GreyZone

An Interaction Design Promoting Smartphone Non-Use

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Abstract:
Consistent and frequent interactions with smartphones have become an increasing tendency in the modern society. Smartphone over-use is among several problems critical and severe as it appears as a dominating element invading the individual and social nature and quality of everyday living leading to less physical and mental interactions with fellow people. Current strategies utilised for promoting smartphone non-use mainly provide successful results within a short-term period. This Master's thesis presents "GreyZone", a provocative interaction design, as well as investigates whether this design persistently promotes smartphone non-use over a selected period methodologically by integrating research through design within natural settings. GreyZone is fundamentally designed and constructed by integrating and combining the four provocative aspects *aesthetical*, *conceptual*, *functional* and *material* as an attempt to promote visibility in order to initiate critical reflection regarding own smartphone usage in-situ. This visibility of the actual usage is provoked as GreyZone restricts the availability of the smartphone to one hour a day. The effectiveness of provocatively promoting smartphone non-use was qualitatively and quantitatively measured throughout a study period involving eight participants with high diversity within the combination, GreyZone was handed out to five participants for 14-20 days. The findings of the investigation clearly showed similarities in the perceptions of GreyZone. The analysis of the gathered data shows large changes in behaviour during the trial period with GreyZone as well as in the weeks following the trial due to its ability to provoke reflection upon both self-selected and invoked interactions with the smartphone. Unfortunately it is a tendency returning back to usual patterns.

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By signing this document, each member of the group confirms participation on equal terms in the process of writing the project. Thus, each member of the group is responsible for all contents in the project.

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1. INTRODUCTION

In the recent decades, smartphone usage has increased significantly and appears as an integrated element in everyday living. A smartphone is an ubiquitous interactive device and it has become an increasingly attractive phenomena causing the countless opportunities it is technologically capable to deliver, beneficial for everyday living. In modern society, a smartphone is both habitual and time demanding among people (Oulasvirta, et al., 2012).

Although a smartphone is an optional device to own, the decision-making is indirectly associated with external factors, such as social norms and digitalisation. Owning a smartphone, as well as frequently interacting with it, has become an expected social norm, especially due to the external requirement of constant availability associated with the modern technological society (Frissen, 2000). The highly increasing digitalisation indirectly forces people to own a smartphone and simultaneously persuades them into increasing the number of interactions and hence hours spent with the device, leading to supporting smartphone overuse. Not owning a smartphone leads to technological complications and disadvantages regarding lack of accessibility of for instance personal information or to deliver required personal information to others. Concrete scenarios currently occurring in everyday living are, among other, communications related activities, e.g. two-factor identity verification through a random password generator sent to the user using Short Message Service, specifically required before entering educational systems at Aalborg University, or the NemID application associated with E-Boks, a mandatory national service system containing information between citizens, companies and state-related factors. Oppositely, it is clearly supporting the fact that a smartphone is a multifunctional device capable of making everyday living easier.

As previously mentioned, plenty of technological advances contribute to simplify everyday living, but it is necessarily not without consequences. Peoples' intensive engagement with the prevalent smartphone is problematic in social contexts as it contributes to excluding them from physical, mental presence and intimacy as well as experiencing physical surroundings. Similarly, this intensive engagement has an impact on the smartphone user's individual quality of living. An unhealthy relationship to the device is primarily caused by the disturbance from external and internal sources, e.g. incoming data such as notifications and the user's own mental urge to interact with the smartphone. These *external* and *internal* sources of disruption are time demanding as they interrupt routines and delay daily processes which can entail lacking productivity and sleep disturbances. Furthermore, these sources contribute to inappropriate conflicts in social contexts as it affects people's mental presence as their primary focus is aimed at their smartphone. In general, they can decrease the quality of concentration intensive practices (Frissen, 2000) (Heitmayer & Lahlou, 2021) (Lee, et al., n.d.). Another event which contributes to unnecessary overuse is the iterative behavioural pattern known as getting '*caught in a loop*'. Initiating interaction is frequently followed by another as a trigger triggering the user to continue interacting with the smartphone resulting in further time investment. This loop occurs caused by features which are specifically designed for promoting persistent usage but omits conveying the time spent (Frissen, 2000).

In contrast to the fact that a majority of the smartphone users lack managing their own self-control and time-structuring of their smartphone usage, there is an inner desire to convert smartphone overuse into limited time of usage from the users themselves (Lee, et al., n.d.). Instinctively, smartphone users are adopting existing common non-use strategies, such as *intervention software* or *physical separation*, into practical usage aiming at decreasing their current smartphone usage. According to Lee et al., these coveted non-use strategies are limited to only functioning within a short-term period as users are commonly discarding them and returning to their usual habitual behavioural patterns (Lee, et al., n.d.).

The core aim for this thesis is to investigate whether it is possible to establish a stable balance of smartphone users' own relationship to their smartphone in comparison to their surroundings. In addition to the short-term effects of non-use strategies, our specialisation aims at promoting smartphone non-use within a long-term period by exploring and constructing the provocative design provotype, *GreyZone*, which is innovatively an incremental design suggestion, by adopting the methodology *research through design* and the method of provocative interaction design (Raptis, et al., 2017). Methodologically, research through design is appropriately selected for our in-depth exploration as our motivation is to promote and study non-use by designing and constructing a mobile physical interaction design. Aiming at investigating how the participants critically reflect on their own smartphone use practices within natural settings using an interactive provocative design solution in a long-term period is the focus of this research. The provocative interaction design method contains the provocative aspects; *aesthetical*, *functional*, *conceptual* and *material*. Bardzell et al. highlight these aspects as an approach to construct an interaction design aiming at challenging and influencing people's current practices, routines or norms, leading to constructively communicating design critiques regarding the design solution (Bardzell, et al., 2012) (Raptis, et al., 2017).

1.1. Research Question

The main purpose of this thesis is to encourage our participants to critically reflect on their desired interactions to discard unnecessary interactions and decrease smartphone overuse, by constructing the interactive provocative GreyZone. Another purpose is to examine provocation by designing provocative elements, aiming at gaining knowledge of whether these are too or less provocative and to potentially challenge existing behaviour and smartphone usage as well as to make the users reflect on their intended actions before they are performed. These reasons lead to the following research question.

To what extent and how does a physical design support critical reflections on smartphone usage? And what are the experiences of using this in daily life?

REPORT STRUCTURE

A slavish overview of the entire master thesis report.

Introduction CHAPTER 1

The introduction firstly elaborates the foundation for promoting smartphone non-use before presenting the formulated research question.

Background CHAPTER 2

The background elaborates the initial research and contains an in-depth investigation establishing the foundation for the master thesis. It specifically initiates our pre-specialisation work followed by investigating non-use of technology and provocation.

Related Work CHAPTER 3

Related work introduces and elaborates two existing researches both adopting research though design by designing and constructing a provotype, therefore it was an appropriated inspiration source.

Provotyping GreyZone CHAPTER 4

This chapter present the design and constructive process including a visually presentation of the development and the high fidelity provotype GreyZone.

Field Study CHAPTER 5

We conducted a field study to investigate whether GreyZone contributed to smartphone non-use within natural settings.

Findings CHAPTER 6

The gathered qualitative and quantitative data from the field study and final interview were analysed, presented and discussed.

Reflection CHAPTER 7

This chapter contains a reflection on selected areas within this master thesis which could have been done differently and suggests alternatives.

Conclusion CHAPTER 8

The conclusion answers the initiated research questions.

2. BACKGROUND

This chapter contains an in-depth elaboration of theoretical and methodological approaches, shortly presented in the previous chapter, *Introduction*, primarily regarding smartphone non-use and use of provocation within research through design. During our pre-specialisation, "Promoting Smartphone Non-Use", we conducted semi-structured interviews in which findings are initially explained as these are potential for this specialisation and substantiates the necessity of conducting a longitudinal study (Geisler & Ryberg, 2020).

2.1. Pre-Specialisation Work

The findings from three semi-structured interviews conducted during our pre-specialisation project repeatedly highlighted that smartphone overuse leads to dissatisfaction regarding either own or others' smartphone usage. The main results related to usage, tendencies and conflicts clearly appearing in the analysis were structured into the following overall categories; *High and Frequent Usage, Desire for Changes in Current Usage, Desire for Keeping Elements in Current Usage, Conflicts in Internal Social Contexts, Impulsive Behavioural Tendencies, The Smartphone's Control over the User* (Geisler & Ryberg, 2020).

Regarding our pre-conducted data gathering, in the category *High and Frequent Usage*, the individual self-estimated average usage was calculated to 3.66 hours daily. This is similar to the findings by Lee et al. in 2017 that found the average smartphone usage to be 4.47 (also self-estimated), which supports that it is not a random coincidence occurring among our selection of participants (Lee, et al., n.d.). Supporting the high usage, an investigation by Oulasvirta from 2010-2012 found the average self-estimated smartphone usage to be 2.70 hours on a daily basis. This shows a significant increase within a decade, which indicates smartphone overuse is progressively increasing (Oulasvirta, et al., 2012).

In addition to spotting similarities and tendencies by asking predefined open questions, intensively observing both facial and verbal expressions promoted an impression of frustration and dissatisfaction regarding both own and other's usage in social contexts. The social dissatisfaction, also connected to the *High and Frequent Usage* category, was primarily expressed within the impact on the social atmosphere, for instance in scenarios where intensive attention and interaction is needed from other individuals. Another tendency causing smartphone overuse was the frequent incoming notifications received from a wide spectrum of self-selected applications and integrated functionalities. Notifications appeared as a disturbing element leading to *Conflicts in Internal Social Contexts,* as half of our participants were either consciously or impulsively reacting to notifications, promoting negativity to the atmosphere in the social context. Another behavioural pattern for a majority of our participants was the physical placement of the smartphone itself. In terms of distance, the smartphone was primarily placed right at hand, or they perceived their smartphone as a wearable. This decision signalised that they either perceived the smartphone as a necessity for everyday living or it was an incorporated habitual behavioural pattern.

Supporting the smartphone's previously mentioned contribution to an easier everyday living, our participants strongly identified their main activities as; communication, entertainment and smartphone advantages e.g. alarm, calculator, calendar or flashlight which entailed attractiveness to our participants and highlighted the beneficial sight of owning a smartphone (Geisler & Ryberg, 2020).

An outcome from the semi-structured interviews clearly signalled as a *Desire for Changes in Current Usage*, e.g. minimising the number of hours spent as well as indirectly or unconsciously using current non-use strategies. A participant mentioned the experience of getting 'caught in a loop', specifically by scrolling down the Facebook feed endlessly to pass time. Additionally, this participant perceived this interaction as being unnecessary, not providing any value and being a waste of time. Regarding *The Smartphone's Control over the User*, the frequent reactions and attention to notifications were also undesirable clearly highlighted in a participant's statement:

"Stop reacting to notifications, it is unnecessary that the notifications appear, I check my phone like an empty fridge to see if there is anything new and to be the first".

Regarding *Impulsive Behavioural Tendencies,* another unconscious tendency was the behaviour of picking up the phone impulsively without any target or purpose.

The desire of changing current usage does not only involve own smartphone usage but is additionally related to other participants' usages. As mentioned in the introduction, the norm regarding expectations to others' usage was frequently promoted in all three interviews as it ought to be an enrolled behavioural respect to both physical and mental presence. For instance, a participant expected constant availability from others, specifically the ability to reach them by call or other communicative applications. Although it appears as an advantage to being able to easily get in contact with others, it sometimes leads to internal conflict within social contexts such as mental absence and may be uncomfortable in social contexts as the phone appears as a priority over people. Although there is a general desire to minimise the current individual usage, there are also circumstances where the smartphone appears as an attractive element in the situation. There is also a *Desire for Keeping Elements in Current Usage*. For instance, there are elements they perceive relevant for their everyday living, which are practical and not time demanding such as setting an alarm or using payment applications.

2.2. Non-Use of Technology

Technology and the users' interactions with it play a central role within the field of Human-Computer Interaction (HCI). In recent years, investigating non-use has received a significant interest from researchers and designers within HCI. Non-use is, by Fuschberger et al., considered as an activity, as discarding technology usage is an action taken by the user, either consciously or unconsciously (Fuchsberger, et al., 2014).

Although the simple definition of non-use is the absence of use of a technology, i.e. the action of not using a technology, the term encompasses more than just the absence. As Satchell and Dourish express, "*Non-use is, often, active, meaningful, motivated, considered, structured, specific, nuanced, directed, and productive.*" (Satchell & Dourish, 2009). It encompasses that people have different

reasons and approaches for practicing non-use of technology and can explain the relationship between humans and technology (Satchell & Dourish, 2009).

A theory called the diffusion of innovation explains the extent to which rate an innovative technology is adopted by people as well as when non-users become users (Rogers, 1962). Furthermore, it implicitly assumes that those non-users will eventually become users to some extent. This view of technology innovation perceives non-users as either future users, non-existing or irrelevant (Lee, et al., n.d.) (Selwyn, 2003). The scientific paper by Baumer et al. dispute this binary view of users and non-users as they instead view them as being more complex (Baumer, et al., 2015). The binary view causes several illogical cases which describes a person as either just a user or a non-user. A concrete example is when an individual, after having used a technology for a period, decides to discontinue their usage for a while and eventually resumes it. Another example is an individual who has access to a computer through a public library and uses it on a monthly basis. In these cases, and plenty others, it is difficult to place the individuals as either a user or a non-user as it is often temporary and can change at any given time. As Baumer et al. state: "*a given individual is neither a user nor a non-user, but rather constantly (re) negotiates dis/engagement with the technology*" (Baumer, et al., 2015).

As mentioned, there can be several reasons why people wish to limit or entirely stop their usage of technology. In a study conducted by Lee et al., five frequently selected non-use strategies were identified: *altering smartphone settings*, *intervention software*, *physical separation*, *mental efforts*, and *downgrading*. Although it was reported that these various non-use strategies were to some extent effective, the participants often failed to sustain them over a longer period of time (Lee, et al., n.d.).

There are elements of the non-use strategies that can challenge the sustainability of not using technology. Concrete non-use strategies examples are temptations to use technology, lack of self-control and external sources such as requirements to use a specific technology (Baumer, et al., n.d.). An observation in our pre-specialisation, was that despite the participants' desire to limit their current smartphone usage, they continued in their usual routines, which is '*lagging resistance*' (Baumer, et al., n.d.). Another finding in our pre-specialisation highlights that people are more inclined to keep non-using specific technology when provoked by others, compared to when controlling their own usage (Heitmayer & Lahlou, 2021).

2.2.1. Non-Use of Smartphones

As previously mentioned, a smartphone is a device primarily intended for making everyday living easier, but this entails an expected social norm of constant availability and causes disadvantages of not having access to one. It is evident that practicing non-use of a device, intended for making everyday living easier could make various daily activities more taxing and laborious. Lee et al. state that it is not always feasible to practice complete non-use of smartphones (Lee, et al., n.d.). The findings in our pre-specialisation supports this theory as the participants desired changes, but also a desire for keeping elements in their current usage. On these matters, as well as that engagement of technology is constantly renegotiated, we prefer to focus on *temporary non-use* of smartphones.

Lee et al. propose that temporary non-use could be supported by utilising *inconvenience interaction design* among other guidelines. Inconvenience interaction design is described as a design guideline with the intention to make a design inconvenient to interact with by increasing the physical, cognitive, or temporal load, or several of these simultaneously (Lee, et al., n.d.).

Smartphones are designed to be accessible and uncomplicated to use and can provide quick gratification to the user. This instant accessibility of the smartphone can be a gateway to acquiring a habitual behaviour (Oulasvirta, et al., 2012). Moreover, our pre-specialisation findings indicated that the majority of the participants checked their smartphones out of habit several times within short time periods presumably caused by the minimal physical, cognitive and temporal loads of using a smartphone.

Based on our research into non-use and our pre-specialisation findings, we have decided to incorporate inconvenience interaction design as well as to investigate how it can be combined with provocative designs in order to provoke temporary non-use of smartphones.

2.3. Provocation

As previously expressed, it is our desire for this thesis to provoke *temporary non-use* as well as to hinder the *renegotiation of engagement* with smartphones. Renegotiation of technology engagement is a tendency primarily occurring due to the smartphone users' ambivalent relationship to their own and associated persons' smartphone usage, elaborated in section *2.1.* The motivation for relating to engagement in renegotiation is to strengthen or promote usual behavioural patterns related to smartphone overuse (Lee, et al., n.d.) (Baumer, et al., 2015).

Integrating provocation when creating a technological design solution is beneficial as it helps preventing renegotiation in everyday practices. According to Bardzell et al., a provocative design ought to consist of the aspects *aesthetical*, *functional*, *conceptual* and *material*. These provocative aspects can be promoted and expressed by designing and constructing a *provotype*, appearing as a tool contributing to research through design (Bardzell, et al., 2012) (Mogensen, 1991).

This subsection elaborates Bardzell et al.'s four provocative aspects as these are fundamentally assumed as a pathfinder leading to structuring, creating and designing a provocative design as an essential part of promoting provocation in research through design. Table *2.1* presents an elaborating explanation of the four above mentioned aspects (Raptis, et al., 2017) (Fuchsberger, et al., 2014).

Bardzell et al.'s Four Provocative Aspects	
Aspect	**Explanation**
Conceptual	The conceptual aspect includes the decisions regarding the design idea.
Functional	The functional aspect is related to how the design functionally works.
Aesthetical	The aesthetical aspect involves how the design visually looks.
Material	The material aspect contains the physical components the design consists of.

Table 2.1: Explanation of Bardzell et al.'s four provocative aspects (Bardzell, et al., 2012).

These aspects are necessary to include in our study as: *"A Provocative design refers to design approaches that operate in a design space where asking questions is as important as solving a problem"* (Raptis, et al., 2017), specifically due to their influence on the construction of our interactive *provotype.* Bardzell et al. explain that these aspects are appropriate in an interaction design but also relevant in a provotype as well. These reflections lead to the next section containing a detailed description regarding how integrating provocation as the main element within conducting research through design might influence everyday living (Raptis, et al., 2017) (Bardzell, et al., 2012).

2.2.1. Provotyping and provotypes

The chapter initiated the decision regarding methodologically adopting research through design, a relevant scientific approach for promoting and highlighting provocation as a frame for our research. A similar approach for exploring provocation is Mogensen's research titled 'provocation through concrete experience', adopting a prototyping approach occurring in everyday practices. A conspicuous quote claim is "*Provocation is A Question of Balance*" (Mogensen, 1991).

By referring back to the previous quote by Rapthis et. al., similarly, Mogensen, P, portrays this approach and focus as being appropriate while conducting an investigation, practically by iteratively designing and constructing a provotype (Raptis, et al., 2017) (Mogensen, 1991).

Mogensen highlights that when designing new systems it specifically requires a customisation in an existing context, and simultaneously must be either radically or incrementally innovatively developed. The previous quote stated by Mogensen fundamentally suggests asking for an optimal degree of provocation when actually integrating provocation in a system. Moreover, Mogensen treats conflicting aspects regarding how to evaluate the quality in new systems and secondly to secure the system's usability in existing practices (Mogensen, 1991).

As mentioned, Morgensen highlights the dilemma regarding iteratively balancing the degree of provocation. Combining element from a *prototype,* which is potential when solving a problem and *activity theory,* which relates to behaviour, is described as a way to balance provocation. A balance of this combination is relevant when developing the repeatedly mentioned provotypes.

INVESTIGATING THE PROBLEM USING PROVOTYPES

As previously mentioned, Mogensen examined how provocation in existing practices promotes potential solutions. In those practices, the problems become invisible, causing lack of criticality to the problem as the primary focus is on improving the design which entails the problem is taken for granted (Mogensen, 1991).

Normally, the focus is on the interaction design and not the problem itself when prototyping. Provoking with provotypes is an alternative more radical approach contributing to make the invisible visible, which, according to Mogensen's three roles, *expert*, *facilitator* and *provocateur,* is the provocateur's responsibility to complete. A provocateur helps the users to experience the potential

and effect in the actual context. The provocateur is also appropriate when a solution must contribute to making the problem easier or similar the aim (Mogensen, 1991).

ADOPTING PROVOTYPING

Adopting provotyping is appropriate within our conduction of research through design as our desire is to design and construct a provotype to make current situations related to the problems appear concrete and visible.

The result of Mogensen's investigation was the idea of combining provocation and concrete experience (Mogensen, 1991). This is an ideal approach as the purpose of this master thesis is to promote smartphone non-use by conducting research through design. Compared to our approach, our role is identical to a provocateur's position as our aim is to provide discrepancies and new perspectives in everyday living rather than testing functionality and usability in a design. The aim is to more radically reach a more in-depth comprehension of smartphone behaviour by designing and constructing a provotype, to see whether it is possible to effect. Specifically, this approach contributes to our desire to conduct research through design as provocateurs to investigate current users' reflections on smartphone usage in-situ as the current non-use strategies are ineffective in a long-term period.

3. RELATED WORK

This chapter presents two different existing investigations handling provocation in two different ways, specifically through an interactive application and an interactive physical design. Common for both investigations is their methodological approach adopting research through design and develop a provotype. The purpose of presenting specifically these two existing investigations is to gain inspiration as these are similarly the motivation and direction of our master thesis (Bruun, et al., 2020) (Raptis, et al., 2017) (Jensen, et al., 2018).

3.1. Pup-Lock

An existing investigation regarding consumption of mobile devices, resulting in renegotiation engagement, is the interactive provotype, Pup-Lock. The purpose of Pup-Lock is to make mobile devices inaccessible within family domestic settings aiming at promoting non-use. Pup-Lock offers the ability to activate lockdown for all smartphone devices for a duration of 30 minutes appropriated when quality time is prioritised in social contexts. The uniqueness regarding the strategy of Pup-Lock is that the selected non-use is provoked by others, not the smartphone users themselves. In comparison to our investigation, Pup-Lock provides the opposite effect as our desire is to avoid constant renegotiation engagement, and allowing accessibility at the moment the lockdown has expired (Bruun, et al., 2020).

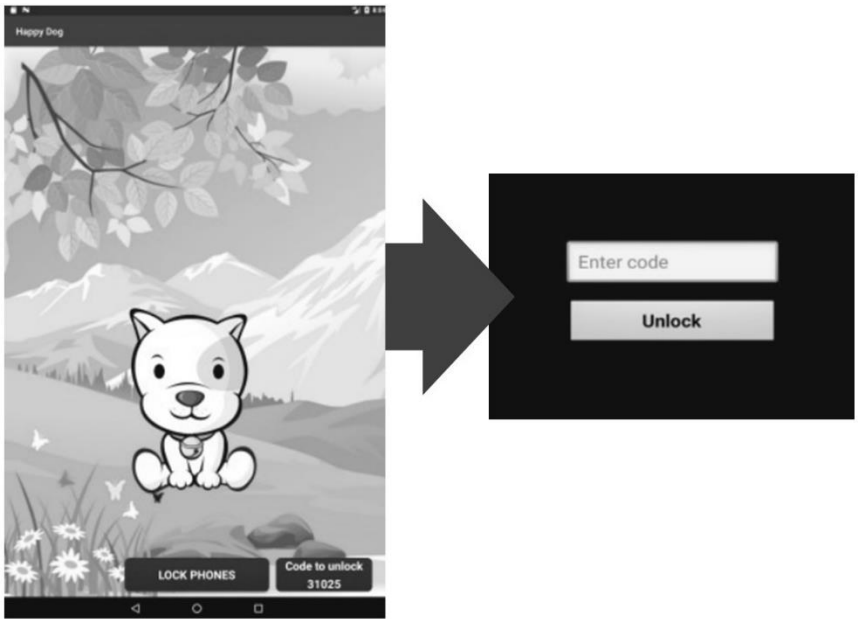


Figure 3.1: Screenshots of the Pup-Lock application, main screen (left) and lockdown mode (right) (Bruun, et al., 2020).

3.2. The Box

Another existing work adopting research through design is the study conducted by Rapthis et al. 2017 and Jensen et al. 2018 (Raptis, et al., 2017) (Jensen, et al., 2018). Rapthis et al. is aiming at gaining comprehension of how provocation is perceived as well as how it can challenge existing practices (Raptis, et al., 2017) (Jensen, et al., 2018).

Rapthis et al developed a physical interaction design called "The Box", which attempts to provoke laundry practices to create sustainable washing practices. They want users to reflect on laundry practices and eventually change them. The Box is not a product but a research tool. The principle of The Box is visualised in Figure 3.2. Specifically, "a" is the screen visualising when it is sustainable to wash, "b" shows the cost saving, "c" shows the number of times the override button ("d") has been pressed and "e" shows whether the current electricity is green or red (Raptis, et al., 2017).

During the design process, they facilitated three of Bardzell et. al's provocative aspects (Bardzell, et al., 2012). The conceptual provocation shows when electricity is green and the cost of electricity. To functionally provoke, they forced the user to make a decision about whether it was important to wash when the costs were high, by cutting the power when electricity was red. However, the user could decide to reactivate the power by using the red override button, but it was visible how many times the override button was pressed. The aesthetic provocative aspect dominated the visual design of The Box as it does not look modern and sleek, but bulky and physical as presented in Figure 3.2. (Raptis, et al., 2017).

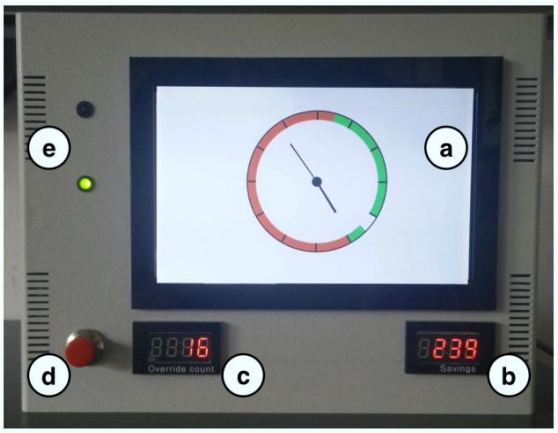


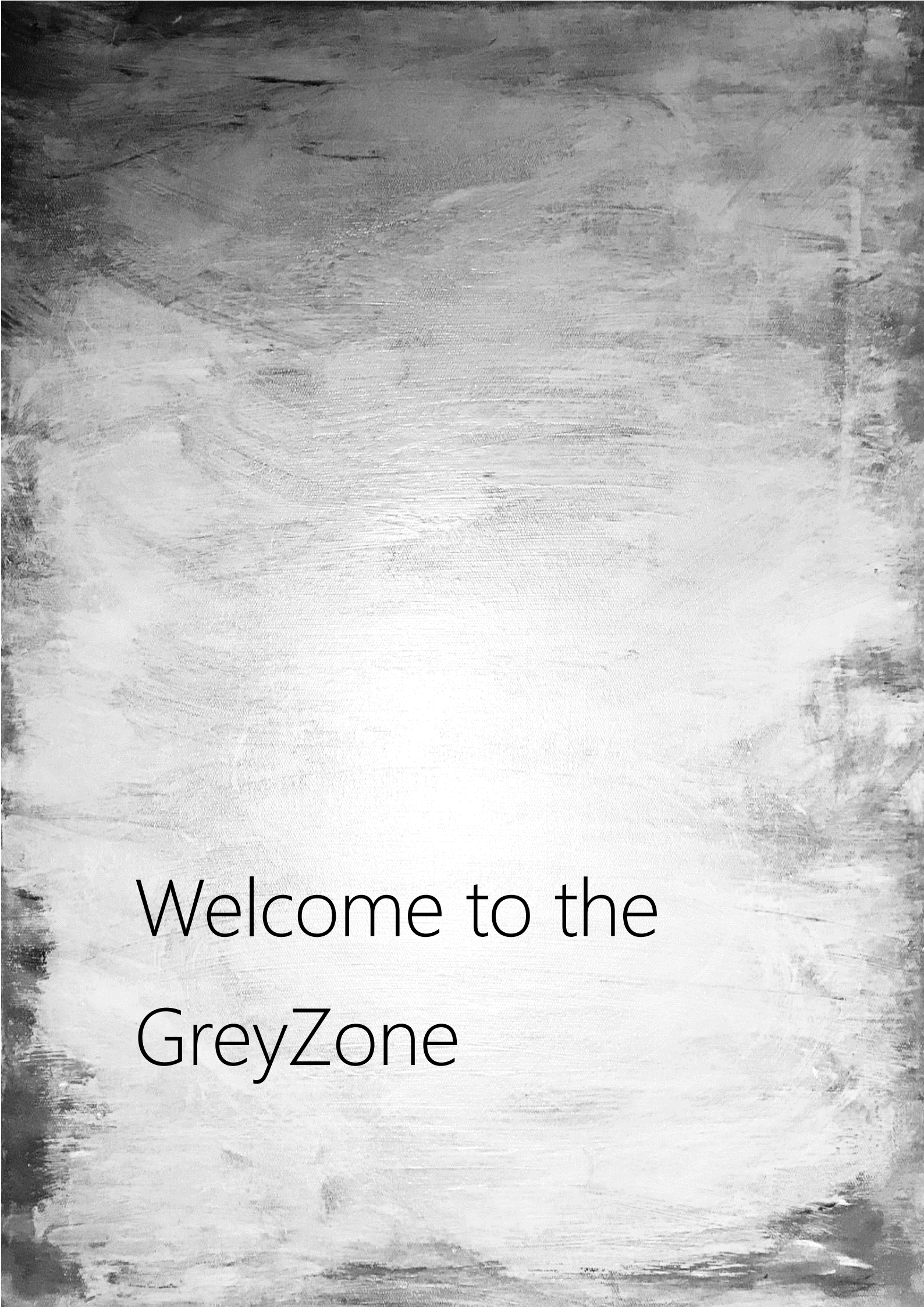
Figure 3.2. Principle of The Box. (Raptis, et al., 2017).

METHODOLOGY

Methodologically, the authors conducted a pilot study with one family to test The Box before the actual study and found bugs and fixed them. In the full study, four families used the box for four weeks. Additionally, they conducted two interviews with each family, one before and one after using The Box (Raptis, et al., 2017).

FINDINGS

Regarding conceptual provocation, the families were challenged but started to reflect on their laundry use. According to functional provocation, the families felt provoked by the override button and counter, although they were not challenged by the functionality. Within the aesthetic provocation, the users liked the physical design, e.g. the visible counters, but described it as being ugly. Generally the families saved money when they interacted with The Box during laundry. The participants also reflected on the detergent and the water temperature even though The Box was only concerned with electricity. The participants also reflected on using similar electricity-requiring machines when The Box was green e.g. the dishwasher. As a learning from the study, the authors found it important to use provotypes in the real world situations in order to use them in a research through design study (Raptis, et al., 2017) (Jensen, et al., 2018).


Welcome to the
GreyZone

4. PROVOTYPING GREYZONE

GreyZone from Idea to Sketch to Physical Interactive High Fidelity Provotype.

This chapter presents a wide range of suggested design alternatives followed by the decision-making process during the iterative development of GreyZone – the provocative interaction design. As elaborated in the previous chapter, provocation is crucial when designing GreyZone. By adopting the principles of Bardzell et. al.'s provocative aspects, *conceptual, functional, aesthetical* and *material,* we compromise natural interaction design theories (Bardzell, et al., 2012). These aspects work as a pathfinder in our decision by separating the provocation in each part of constructing and designing for provocation. The entire design and construction are iteratively discussed and selected based on own competences as interaction designers which are encapsulated in each of the four aspects. It is important to mention that there is a correlation between all four aspects, as these are related to each other. We employed design authorship as proposed by Raptis et al. when designing GreyZone, which argues for our design related decisions (Raptis, et al., 2017).

4.1. Conceptual Aspect

" The conceptual aspect includes the decisions regarding the design idea."

(Bardzell, et al., 2012)

The norm is an availability in duration of 24 hours a day, but according to our research access is limited to one hour intense smartphone usage. The conceptual aspect contains different overall alternatives regarding how to potentially promote and provoke smartphone non-use, but will overlap considerations from the other three provocative aspects (Bardzell, et al., 2012).

4.1.1. Conceptual Alternatives

The top figure in this section presents four different existing design alternatives considered during our pre-specialisation, namely a flight case, a craftsman's tool box, a safety box and a treasure chest. Common for each of these physical concepts is that they visually signalise safety, robustness and are opaque which is intentional as to complicate access and promote non-visual connection to the smartphone. Specifically, this direction was selected after an idea generating process by creating both communication sketching, idea generation sketching as well as quick sketching. The selected concepts all signalise fragility, security or danger inside, as it from a design perspective is not allowing opacity and transparency. As previously presented, the concept can be designed differently depending on the way of physically locking in a smartphone, by requiring several steps before getting access to the content. Technically, this is solved by the cumbersome locking mechanisms in each of them such as a key, a password, a turning mechanism or a combination that require one or more interaction. The opacity contributes to distance the focus from the smartphone (Geisler & Ryberg, 2020).

4.1.2. Selected concept

Our aim regarding the conceptual aspect is to physically obtain visual distance by hiding the smartphone from the user. Additionally, it must be portable as a smartphone is a portable device. The flight case and craftsman's tool box are technically similar and are the only two designs that are obviously portable – in contrast to the safety box and the treasure chest which are perceived stationary. Flight cases are conceptually constructed to protect fragile elements inside during transportation under though circumstances, where the craftsman's toolbox is designed for hard and solid tools almost unbreakable. The flight case design visually signalises "be careful, handle carefully" as a smartphone today is like wearing a small window. Flight cases are available in all sizes and can be aesthetically designed as preferable.

How is it conceptually provoking?

Integrating elements from the flight case is the overall conceptual design selected to provoke at the starting point for designing a more detailed provotype supporting this provocation. The idea behind provoking by taking inspiration from the flight cases is primarily to hide visibility to the smartphone but create visibility to potential overuse. Among other considerations, selecting heavy raw materials are elaborated in the material aspect section, as well as how to technically accommodate the visibility of usage is explained in the functional section. Figure *4.1* presents a detailed sketch of our initiating design suggestion for a miniature flight case which is inspired by the concept of a physical portable cell phone from the Cold War era in the 80s, see Figure *4.2*.

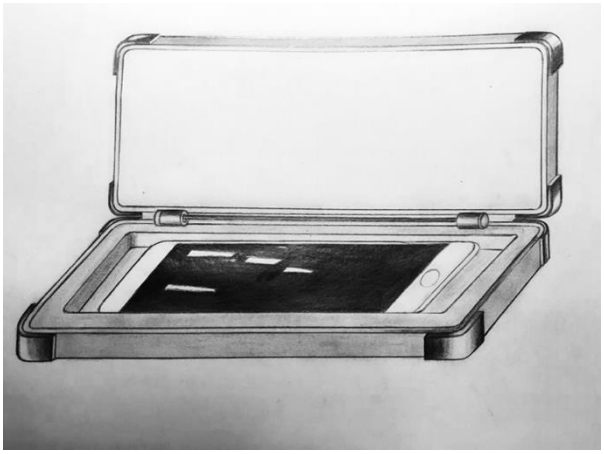


Figure 4.1. Detailed sketch of a miniature flight case.

Figure 4.2. Inspiration from cell phone from the Cold War era (Anon., 2018).

The purpose is to provoke by adopting elements from the cell phone from the Cold War era's as it aesthetically and materially expresses intangibility. The design of provocations of the flight case also appears in association with a smartphone as it complicates the transportability. This is selected to lead the user into a reflective process regarding the necessity due to a world without a smartphones luxury.

4.2. Functional aspect

"The functional aspect is related to how the design functionally works."

(Bardzell, et al., 2012)

The norm within the functional aspect is unlimited smartphone availability in a duration of at most 24 hours a day, with several easy unlock options such as fingerprints, password, face and voice recognition. This norm is similar to the classical norm within Human Computer Interaction, hence forth HCI, saying that interaction design technologically must contain minimal interaction (Norman, 2013).

Obtaining success within HCI requires focus on user-centred design fulfilling the users need. It depend on the elements the design consists of, its functionality and the control of interactions between humans and technology in order to obtain a positive user experience as interaction designers. A traditional rule of thumb within HCI says that an interaction design must maximum contain three interactions per functionality. As we are designing a provotype, this rule of thumb will be discarded on purpose during the design process as it might prevent the ability to provoke correctly and promote reflections in-situ (Bardzell, et al., 2012) (Norman, 2013).

How to functionally provoke?

Our thought regarding the functionality required when constructing the hardware and software of a provocative flight case, is to first delimit and standardise the amount of time available on the smartphone, which is against the norm of 24 hour availability. Provoking personal considerations regarding the necessity of the selected action can be done by confronting the actions by promoting reflections before reaching physical smartphone access. There exist plenty of optional equipment and electronics to collect and construct an overall provocative functionality. We have narrowed down a large number of opportunities to evaluate only the most obvious for our purpose.

4.2.1. Functional alternatives

During the idea generation process, the functionality has expanded to further and more detailed considerations from the starting point, which was only one hour availability. This subsection elaborates each provocative alternative, both manual and electronic, supporting the functional provocative aspect.

Time expired

To signalise that the available time has expired, we considered the different types of feedback technically possible to implement in the flight case: *light*, *audio*, and *haptic*, specifically *vibration*. However, as the smartphone can be physically separated from the flight case, light and haptic feedbacks are not optimal approaches, as the user focuses on the phone or might be physically distant to the flight case. The most attentional and ideal type of feedback is audio, as it neither requires visual or physical contact to the flight case. To obtain provocation, we considered several types of audio, primarily perceived disturbing, annoying, warning or attention-grabbing. A high level of volume is required for the case to be attention-grabbing. We considered the following existing and recognisable

sounds: doorbell, speaking voice, crying baby, ambulance, fire alarm and a combination of different sounds simultaneously.

Emergency required

Due to ethical circumstances and responsibility, emergency accessibility is an required implementation to allow the user to deactivate the selected warning sign and kill the noise. The selected type of emergency is a button, which aesthetical appearance will be discussed in the aesthetical aspect section.

In or out of flight case

A scenario considered is that the user can be tempted to exceed the limited time, and it is therefore important to track and reveal the placement of the smartphone. Besides implementing technology provocatively forcing the user to leave the smartphone behind inside the flight case, it is also important to limit the volume of the flight case to only fit the average smartphone size. The alternatives generated were compression springs and sensors existing in plenty of types depending on size, shape and sensitivity.

Locking mechanism

The purpose of considering locking mechanisms is to prevent the user from dropping the smartphone from inside out the flight case. Additionally, the interaction of physical locking mechanisms is time demanding as it is a process containing steps which stand in contrast to the norm of using the artificial and recognisable technologies mentioned in the initiating part. The physical locking mechanisms suggested are a padlock with associated key, a keyhole with associated key, an automatic lock, buckles and a physical code lock with self-selected enumerable combinations. Each locking mechanism provokes, as they require focused interaction, with the exception of the automatic lock which only signalises security.

Power supply

Depending on the amount of electronic elements in the design, the power supply alternatives are important to consider, especially in relation to capacity and size. The examples are a power bank, a battery driven or nothing (requiring a purely non-electronic design).

4.2.2. Selected functionality

We decided to visually display the time spent and time left on a screen. When the time expires, an audio noise similar to a fire alarm will activate. A physical sensor tracks whether the smartphone is in or out of the flight case. In case emergency is required, a physical button allows for 10 extra minutes of smartphone usage without the stressing alarm. The selected locking mechanisms are designed by combining two of the alternatives previously considered, indeed the buckles and the automatic lock. The automatic lock is supportively selected for the experience of hearing a thoroughly locking sound. It is important to mention that the flight case must be closed containing a smartphone. As the functionality primarily consists of electronics, a power supply in form of a power bank is necessary to secure a fully charged flight case all day.

4.3. Aesthetical aspect

" The aesthetical aspect involves how the design visually looks."

(Bardzell, et al., 2012)

A stylistic, minimalistic and elegant design is defined as being visually beautiful from an aesthetical perspective, inspirationally visualised in the initiating appetizer figures. A necessary factor to highlight when discussing aesthetic is the visual look, as the design must appear as what the human eye perceives as beautiful. Beautifulness of material objects is mostly related to organic shapes, symmetry and contrasts calm for the human eye (Lim, et al., 2007). Although the focus is on provocation, it is equally important to reflect on creating an aesthetically beautiful provocative design as interaction designers which is why we consider this aspect (Bardzell, et al., 2012).

4.3.1. Aesthetical alternatives

Referring to the four conceptual alternatives presented in the introduction of the conceptual aspect, each of the alternatives has a different expression. The aesthetical expressions of each are potential to consider as all consist of materials technically possible to construct the flight case of.

4.3.2. Selected aesthetics

Specifically in this aesthetical aspect, the decision making is based on our own preferences and skills to fulfil the expression and provocation we aim at. The aesthetical design of the flight case is inspired by the already existing appearance and safety the flight case expresses. By visually customising a miniature edition of the flight case, it offers a wide range of opportunities to select any colour and it is possible to adapt for the hardware. According to pantone and metallic colours and contrasts, we selected a combination of a cold grey toned colour palette. Specifically, we selected a light grey aluminium for the edges, silver for the corners and a dark grey pattern for surfaces in metallic texture. For the buckled closing mechanisms we decided on silver as it matches the edges. Lastly, for the emergence button, we selected the colour red as it signalises danger which might prevent the users for using in case they feel tempted. The design visually appears industrial and solid while simultaneously having cold and gloomy expression.

4.4. Material aspect

" The material aspect contains the physical components the design consists of. "

(Bardzell, et al., 2012)

On-device applications are the norm according to our research and according to Raptis et al. (Raptis, et al., 2017). Oppositely, we have decided to design and construct a provocative physical interaction design for our research. Therefore, the material aspect is interesting to include in our considerations as it relates to both the functional and aesthetical aspects (Raptis, et al., 2017) (Bardzell, et al., 2012).

4.4.1. Material alternatives

Aesthetical

The different materials visualised in the initiating figure, i.e. wood, copper, cement, steel, aluminium, iron and leather, are those we find appropriate to accommodate the aesthetical industrial look in combination.

Functional

According to the functionality, some components require physical and technical capacity before implementation due for instance size, maximum capacity in different unit, and possible construction of it.

4.4.2. Selected materials

Aesthetical

The material aspect additionally involves selecting materials for the aesthetical aspect to aim at expressing an industrial, cold, gloomy, and solid look. The materials supports the aesthetical aspect regarding reaching an industrial expression.

Functional

The primary material selected, those for comprehending the assemble of the flight case are listed in narrowed down bill of materials in Table *4.1*. For more detailed elaboration of the bill of materials, see Appendix 1.

BILL OF MATERIAL		
#	Material/Component/Item	Quantity
Flight case		
1	Microphone hardcase	1
Electronics		
2	Arduino Uno R3	1
3	Digital display	1
4	Speaker	1
5	Momentary Button	1
Locking mechanism		
6	3D-printed Body	1
7	Motor	1
Platform		
8	Wood board	1
Related components		
9	Micro SD card	1
10	USB power bank	1

Table 4.1. Bill of Material

The platform and foam included in the microphone hardcase coordinate the position of the smartphone. The Arduino components were programmed in Arduino 1.8.13 software in the imperative programming language C, for the entire program, see Appendix 2.

4.5. The Provocative Design

GreyZone

GreyZone - A High Fidelity Provotype.

The final choices within each of the four provocative aspects have established the entire foundation and procedure for constructing the interactive provotype “GreyZone”. The name GreyZone is selected due to the internal conflicting dilemma regarding the importance of consuming smartphone time as the idea is to lead the user into a reflecting zone. The purpose is to confront the participants with their own ambivalent smartphone relationship and reflect on whether pre-defined interactions are valuable or irrelevant and therefore should be discarded from the mind. This section is separated into a design part visually presenting GreyZone followed by a constructive part elaborating the stepwise process fulfilling the decisions made based on the provocative aspects.

4.5.1. The Concept of GreyZone

This subsection visually presents GreyZone from different perspective views, visualised in Figure *4.3* as well as the dimensional measurement in centimetres(cm), see Figure *4.4*. Lastly the use case scenario in Figure *4.5* slavishly presents the entire stepwise interactive process when using GreyZone.

Figure 4.3. Three dimensional photographs of GreyZone from other different perspective views.

Figure 4.4. GreyZone's dimensional measures.

USE CASE SCENARIO

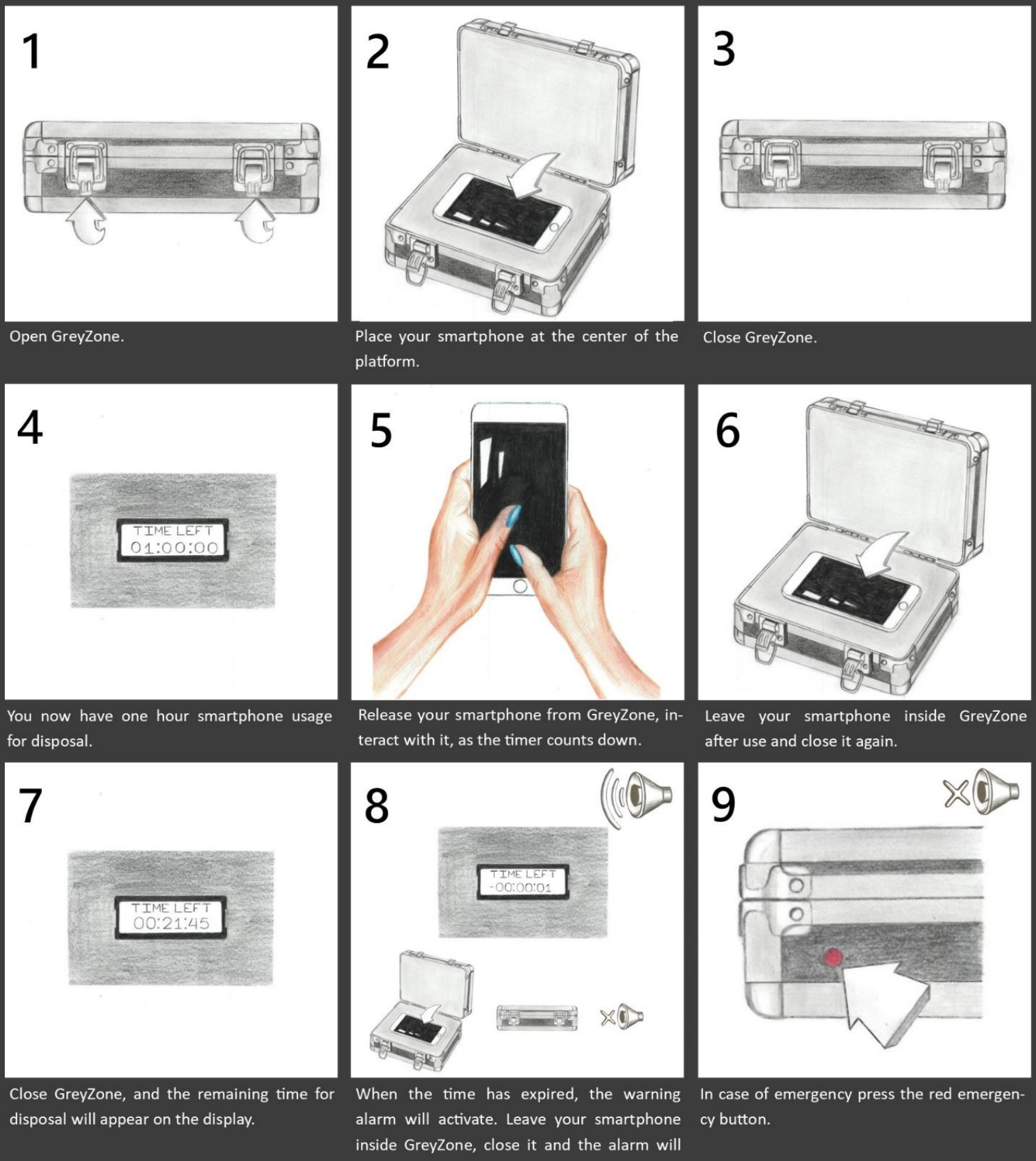


Figure 4.5. Use Case Scenario.

4.5.2. The Construction of GreyZone

The subsections visually elaborates the constructive development of GreyZone containing the assemble process and documents our stepwise organised working process. Figure *4.6* explains and visualises the assembly process of GreyZone.

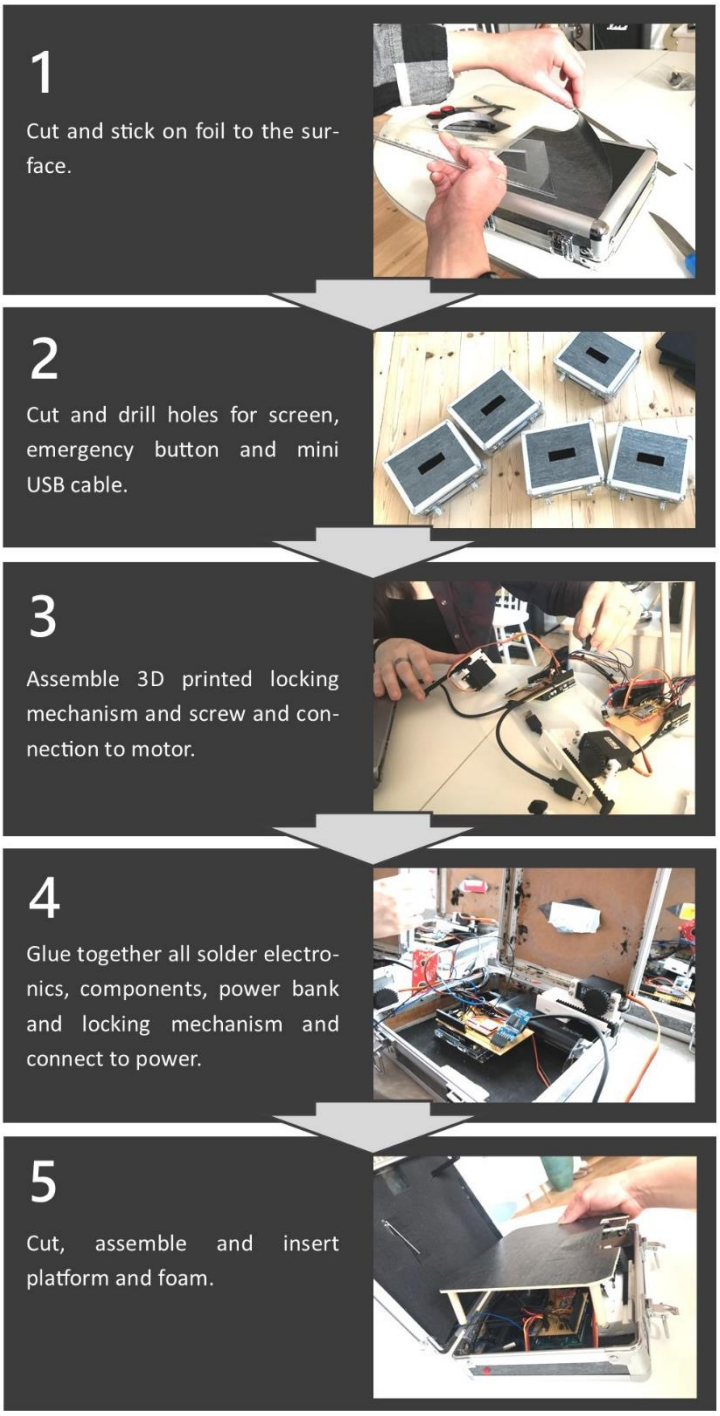


Figure 4.6. Assemble Process.

GreyZone From Upside Down

The physical architecture of GreyZone can be separated into three layers visualized in Figure *4.7*. Figure *4.8*. presents a clearer and more detailed close up photography of the electronics (Layer 1).

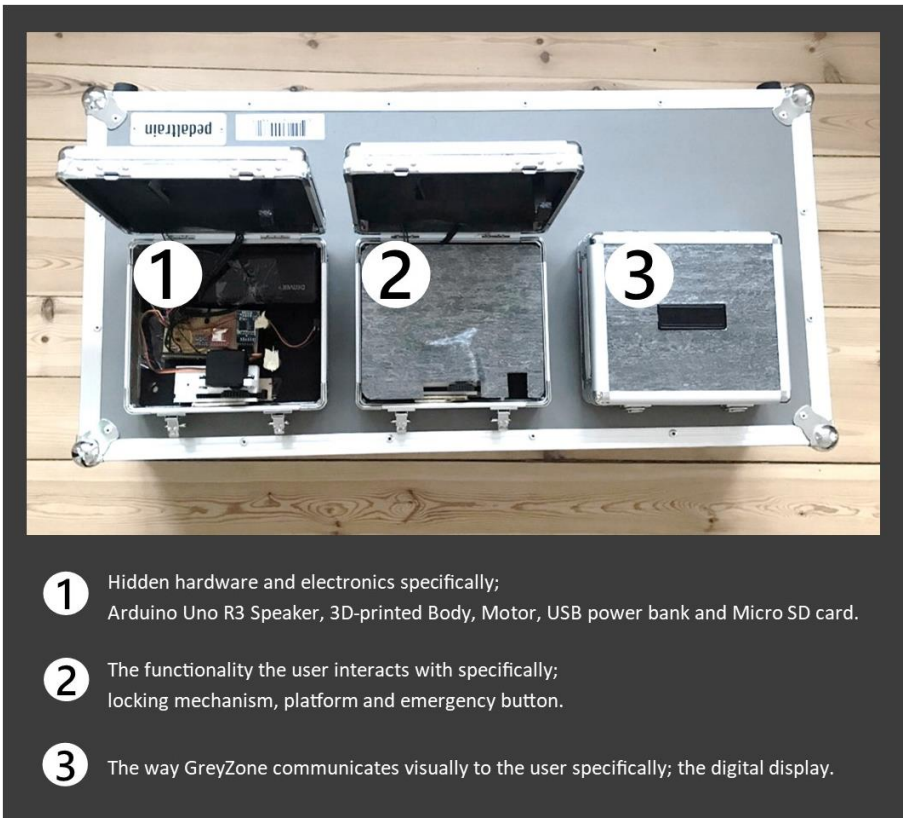


Figure 4.7. GreyZone's three layers.

Figure 4.8. Close up of hidden hardware(Layer 1)

5. FIELD STUDY

The purpose of conducting this field study was to explore to which extent GreyZone supports critical reflections on smartphone usage in addition to the associated experiences using the provotype within natural settings. The frame for this specialisation included a field study, adopting the methodological approach defined as a mixed method study, i.e. a combination of quantitative and qualitative data gathering methods. The study extended over a duration of 14 to 20 days and included three families, in which one, several or all of the family members used the provocative GreyZone. This chapter describes the entire process of conducting the field study including identifying the participants, the field study design and the collected data as well as the reasonings behind our choices.

5.1. Procedure

The purpose of conducting a field study was to investigate what happens when GreyZone becomes an integrated element in everyday living. An additional goal was to gain insight and knowledge into the participants' reactions within natural settings, as it contributes to a realistic representation of GreyZone's effect on everyday routines. This section elaborates the entire procedure of our field study and is separated into three parts; an overall description of the participants, the study design and finally the gathered data including analyses.

5.1.1. Participants

The selected eight participants were the same three families who participated in initiating interviews during our pre-specialisation. Here we gathered the initiating information and fundamental data regarding their perception and desire of their own usage as well as the usage of their relatives. Based on the results from the qualitative data analysis of the interviews, the five members were selected to use the provotype in the study, henceforth being referred to as provotype users and the rest as non-provotype users. Table *4.2* shows the participants identification by name, age, gender, participant number, occupation, and if they are selected as provotype user or non-provotype user. When discussing both the provotype users and non-provotype users, they will be referred to by first name (Geisler & Ryberg, 2020).

Segment (Family)	First Name	Age	Gender	Participant Number	Provotype User (P)	Occupation
Senior Couple A	Jens	61	M	1	P	Environment Technician
	Marianne	58	F	2		Urban Planner
Young Couple B	Christian	27	M	3	P	Sound and production Student
	Anna	25	F	4	P	Music Student

Family with Teenager(s) C	Irene	15	F	5	P	Elementary School Student
	Emilia	19	F	6		High School Student
	Claudia	50	F	7	P	Self-Employed Day Care
	Morten	53	M	8		Environmental Economist

Table 4.2: Participant overview.

Selection of provotype users

The five provotype user were not randomly selected due the direction of our research focusing on both individual smartphone usage but also usage that influence on their relatives. The distribution either caused the participants significant high smartphone usage or their smartphone is work-related. Please notice that not all the participants were assigned GreyZone simultaneously or in the extend of period.

Family A: The senior couple's smartphone usage entailed some limitation to our study as Marianne's phone was simultaneously used for private and work-related circumstances. Therefore, it was obvious to make Marianne non-provotype user and Jens provotype user.

Family B: For this young couple, it is relevant to investigate the effect for both Anna and Christian, as their smartphones are only for private usage. It is interesting to reach insight in whether they reflect on each other's actions and spend their time differently. Therefore, both of them were assigned GreyZone as provotype users.

Family C: In the family with teenagers, the age distribution is the widest of all families. As such, the family can be split into two subgroups, i.e. teenagers and adults, as it was interesting to examine the outcome from one participant in each subgroup. The person with the highest usage in each subgroup was selected as provotype user to see whether it had an effect on the non-provotype user's usage.

5.1.2. Study Design

As mentioned, the field study period extended over 14 to 20 days, where five participants of three different families were provotype-users. The study initiated by providing GreyZone to the provotype users as well as conveying the purpose of the study, explaining the functionalities and the stepwise interactions with GreyZone and encouraged them to report problems or ask questions if necessary. As visualised in Figure *5.1*, we designed a GreyZone package containing GreyZone, an associated user manual, a personal diary and a matching ball pen. See Appendix 3 for unfilled version of the GreyZone manual and dairy.

Figure 5.1: Package for the provotype using participants.

As our study aims at promoting non-use of an electronic device, it was contradictory and inappropriate to deliver an electronic version of the manual and the diary available. Additionally, the printed formats contributed to obtaining a physical experience, which was important because our focus is on a physical interaction design.

3.1.1. Data Acquisition & Analysis

As previously mentioned, the data collected in our field study was designed as a mixed method study with the purpose of analysing the interviews, the diary entries, the provotype and the participants' smartphones. The qualitative data provides a more subjective data formulation and insight into the participants' thoughts and reflections while the quantitative data provides an objective numerical representation of the smartphone usage patterns.

Diary Study

The provotype users were instructed to fill in a diary at the end of each day during the study. These diaries were used for gathering self-reported data and were constructed utilising the Day Reconstruction Method [8]. This type of survey method was chosen for this study to keep our participants' labour intensiveness required to a minimum. The first question was concerning the most memorable experience of the day, whether it was negative or positive. This was followed by assigning the experience a title, time of entry, in which situation it occurred, the persons involved, and associated emotions separated into two affect descriptors. The two descriptors were *frustrated* and *satisfied*, rated on a scale from 0 (*not at all*) to 6 (*very much)*. Lastly, it was optional to add a further elaboration of the experience of the day. The purpose of encouraging the provotype users to fill out the diaries was to document experiences for further discussion at the weekly interviews, see Appendix 4.

Weekly Interviews

During the field study, we conducted weekly semi-structured interviews with each of the families. It was beneficial to collect the entire family participants including the provotype users and non-provotype users to investigate GreyZone's effect in a collective context. The non-provotype users helped the provotype users to reflect on their experiences from another perspective. In addition, it was desired to gather information regarding reflections the participants made, both from the GreyZone users and the non-provotype users. The content was based on the prior week's diary entries aiming at converting their daily experiences into reflections about their smartphone usage.

Final Interview

The purpose of conducting a final semi-structured interview was to ask about the participants' perceptions and opinions about GreyZone including provocativeness related to the aesthetic, functional, conceptual and material aspects. Another purpose was to reach insight into their final perceptions of their own and others' smartphone usage for both the provotype users and the non-provotype users. Lastly, we asked the participants if they could envision using GreyZone outside of the study.

Qualitative Data

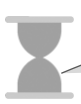
The qualitative data was acquired from the semi-structured interviews and the diaries. The interviews were video recorded allowed within statement of consent from each family and to highlight conspicuous quotes. Supplying quantitative data was collected in the diaries as the content were routinely discussed in the weekly interviews. Additionally, we analysed the participants' responses to the descriptive scales in relation to the other data as they were not commonly mentioned in the interviews. Due to the copious amount of data to analyse, the most conspicuous comments and data in the interviews were documented immediately. As the purpose was to spot tendencies among all participants the recorded videos were not transcribed.

Quantitative Data

The quantitative data was acquired from the provotype and the participants' smartphones. For the duration of the field study, the provotype logged data into the SD card when the condition changes. The data consisted of which condition it entered and the current date and time. Moreover, at the end of each day, it logged either how much time was left or how much the time had passed over the daily limit. Additional interesting quantitative data to highlight is the number of time they took out the smartphone, for how long time and frequently and time distribution.

Data Comparison

The data from their smartphones from 0-2 weeks before the field study until 1-4 weeks after the study, contributing to see the development in long-term. The qualitative data and quantitative data were analysed and compared to substantiate compliances. Additionally, the data gathered from the field study was compared to the data gathered in our pre-specialisation project to see the long term effects of the provotype.



6. FINDINGS

This chapter presents and elaborates the outcomes and findings from the analysis of the gathered data focusing on presenting the influence of integrating the provocative interaction design, GreyZone, in an everyday living context in the period. The findings from both the qualitative and quantitative gathered data has been organised in categories representing one or more similar tendencies frequently or strongly occurring. The findings include the data gathered before, during and after interaction with GreyZone in the field study. The selected categories and associated tendencies will be explained and substantiated with associated quotes and compared to the quantitative result. Additionally, the results will be highlighted and compared in relation to similarities, neutralities and differences. Lastly, this chapter contains the overall opinions of GreyZone itself, which differ from family to family, and compares these opinions to the qualitative and quantitative data gathered in the pre-specialisation project.

6.1. Field Study Findings

This section presents the results from the data gathered from the weekly interviews during the field study. The entire data is filtered and grouped into five categories containing associated tendencies, see Figure *6.1*.

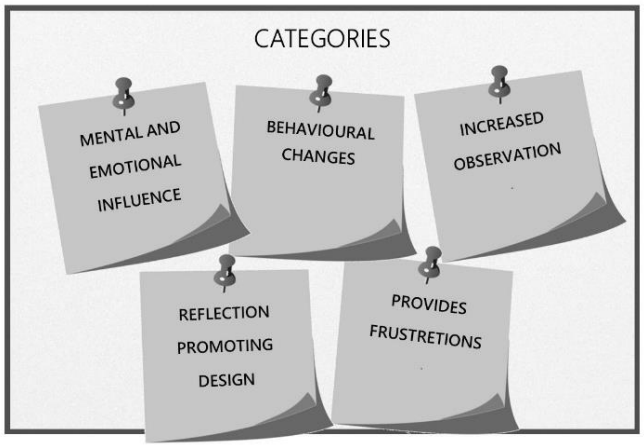


Figure 6.1. Overall categories.

6.1.1. Category 1: Mental and emotional influence

GreyZone influenced four of our participant mentally and emotionally, but in a positive direction. They perceived the time of smartphone non-use as de-stressing. Particularly interesting was their observation of increased memorability. One participant perceived smartphone non-use as a prestige in social context.

Destressing

Not frequently interacting with the smartphone was transferred into being a de-stressing factor in everyday living. It was a tendency occurring periodically for some of our participants, directly or indirectly supported by the following quotations.

Marianne:

"*I am more conscious of not looking and use it all the time, it can be a stress factor, I have become conscious regarding leaving it and delimit the usage to specific times. Constant availability can easily become enough, it is annoying as it provides mental turmoil… I guess Jens' decreased usage has influenced me, mentally I want to leave it behind, as it is stressing and overexposed*"

Jens supplied by supporting the quotation by confirming the promotion of peace. Similarly, Irene experienced the same before bedtime as quotes:

"*It's very nice in the evening that I do not use my phone before I go to bed, and I did not think about it before, it gave a lot of peace … using my phone before bedtime is the wrong way to relax.*"

This de-stressing factor is generally conveyed as a benefit in their everyday lives, which shows that GreyZone's forced time limitations to some degree have had a positive effect on the quality of their time and wellbeing.

Increased memorability observations

An interesting observation was that four of our participants, both provotype users and non-provotype users, experienced that the non-use or limited usage increased their memorability. The following quotes describe concrete episodes from their everyday during the field study.

Jens:

"*We have made an observation. When checking the weather, you forget it five minutes later and do it again. You do not react on it because you just look it up the next time. So you actually forget what it really is you are looking at.*"

Marianne:

"*It was the opposite in the old days when you looked at the weather forecast at the back of the newspaper - you have reacted on it. Today, we observe it in a different way, I think our brains become bad at remembering. You do not have to be so careful, which also helps you pick up the phone several times during a day because you can easily check it again. It's inappropriate.*"

Irene:

"*It has changed my way of doing thing, for example I remembered a route better. By being able to look at google maps only once I have become more independent.*"

Anna:

"*When I was in the shopping mall, I did not bring my phone with me. Suddenly, had to remember the shopping list and I actually remembered it, I just had to think about it a few times.*"

These quotes show that the smartphone is smart as it helps people remember things. However, this may come at the cost that our brains become worse at remembering things. It is therefore beneficial that non-use improves memorability or at least make our participants conscious about their ability to remember on their own.

Non-use promotes prestige and uniqueness

For some participants, smartphone non-use in public environments evokes prestige and uniqueness. This was an unexpected consideration appearing strongly during the field study. According to Irene, she strongly feels a personal improvement, as can be seen from her quote:

"*In the train instead of picking up my phone I picked up a small book which I think is actually very nice, it is still a nice feeling that you can sit in a train, having a book and reading it, which is not common and when people look at you like: "do you read a book" - yeah. It's a little cool.*"

"*In public, I think, I want to stand out from the norm a little, I do not want to be one of those who looks at it, I also think it is a uniqueness, that I prefer to become part of.*"

6.1.2. Category 2: Behavioural changes

Individual behavioural changes

Both small and large individual behavioural changes have occurred during the field study. For example, participants reduced time spent on specific applications, improved concentrating on only one task or began to use old technology. Irene informed frequently in all weekly interviews that she was less addictive to the smartphone, specifically social media, for instance Irene's short conversations with her friends.

Irene said:

"*Personally, I have become much better at not being that addicted to my phone, when I have a conversation it is like: "hi, goodbye again".*"

Similarly, Jens mentioned that he during the field study avoided checking the e-mail, and, additionally, he has returned back to the technology of a credit card during shopping. He quoted:

"*I used to use Mobile Pay, but returned to the credit card.*"

This observation leads to the next tendency regarding decreased usage.

Decreased usage

During the pre-specialisation, all participants estimated their smartphone usage (Geisler & Ryberg, 2020). The participants' own estimations as well as the data gathered from some of the participant before the field study are interesting compare to the field study data. The collected qualitative and

quantitative GreyZone data during the fields study overall shows a tendency of decreased usage except from one provotype user, Claudia, who discarded GreyZone after two days.

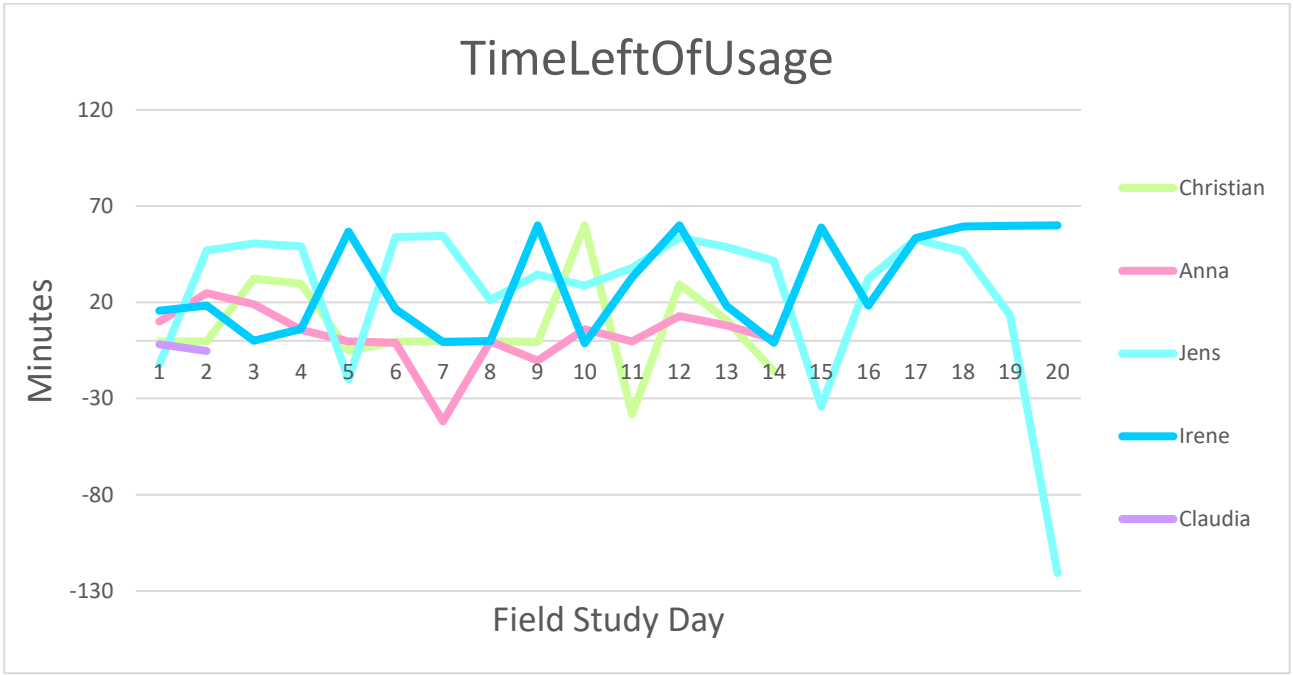
AVERAGE TimeLeftOfUsage	
Jens	23,93
Irene	29,5
Claudia	-3,54
Anna	2,34
Christian	7,22
Sum	59,5
Total Average	**11,9**

Table 6.1. Average Time Left of Usage in minutes.

AVERAGE EmergencyButtonPressed	
Jens	0,4
Irene	0,0
Claudia	0,0
Anna	2,3
Christian	0,5
Sum	3,2
Overall	**0,6**

Table 6.2. Average Emergency Button Pressed.

Despite Claudia's, decision, all numbers in Table *6.1,* which presents the provotype users' individual as well as total average of times left of usage, are positive. Numerically, the total average of time left of usage is 11,9 minutes, which means our five provotype users in total spend less than an hour on their smartphone daily.



Graph 6.1. Curve Diagram over Time Left of Usage.

Although all provotype users' individual average signalises time left of usage, there are still clear variations on a daily basis throughout the entire field study, shown in Graph *6.1.* Specifically, Christian's, Anna's and Jens's behaviour tangents into exceeding the limit by 30 minutes or more

some days. There were different interesting reasons for the overuse these days, supported by quotes and the qualitative dairy data.

Anna	
Day nr.	Day 7
TimeLeftOfUsage in minutes:	- 41,87
EmergencyState:	4

Table 6.3. Excerpt from table of Anna's usage.

Jens	
Day nr.	Day 20
TimeLeftOfUsage in minutes:	- 120,73
EmergencyState:	1

Table 6.4. Excerpt from table of Jens' usage.

In addition to the quantitative data from Table 6.1., the participants' own perceptions and reflections are also important to include to reach a more subjective perspective and insight into their decision-making. For instance, Anna exceeded an hour smartphone usage on field study day number seven, as can be seen in Table 6.3. Anna additionally noted the following in the dairy: "I was calculating bills. It was impossible to adhere one hour, as it took about 30-40 minutes to calculate it, therefore I used the emergency button several times." Anna is the most diligent to press the emergency button with an average of 2.3 times, see Table *6.2*. Similarly, Jens exceed the one hour daily usage significantly at field study day 20. In the dairy, Jens supplied with the fact that he brought the smartphone outside GreyZone but did not interact with it. Jens has frequently during the study mentioned that, in order to feel safe and secure, he brought his phone when leaving the house for exercise in the nature. Both cases show that although the quantitative GreyZone data reveals the time spent, this data cannot stand on its own. Irene is the only provotype user who maximally exceeded the time limit with 1.32 minutes (on day 10).

Irene mentioned:

"*When I see GreyZone and on my way to take it out, I think I do need it for good, I reflect over it.*"

Similarly, Jens mentioned:

"*I am much more conscious regarding what I do within the limited hour, I do not open it 20 times a day.*"

Marianne, being a non-provotype user, supplied with her usage based on Jens' interactions with GreyZone, mentioning:

"*I have deselected social medias after Jens has got GreyZone and prioritise the functionalities the phone offers.*"

Specifically, this quote confirms that the entire process of opening GreyZone before access provocatively prevents the user from interacting with the smartphone, but also that it has an effect on people in the near social circle.

Additional tendencies influencing the decreased usage are the lack of physical transportability and the use of alternative electronic devices, as will now be described.

Transportability issues

Transporting GreyZone physically is a cause of the decreased usage among the provotype users. All provotype users highlighted that GreyZone was a burden to carry around physically and was most optimal to leave behind, e.g. in a car or at home. Anna found it annoying as quoted:

"*Once I was attending a party I left it at home as it was too annoying to bring*"

Using alternative electronic devices

It was a tendency within Family A and Family B to interact with other similar electronic devices, such as tablets and laptops, instead of the tracked smartphone. An additional factor contributing to decreased usage was the internal logistical and practical coordination of using and sharing the non-provotype user's smartphone, which specifically happened in Family A. It contributes to a marginal insecurity but can also be an associated reason to the limited smartphone usage during the fields study, as we did not measure activity on those devices. Family A mentioned following during a weekly interview:

Marianne:

"*Practically coordinating that I bring my phone*."

Jens:

"*I get Marianne's smartphone to check things out because my usage is limited.*".

6.1.3. Category 3: Increased observation in social contexts

Observing fellow people's behaviours in social contexts

The social influence within social contexts was an observation strongly appearing within all of the families, as they mention episodes where smartphone non-use is in focus as having a positive impact on the situation. Generally, it promoted mental presence and memorable quality time. The two following episodes present to different observations contributing to further reflections on smartphone non-use in social contexts.

Anna mentioned an episode promoting a special social moment:

"*At Christian's birthday, we had cake, and we were just talking to each other and concentrating on eating cake and enjoyed it. It is not because we are that much social although we live together. So we just need this social moment, and GreyZone contributed to this.*"

Irene's observation within a social context was interesting as to she took on the role of the responsible for promoting non-use during a family cosy evening. Claudia entered by conveying this as she quoted with a high strict pitched tone:

"*Yesterday, when we were playing cards Irene said "mom, mom you are using your phone!*"

Irene confirmed:

"*Put that phone away! When we have family social time it is nice you do not look at the phone, then I tell them put it away.*"

Claudia confirmed Irene's control of her usage is justified:

"*Due to Irene is not addicted and reserved to her phone when we are playing cards, it contributes to more quality time - we focus on what we are doing.*"

Both episodes clearly promote mental presence in social contexts during the field study.

6.1.4. Category 4: Reflection promoting design

Reflecting on the necessity of pre-conducted interactions discarded spontaneous interactions. As previously mentioned, Irene was frequently reflecting on her interaction, and this is also a tendency occurring among the other participants. Specifically, Marianne, a non-provotype user, was reflecting in-depth and frequently over her interactions, as she mentioned:

"*I think a lot about the counts and try to avoid … I am more conscious regarding using it less, it is a mental efforts, as I prefer being more structured of when I use it, it is calm and relaxing.*"

According to Anna and Irene, one hour of smartphone usage is not that much, and they both reflected on distributing the time most optimally and correctly as it is easily spent. Irene metaphorically compared the situation as follows:

"*You are not allowed to have an ice cream, even though you really want it, it is about the feeling and reaction when someone tells you that you are not allowed.*"

followed by the reflection:

"*I could coordinate my time better, instead of spending it all in the morning, I ought to save for the afternoon, where I really want it.*"

6.1.5. Category 5: Provides Frustrations

In addition to the positive effects of GreyZone described in the previous sections, it also introduced frustrations among all of our participants in specific situations and circumstances. The frustrations primarily appeared when GreyZone prevented and forced the provotype users from passion and relaxing everyday practices such as taking photography and listen to music and audiobooks in combinations with other practices. Specifically, Jens described it as burdensome and restricting as he expressed his frustration:

"*On a walking trip I cannot take a photograph… It is a restriction in my everyday living.*"

Irene experience similar frustrations as she expressed:

"*It is annoying that I cannot bring my phone when showering, as I cannot listen to music, without being in a rush.*"

Additionally, using GreyZone caused technological delimitations such as unsuccessfully connecting to Bluetooth speakers as the signal disconnects immediately as Anna mentioned:

"*When I use the Bluetooth speaker, the signal disappears when it is inside GreyZone.*"

These specific experiences substantiates the quantitative data of average ratings of satisfaction and dissatisfaction gathered through the dairies, presented in Table *6.5*.

AVERAGE RATING		
	Dissatisfied	Satisfied
Jens	2,4	2,1
Irene	4,4	1,2
Claudia	6	0
Anna	3,5	0,6
Christian	2,4	1,9
Total average	**3,7**	**1,2**

Table 6.5. Rating of dissatisfaction and satisfaction.

The average dissatisfaction is both individually for each provotype user and in total higher that the average satisfaction. The total average ratings of dissatisfaction on a numerical scale from 0 to 5 is calculated to 3.7 (74 percent) in total average, whereas the total average ratings of satisfaction is 1.2 (24 percent). It can be discussed whether the design of GreyZone is to provocative or not, as the dissatisfaction differentiated with 2.5 (50 percent) compared to the satisfaction.

6.1.6. Defects in quantitative data

Technically, both hardware and software barriers occurred, which have been a barrier both during field study when analysing of the quantitative data.

It is important to mention that on some days, GreyZone, and especially one of the provotypes, had defect hardware. There have therefore been days and partial days where the GreyZone have been under repair. The data log file also presented unidentified behaviour, causing manual calculation of the TimeLeftOfUsage. Additionally, all the sensors have been too sensitive and active at moments where GreyZone has not been interacted with. The data was frequently structured as presented in Figure *6.2*.

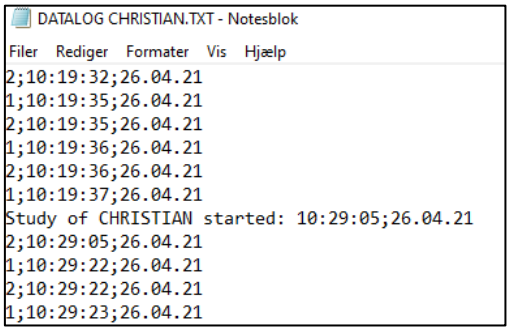


Figure 6.2. Data Failures.

The data in Figure *6.2*. indicates that the smartphone was removed from GreyZone 3 times within five seconds, which is physically impossible. We have therefore discarded the measurements of the number of times the phone has been in- and outside GreyZone.

6.1.7. Overall Reflections & Evaluations of the Field Study Findings

Based on the findings within each of the five categories, it is clear that specifically the provotype users have had an ambivalent relationship to GreyZone, which is similarly to their relationships to their smartphones. Although four out of five provotype users approximately restricted their usage to one hour, it has generated both frustrations and joy as they enjoyed smartphone non-use in social contexts but were frustrated in individual contexts.

6.2. Post-Data

Based on the final reflections from the participants, it has been interesting to investigate whether the new behavioural patterns occurring during the GreyZone use are persistent, both for provotype user and non-provotype users. The next sections separately elaborate each family's subsequent perception of own usage supported with quantitative data collected during the entire study period. Lastly, it contains general user feedback and opinions about GreyZone's design and usability.

6.2.1. Usage and Behavioural Patterns

This section highlights and elaborates the following behavioural tendencies occurring within the entire study period in the specialisation. Specifically, it describes whether our participants' smartphone usage has increased or decreased and whether this change has been permanent or temporary, i.e. whether they have turned back to their usual patterns, kept on reflecting or continued the decreased usage. The results will be presented separately for each family.

Family A

The senior couple was the only family delivering all required data during the entire study. Table *6.6.* and *6.7.* show their individual average daily counts (the number of times the smartphone has been turned on) and hours spent on average. GreyZone was used in weeks 3,4,5, see Appendix 5 for further elaboration.

Marianne									
Average counts on weekly basis									
Week	1	2	3*	4*	5*	6	7	8	9
Counts	68	48	51	56	65	58	53	65	72
Average hours on weekly basis									
Week	1	2	3*	4*	5*	6	7	8	9
Hours	1,55	1,48	1,37	1,68	1,82	1,36	1,55	1,55	1,68

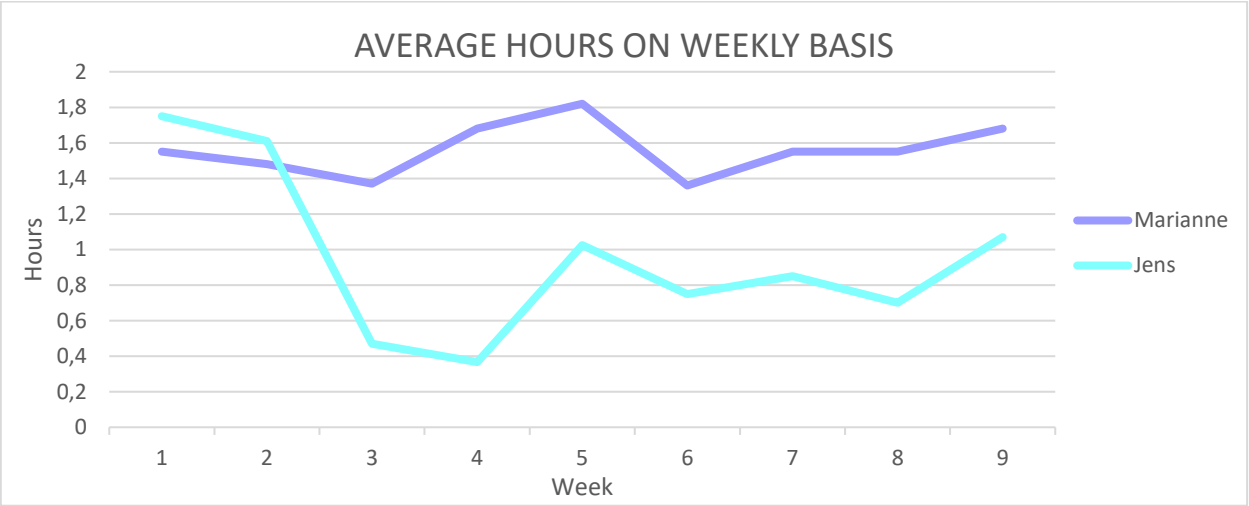
* = Field study period

Table 6.6. Marianne's weekly average counts and hours spent.

Jens									
Average counts on weekly basis									
Week	1	2	3*	4*	5*	6	7	8	9
Counts	104	98				74	56	86	12
Average hours on weekly basis									
Week	1	2	3*	4*	5*	6	7	8	9
Hours	1,75	1,61	0,47	0,37	1,02	0,75	0,85	0,70	1,07

* = Field study period

Table 6.7. Jens's weekly average counts and hours spent.



Graph 6.2. Family A's average hours on weekly basis.

We do not know exactly how many times Jens has opened GreyZone due to sensor defects. However, summarising what he explained in the quote in session 6.1.2:

"*I am much more conscious regarding what I do within the limited hour, I do not open it 20 times a day.*"

Specifically, a self-estimated count of less than 20 is not unrealistic, considering to the fact that Jens is the only provotype user who has a persistent restricted smartphone usage. Additionally, Jens is the only provotype user who has kept reflecting similarly both during and after the field study and, according to the average hours spent, visualised in Graph *6.2.*, his usage has decreased to approximately half of the time he used to spend before the field study. Jens quoted:

"*Sometimes I have caught myself in picking up the phone and reflected I do not need it for good and leave behind.*"

This quotation shows that he react to his reflection, which is also clearly visible in Graph *6.2.* However, he also enjoys the easy use of payment when shopping. According to Marianne's Smartphone usage, it not signalising large fluctuations although she quoted:

"*I am quite conscious and can sense I do not need to use it so much, it does something generous, it creates some peace…I have the feeling it gives something good... I think it's because of the GreyZone.* "

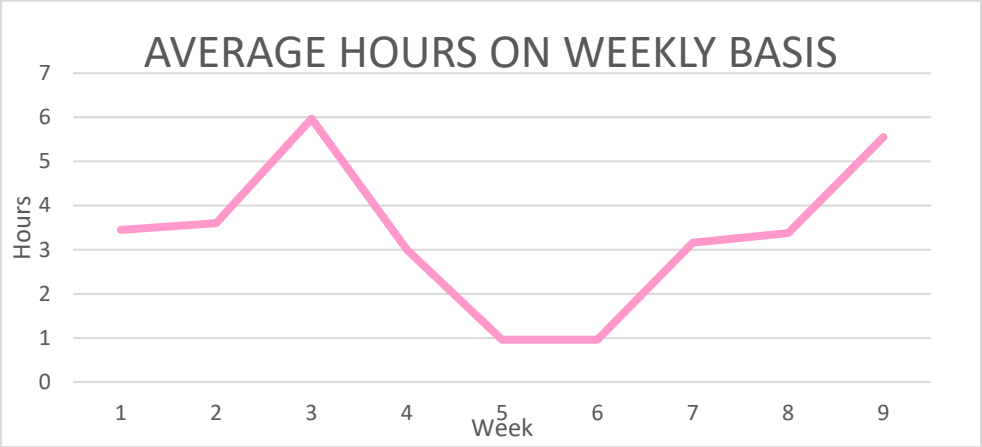
Furthermore, Marianne quoted:

"*I'm becoming more aware that I need a private phone and a work phone, this is a mess, it is all collected. I am convinced about this part as I feel stressed, as you feel a little bit you are physically on work*"

This quote and the combination of a private phone and work phone might also explain the approximately even curve in Graph *6.2*.

Family B

The young couple's limited smartphone usage during the field study was not persistent, as both participant returned directly back to their usual behavioural patterns .



Graph 6.3. Anna's weekly average for the period.

As Graph 6.3. indicates, Anna has returned to her same old habits as the curve progressively has increased after the field study in week 5 and week 6 was completed. Anna supplied:

"*I am totally back at the beginning, I busted myself in just pressing on the screen after an exam while waiting my grade, an shot it down again*."

Furthermore, Christian is also back to the old behavioural patterns as he explained:

"*My usage has just flown back to where I left off. It is so autonomously for me that I do not even notice anything. I still open my phone like a refrigerator like I usually did. I just spontaneously do it and I can compare it to an ordinary habit, grabbing the bag of chips and just eat until the bag is empty, it is the same with time and battery on a smartphone*."

As presented in subsection *5.1.1.* we selected specifically Family B to only consist of provotype users to investigate potential differences in their smartphone usage compared the families with a combination of provotype users and non-provotype users. Differentiating the distribution by

assigning GreyZone to both participants in family B did not have any advantaging contribution to persistent decreased usage. Although they were motivated under joint circumstances when having GreyZone, they were as demotivated under free rein.

Family C

The two provotype users in the family with teenagers were behaviourally acting completely different. Irene was the youngest participant of the entire study and the provotype user with most times left of usage on average (see Table 6.1), whereas her mother Claudia discarded GreyZone after two days in the field, as previously mentioned.

Average Usage After Field Study				
	Irene	Emilia	Claudia	Morten
Sum	5,49	13,75	13,55	1,24
Average	**1,83**	**4,58**	**4,52**	**0,41**

Table 6.8. Average usage after GreyZone.

In comparison to the different results, Irene's behaviour has not affected the others' behaviour in the direction to non-use. Table *6.8.* shows each family member's average usage during the period after the field study. Irene is the only succeeded provotype user in Family C, but her average usage has increased compared to the 30.5 minutes she spent in average during the field study. In contrast to Irene's own ambitious and motivated participation in the field study, she mentions:

"*We are gone completely junkies, as I do not use GreyZone no longer, has not become a general discipline in the rest of the family.*"

Claudia confirmed:

"*It is very I mean very junkie likely*."

Morten explained:

"*My smartphone usage is minimal, but I do not know anyone like Claudia who is able to spend it on so much sensible but simultaneously on time waste. I my opinion GreyZone needs a dimension in which the user decides to which extend the usage is it is accepted, as it is a question of balance, and not the surroundings who judges you.*"

Claudia replied:

"*But sometimes you cannot judge yourself, because if you are a junkie it is difficult to change habits. Previously it was yes ye I just us my phone however it is time waste, now I realise I use it again."*

Irene confirmed:

"*There are those who spend it on time waste and those who used it for purposes.*"

Claudia ended the discussion:

"*Yes and those who do not spend it on time waste, they win.*"

In the their discussion it is clear the Claudia is conscious about high smartphone usage but cannot control it. Furthermore Claudia perceived GreyZone as a design controlling her, due to her perspectivation to handcuffs as she expressed:

"*It reminds me of the principle of handcuffs. Suddenly the police came and handcuffed me"*

These internal discussions and own perceptions of smartphone usage shows that GreyZone did not have an substantial effect on their behavioural patterns within smartphone usage.

6.2.2. GreyZone Design

In the final interview, qualitative data regarding the design of GreyZone was also collected. The purpose was to reach additional insight into the aspects contributing to provocation, as GreyZone caused rejection, in some cases non-persistence and generally was unwanted. Additionally, we were curious about their reflections and opinions about the design itself, as it relates to the conceptual, functional, aesthetical and material provocative aspects of the design, which can help to reconsider the design of GreyZone and its acceptance in the field. The most remarkable reflections and opinions are elaborated below.

Functional Complications

The functionality of the design of GreyZone met several points of critique, e.g. that it prevents charging of the smartphone, its physical placement and lack of transportability. Due to the charging process, the smartphone cannot charge when it is locked inside GreyZone, requiring coordination of charging times and the one hour smartphone usage which provoked frustrations among all provotype users. Additionally, the power did not last for long in some of the provotypes which generated frustrations, for example those of Irene:

"*I need to walk all the way upstairs at 1st floor to check my phone and all the way back down, as the battery does no keep the power*"

GreyZone's physical size, presented in Figure *4.4* did not always fit into other physical places e.g. Anna's and Christian's small apartment and physical transportation products such as Irene's bag. GreyZone was either not easy portable and unhandy causing density and weight. According to Anna and Claudia, GreyZone was heavy to carry. Anna quoted:

"*It is difficult to physically carry it together with all the other stuff I carry around. Additionally I have back problems.*"

It signalises that we have perhaps demands a much more luxury everyday living in the modern society, compared to the old cell phone from the Cold War era, presented in Figure *4.2*, which GreyZone among other inspiration sources is inspired by. In this period a majority of the population was not either wearing cell phone so integrating it in everyday living was not an existing phenomena.

Aesthetically Accepted Design

The aesthetical design of GreyZone was generally compared to other existing everyday designs as the participants associated it to objects such as a cash register, old children's suitcase. Besides the concrete relations, the visual look was according to all participant positively described, for instance Irene expressed:

"*The appearance was professionally designed, a cash register-like and the timer was awesome, very nice, it looked really cool.*"

Additionally, it was described as neutral, classic, retro, discreet, and in relation to the selected colours, Jens mentioned:

"*Nice design, if it has been orange I would never use it.*"

Anna was scared that fellow people or strangers would think it was a bomb she carried. Additionally, the participants appreciated that the fragile electronic was hidden and protected.

6.2.3. GreyZone Study

Finally, the participants were asked whether they could envision using GreyZone outside of the study. The reaction was the same for all participants, as none of the provotype users could imagine GreyZone as an continuous and persistent a part of their everyday lives. For instance, Claudia expressed:

"*No! I hated it, it was very provocative.*"

Irene supplies:

"*Because you did not have any control over it.*"

Claudia responds:

"*No, it took control over me*".

Additionally, some of the participants reflected on using GreyZone in other contexts and for other purposes, for instance Jens suggested:

"*Then it should be in periods, where you feel too addicted, and then use GreyZone aiming at returning to better smartphone behaviour, as a rehabilitation method.*"

Anna prefers using it in social contexts as she suggested:

"*We could use it for one evening a home, when we decide to stay social together, we could physically leave it inside GreyZone so none of us is able to see it.*"

7. REFLECSION

This chapter presents the reflections followed by potential reconsiderations regarding different selected areas such as approaches, decisions and outcome obtained in this master thesis. It elaborates the critical findings within each highlighted area and suggests alternative options. The first part considered is concerned with GreyZone's hardware and software as well as its degree of provocation in everyday living. The second part includes reconsiderations of the selected participants as well as the extent and outcome of the field study in relation to the design.

7.1. Quality Test of Hardware and Software

An inappropriate incident we experienced was the occurrence of technical errors and failure in hardware and software, which became a barrier within the conduction of the field study and when sorting and analysing the quantitative data.

7.1.1. Hardware

The hardware failures caused delays in the entire field study due to frequent immediate logistical planning. It also affected the structure of the field study as the consequent day gabs disturbed what should have been a linear time period. The study would have progressed more smoothly by anticipating the failure and avoiding delays within the selected period for the field study. This problem was specifically family A and B, although most critically experienced by family B as it caused a reduction in the duration of the total field study to two weeks. The GreyZone effect was not fully experienced by this family due to the limited time, as they did not reach the phase of getting used to it. This problem could have been solved and avoided by spending few days conducting a pilot study, similar to that of Raphis et. al. presented in section 3.2. with a family outside the study, contributing to correcting errors before the actual field study (Raptis, et al., 2017). However, due to the limited time available for this project, it was not realistic to perform such as pilot study.

7.1.2. Software

During the analysis of the quantitative data from the data log file, the data from two of the participants appeared disorganised and but was still slavishly presented. It was time demanding to manually and mathematically organising and calculating the total "TimeLeftOfUsage" for several days and comparing the days to the dairy data. The reason for these issues was primarily that the sensor delivered unreadable and inaccurate data in the data log file. According to the software errors, it would have been beneficial to test the interaction and connections between hardware and software for instance by using GreyZone ourselves for one day. It would also allow us to use all the conducted data if it was correctly represented as another substantiation to the qualitative data gathered.

7.2. Level of Provocation

From the findings the dissatisfaction regarding integrating GreyZone in everyday living is clear. Specifically, in the final interview, plenty of the problems our participants perceived were experienced when integrating GreyZone in everyday living. Although the potential of creating a provotype is conducting research through design using it, it could be discussed whether GreyZone provokes to much as one participant discarded GreyZone and two family returned directly back to their usual behavioural patterns and spent at least the same amount of time as before the study.

7.3. Selection of Participants

Another reflection regarding this study is that we could have performed a more careful and thorough selection of participants. It was an inconvenience that one participant discarded GreyZone after two active days, and Family B delayed the process by not activating GreyZone on the day they received it. The user motivation lacked at several points. In Family B and Family C, both provotype users and non-provotype were not committed to or misunderstood the importance of delivering all quantitative data for the project and the importance of all members to participate in all weekly interviews. Additionally, one provotype user was not reflecting sufficiently on own interactions with GreyZone in the everyday context and fellow peoples interactions.

Fortunately, not all participants were uncommitted or discarded GreyZone. However, we still ought to have reconsidered the selection of the participants before selecting them for this study. In case the study was not time delimited, we should have spent more time on recruiting some more potential participants. Maybe people with extremely high usage are difficult to influence in any direction and with any design.

7.4. Longitudinal Study

As the field study only extended for 14-20 days, the results cannot with high evidence conclude on long-term behaviour, and it has been a too short a period to influence them to make drastic changes on long term-basis. Conducting a longitudinal study extending over a longer period could have provided a more realistic result of whether GreyZone have had a persistent effect on the participants' behaviours. They would have had more time to get used to using GreyZone as an integrated element in their everyday living and not just a tasting of it. It would have been a more in depth investigation and might have resulted in more persistent behavioural changes.

8. CONCLUSION

This master thesis investigated how to promote smartphone non-use by adopting the approach research through design, specifically by utilising a provocative design, the high fidelity provotype GreyZone within natural settings. GreyZone was designed and constructed based on the provocative aspects conceptual, functional, aesthetical and material, aiming at promoting smartphone non-use. GreyZone was the central element in a field study as it became a part over the everyday living for five out of eight participants distributed over three families. By using research through design, this master thesis aimed at answering the following research question:

To what extent and how does a physical design support critical reflections on smartphone usage? And what are the experiences of using this in daily life?

We have designed and constructed a physical design, named GreyZone, with the purpose of provoking study participating into reflecting critically on their smartphone usage. Based on qualitative and quantitative data gather during the field study, it was evident that GreyZone has contributed to frequent critical reflection regarding both own and fellow peoples smartphone usage. The limitation of time available for smartphone use provoked the participants into reflecting on whether each interaction with the smartphone is necessary or not. For one participant, GreyZone was perceived too provocative, and she discarded the provotype.

As a consequence of the critical reflection, there was general decrease in smartphone usage among most participants during the field study. All provotype users except from one who discarded GreyZone limited their smartphone usage to less than one hour a day on average. However, this low smartphone usage generally did not persist to after the field study. The majority of the participants reverted to regular usage when GreyZone was no longer required. However, GreyZone did have a persisted effect on one provotype user, who reduced the smartphone usage to half the regular use in the weeks following the field study.

GreyZone has both contributed to positive and negative experiences in everyday life among the participants. Some participants enjoyed the social intimacy and presence in social contexts when no smartphones were present. Several participants appreciated a feeling of increased memorisation and some participants enjoyed immersing oneself in e.g. a book instead of looking at the smartphone. However, GreyZone did not only have a positive effect on the provotype users' quality of life. In some cases, it actually restricted them from doing recreational activities they enjoy, such as taking photographs and listening to music. These are not activities that are consequences of the addictive effects in smartphones and hence not activities that were targeted the usage limitation during the study. Similarly, some participants used the smartphone for shopping, parking and safety which should not be included in the time limit. However, smartphones are today used for several different purposes and it is difficult for a provocative design to target only some activities while allowing others. GreyZone uses a time-based limitation to force reflection on usage, but as usage naturally increases due to smartphones becoming multi-tools, a time-based limitation may not be the most appropriate provocative mean.

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