

- What was your first impression?
- Would you use it? Why / Why not?
- In what situations would you use it?