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TITLE:

Tensions and Technology Use in Families with Young Children

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Summary

Because technology not only brings advantages but also disadvantages in the daily lives of families, we decided to focus on the tensions related to technology use. More specifically, we wanted to study tensions related to technology use in co-located families with young children. Existing studies have investigated the topic, but they did not seem to focus only on the tensions related to technology use nor families with children that are 12 years or younger. We made two studies, the second article being based off the first one's results.

The first article used an empirical field study with 4 families with children under 12 to gather in-depth knowledge about the tensions occurring due to their technology use. It attempted to answer the following research question:

"*How are the relationships in families with young children affected by tensions caused by their technology use*?"

The field study included a self-reporting diary approach and semi-structured interviews to support the data. We used open coding to categorise sources of tensions guided by existing literature about tensions related to technology use. We found 6 sources of tensions with varying amounts of subcategories and visualised which intra-family relationships we found to be affected by which sources of tensions. In the discussion, we used family theory literature to discuss what technology (use)'s role was in the identified sources of tensions as some sources of tensions might be explainable without technology playing an important role. We found most sources of tensions could be explained by family theory, where technology acted as a mediator of stress and tensions rather than creating the sources of tensions we identified. Technology generally had a smaller role in these sources of tensions, but two sources of tensions, however, were found to be directly connected to technology use.

The second article challenged the two sources of tensions identified in the first article to be caused by technology use: *Absorption* and *Addiction*. The study used a prototype to challenge the participant families' phone use regarding *Absorption* and *Addiction*. The prototype was made with provocative design and designed to give the participants a forced choice between using or not using their phones when they were forcefully "locked" for a set amount of time. When the phones were locked, the participants were faced with another choice: using the unlock code and negatively affect an animated dog's mood or waiting for the timer to expire. We conducted a field study with the prototype in 3 families lasting 7-11 days for each family, supported by in-depth interviews after the field study. In connection to *Absorption* we found that by using the system, it was possible to interrupt absorption. In connection to *Addiction* we found that when the family members' access to their smartphones was limited, it reduced their perceived addiction. Furthermore, we found that planned breaks away from technology had positive effects on their family life and the relationship between the parents as a couple.

Tensions and Technology Use in Families with Young Children

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ABSTRACT
In this study, we investigated how the intra-family relationships in families with young children are affected by tensions related to the families' technology use in the home. By conducting a field study, we identified tensions that occurred in the families related to their technology use. We compared our findings with literature about tensions related to technology use and literature in the field of family theory. This was in order to discuss if there are potential alternative explanations for the cause of the tensions and what the role of technology would be in those. We concluded that most tensions were not actually caused by technology and could be explained by family theory. In these tensions, it seemed like technology acted as a mediator instead of a source for the tensions. Two tensions, however, could not be explained by family theory, therefore we argue they are caused by technology.

Keywords
Families, family theory, harriedness, individualism, stress, technology, tensions

INTRODUCTION
Technology has become a larger part of our daily lives in recent years, but the fast development of technology also comes with some tensions, which is reflected in both the media as well as academic studies [1]–[7]. Some studies on the topic have focused on advantages and disadvantages of technology as well as tensions that seem to occur from the technology use in families [3]–[8]. In these studies, technology in family life plays an ambiguous role: on one hand, technology is useful for the communication and coordination in everyday family life, but on the other hand it could e.g. distract family members who are co-located and therefore cause tensions [3]–[6].

As the existing studies have mainly focused on both advantages and disadvantages, we wanted to specifically look into the tensions that are seemingly created due to the technology use in families with young children. This is in order to understand how the intra-family relationships are affected by those tensions. Families with young children were specifically chosen as it appears to be an understudied group in relation to technology use. We identified literature about technology use in families and used an empirical study to support the theory. Our field study lasted three weeks and included four families, where we aimed for in-depth feedback regarding tensions caused by technology use in their families. Through this study we intend to answer following research question:

"*How are the relationships in families with young children affected by tensions related to the families' technology use, and what is the role of technology in these tensions*?"

THEORETICAL BACKGROUND
In the first part of the theoretical background, we present literature about tensions from the field of family theory, which are not necessarily technology use related. The second part presents literature focused on tensions specifically related to technology use.

Family Life
In this section, literature from the field of family theory are presented. The literature provides explanations or causes for tensions in families that are not necessarily technology-related, which can be used on our empirical data as alternate explanations for the tensions we identified.

Tensions
The concept "tensions" in this article is used as an umbrella term for negative effects and feelings towards the intra-family relationships, such as guilt, frustrations, and stress. We also include Björnberg and Kollind's definition of conflict as an extension of our umbrella term, which they define as basic conditional inequalities that are expressed when a situation forces it to surface [9]. It is not always expressed openly, but instead as non-verbal discontent that can surface eventually.

Life Arenas
The concept of life arenas comes from Dencik, Jørgensen, and Sommer [10]. They explain the private arena as the family itself. The public arena is described as how the family functions in relation to institutions and society. The personal arena is defined as the individual's personal

approach to their family, e.g. their personal feelings or perceived role in the family. We rely on these terms in order to present the family not as an isolated entity, but a space that can be influenced from the outside as well as from within. The terms will help explain how tensions can be created inside the family, as well as spill over into the family from the outside.

Daily Stressors

Sevón, Malinen and Rönkä investigated the daily lives of families in order to understand the family wellbeing and factors affecting this [11]. They define daily stressors as small challenges of daily life that can be routine or sudden [11], examples being parenting (routine) or a broken dishwasher (sudden). Although daily stressors have immediate effects, they can also have long term effects. Stressors can accumulate and eventually create tensions between family members [11]. The study also mentions routines and set times as being important, as certain "hot spots" of the day can become linked with negative emotions. "Hot spots", as the study called them, are times of the day characterised by lots of actions, emotions and time schedules whereas "cold spots" are related to relaxing [11].

Stress Spillovers

As mentioned, stressors can lead to tensions which is why stress spillovers regarding families can be important to understand. Some theories view the family as a system, which is much alike to the concept of the private arena, and argue that the subsystems (individual relationships in the family) are interdependent [12]–[14]. It is generally argued that individual relationships between family members affect each other, particular focus being on relationships between parents and between parents and their children [12], [14]. Spillovers is a concept of transferring problems from one domain to another [13]–[15]. It can be individual stress spilling over onto a relationship or a joint stressful event that can have individual effects on each spouse [13]. However, it is not limited to these types of spillovers between the private and personal arenas. Stress accumulated in other life arenas, such as work (public arena), can spill over into the family (private arena), causing tensions between the individual and the other family members [11], [13]. Examples of stress spilling over can be parenting difficulties (Parent-Child stress) that can create tensions between the parents (Parent-Parent) or marital issues making parents irritable towards their children or at work [13]. There is a particular focus on how Parent-Child tensions are more likely to occur after Parent-Parent tensions, whereas some studies indicate it can happen up to a day after the initial Parent-Parent conflict [14].

Stress Behaviours

People react to stress in different ways and sometimes their reaction or behaviour can create tensions. It can for example be withdrawal behaviour [16], [17] or feeling "overloaded". Overloaded is described as feeling fatigued, busy, having low energy, and being overwhelmed [15]. A recent study suggests three types of behaviour that follow the feeling of being overloaded: angry behaviour, disregard, and distancing. Angry behaviour can be characterized as e.g. being irritated and showing hostile behaviour. Disregard is meant as a conscious choice to disregard e.g. other people's needs. Distancing is basically a withdrawal or decrease in affectionate contact or disclosure [15].Being overloaded can lead to the mentioned withdrawal behaviour[15]

Individualism

Individualism can be described in various ways: a fragmentation of traditional norms and values [18], a dynamic societal process leading to transformations of institutions [9], and the liberation from communities (such as the family) as well as the freedom to form your own life [10]. However, the individual having the freedom to choose their own norms and values can clash with the family's ideas, creating tensions.

The family used to have a more central role in mediating norms and traditions to the individual, but individualism causes people to be more free to choose their values and which norms and traditions they follow [18]. It also means the idea of what a family looks like, what they're supposed to do together etc. can vary more for the individuals than previously, which could lead to tensions. The value of the family hasn't decreased, but the requirements as to what it is may have changed [10]. With individualism, the individual wants the freedom to achieve their own goals, but at the same time must satisfy their family's needs, which can cause them to have to compromise on one or the other leading to tensions. This does not necessarily mean the individual disregards the family in favour of their own needs entirely [10].

Harriedness

Dencik, Jørgensen, and Sommer mentioned several tendencies in society affecting the family [10]. One of these is a growing demand for the individual to be increasingly mobile – whether that is geographically, socially, or even mentally [10]. The notion is described by other literature as harriedness; people as well as institutions are more mobile and their interactions are not as limited to specific timeslots and locations, which creates a pressure on the individual to coordinate time more efficiently [19], [20]. The individuals feel the pressure of having to coordinate this time between the different life arenas as the borders between them are blurring. The public arena can reach the private arena more easily outside allotted timeslots and places through technology and other means. This could be understood as constant connectivity [21], however harriedness does not specifically include technology as it is more conceptual and focused on the pressure to coordinate time better, not constant contact or pressure to respond [19], [20]. However, both pressures can create stress, which can further lead to tensions as people vent their stress onto other family members.

Technology Use

This section is devoted to research regarding tensions from technology use in families, grouping them by causes for tensions related to technology use. The theory presented in this section will be used as a theoretical framework when analyzing the collected data in this study.

Device Absorption

Some studies have investigated how the relationship between adults and children could change, when an adult was using their mobile phone while co-located with children [5], [6]. The findings in these studies described adults being absorbed in their interaction with the mobile device where they weren't paying attention to the children or the surroundings. The children felt ignored, reacting with frustration and trying to force the attention from the adults, whereas the adults responded by giving robotic answers and gestures to the children [5], [6]. Absorption creating tensions is also found in Oduor et al.'s paper in which they studied the benefits and frustrations of technology use in families [3]. The main findings from the paper are how family members felt tensions when being ignored or excluded due to another family member's technology use. This was sometimes related to the perceived triviality of the family members' technology use [3]. Furthermore, tensions could also arise when family members received notifications and messages on their device, feeling pressured to check the phone in case it was important. This often resulted in interrupted conversations and activities between the family members [3]. The pressure to check described in Oduor et al.'s study seems strongly related to the concept of harriedness described earlier in the paper.

Family Time Expectations

Different expectations to family time have also been found to create tensions, as seen in Blackwell, Gardiner and Schoenebeck's study [4]. The traditional view involves a constant-engagement model, where the family members pay attention to each other and interact at all times during family time. Technology has been found to interfere with this model as it interrupts the constant attention and interaction between the family members [4]. However, watching TV together has become a more common acceptable form of family time, which is a co-located activity where the attention is diverted to the device instead of each other [4]. Family time is often a daily activity, which is used to relax together as a family, making it a cold spot according to Sevón, Malinen, and Rönkä's study [11]. However, as a cold spot it seems to create tensions which isn't part of their study. The tensions occur as the family members' have individual expectations as to how family time looks and how much technology is involved in it. This shows traces of individualism as the norms and values get fragmented within the family and the individual family members may not agree.

Technology Use Strategies

In both Oduor et al.'s and Blackwell, Gardiner, and Schoenebeck's study, the participants spoke of strategies to prevent tensions which often created more tensions instead [3], [4]. Some tried to regulate their technology use either consciously or by the help of apps, placing their devices out of reach, and others tried saying out loud to the other family members present what they were doing on the device. In some cases, the family members avoided talking about technology use with each other because it often ended with tensions being created [3]. However, making rules for technology use was the most common strategy, such as placing time limits on the interaction with the technology. These rules sometimes created further tensions, particularly as they were broken. Generally, the rules that were commonly broken were described as vague, which meant that the children didn't know they were doing something "wrong" until they got caught by their parents [4]. Such rules could be to "not post something bad" on social media, whereas "bad" was undefined. Furthermore, many adults were found to break the rules they set themselves to the dismay of their children.

METHODOLOGY

In this section we go through the methodology used for our field study both for gathering the data and analysing it.

Participants

There were two criteria for selecting the families: First, it had to be couples with at least one child between 2 and 12 years old. We chose this age group for the children specifically as the studies related to our topic mainly focus on teenagers and adolescents. Therefore, we identified a need to further study this age group instead. The second criterion was that the families had to live in or close to Aalborg. The location was out of consideration for the necessity of the face-to-face contact.

Posters in both Danish and English were made and distributed to multiple Facebook groups as well as numerous bulletin boards in Aalborg. Potential candidates amongst our networks were also considered. This resulted in finding 4 families to participate in our study, which are referred to as family A, B, C and D. The structure of the participating families and their age is shown in *table 1*.

Family A consisted of a mother (supervisor at the university), a father (chef) and one son. The family had two smartphones, a tablet and a laptop, which were used mainly by the parents to work, communicate with friends and family, for entertainment, and reading newspapers. Their son didn't have his own technology, but he was allowed to use the tablet and sometimes his parents' smartphones to play games and watch videos.

Family B consisted of a mother (social and health assistant), a father (postman) and three daughters. The oldest daughter and both parents had a smartphone, which they used every day for entertainment and communication. In addition, they had a tablet, which was used by all family members except the youngest daughter. The middle daughter was sometimes allowed to borrow a smartphone to play games.

Family C consisted of four people; a mother (working in purchasing), a father (project manager) and two sons. Both parents had smartphones, which were used for work and relaxing. Their older son was very rarely allowed to watch videos or listen to the music on a smartphone.

The last family is family D, which consisted of a mother (student), a father (software engineer) and two sons. Both parents and the older son had smartphones. The parents were using their phones for work and leisure purposes. The older son was using his phone daily, mainly for games. Only the younger son didn't have a smartphone, but he used his mother's smartphone to play games every day.

	Family member	Age
Family A	Mother	32
	Father	33
	Son	2,5
Family B	Mother	31
	Father	30
	Daughter 1	12
	Daughter 2	7
	Daughter 3	1
Family C	Mother	33
	Father	34
	Son 1	2,5
	Son 2	1 month
Family D	Mother	38
	Father	36
	Son 1	11
	Son 2	6

Table 1: The Participants

Data Collection

The data collection was divided into three stages: Face-to-face interviews, a self-reporting diary approach, and closing interviews. Qualitative methods were chosen as the area is not very well researched and the aim of this study is to gather in-depth knowledge rather than generalise.

In the first stage semi-structured face-to-face interviews were used. The method was chosen as in-depth interviews are considered one of the best choices for gathering in-depth qualitative data [22]. With two of the families we performed group interviews. In the third family, we had two individual interviews with both parents and with the last family, we had an individual interview with the mother from the family. Interviews were conducted in the language the families were most comfortable with.

In the second stage, all the families received a package with diaries for each family member, blank papers, pencils, colour pencils, a memory game, and paper with instructions and inspirational sentences as seen in *picture 1*.

Picture 1: Families' Package

All families were familiarised with the purpose of the study and instructed to write in the diaries about all types of tensions that occurred in their family in relation to their technology use. They were also encouraged to document the tensions in other ways, e.g. video, photos, and audio. The second stage took 3 weeks in total, whereas we contacted the families after the first week to make sure they understood the task and to answer possible questions.

After the 3 weeks, we collected the data from the families and conducted the closing interviews with any final remarks from our participants, which was the third phase of our data collection.

Data Processing

The collected data was in English, Danish, and Spanish. Danish and Spanish data was translated into English for our convenience. All interviews were transcribed, and the diaries were translated and rewritten in electronic form. After the interviews, an instant data analysis session was performed, inspired by the method of the same name created for data analysis in usability testing [23]. We brainstormed categories based on the examples we could remember from the data and eventually defined concrete sources of tensions with the help of the literature on tensions connected to technology use as a guideline. We proceeded with open coding of our data based on the categories we had made using the software NVivo for this. The data was coded in three parts, then re-coded by switching parts. Following the analysis, we looked into literature from the field of family theory, which could give us a deeper insight into the tensions that occurred in the participant families and the role of technology in said tensions.

FINDINGS

In this section, we present our findings from the field study. The findings are represented in *figure 1*. We found tensions in the following three intra-family relationships: The tensions between parents (Parent-Parent), tensions between parents and children (Parent-Child), and tension within the parents themselves (Inner-tension). Inner tensions is a concept used to describe an inner conflict in a person, often conflicting emotions about a certain situation or action.

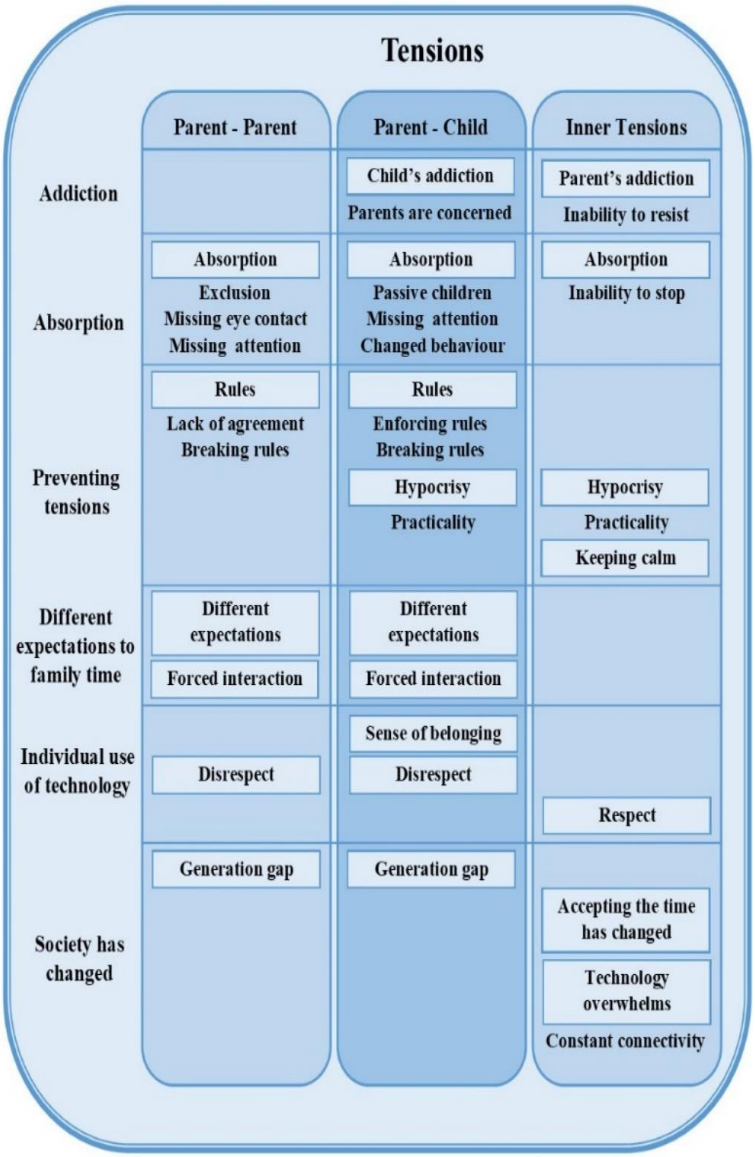

Figure 1: Model of Tensions

As seen in *figure 1*, we found six sources of tensions. In these sources of tensions, we were able to identify smaller subcategories and concrete tensions. We used the theory on tensions and technology use in families as a guideline, since we found some similar tensions to the theory in our data. The two first categories: *Absorption* and *Addiction* were highly present and a source for tensions in all four families. The rest of the categories were also present, however in a lesser degree than the first two. The findings are presented following the same structure as *figure 1*.

Addiction

Addiction was defined by the participants of the study as a feeling of wanting to stay informed and connected to the real world and the virtual world. This means that when the participants were e.g. receiving notifications on the phone, they felt a desire to check their phones even though they were participating in another activity or conversation with co-located family. As seen in *figure 1*, addiction created inner tensions for the parents because they felt that they were using too much time with their phones. They felt technology was taking time away from other activities they would've liked to do, e.g. reading books or spend time with their family. Addiction was also described as the inability to stop checking and looking at their technological devices, which the father from family A described as: *"This mania… you have to look and see what is new out there. It's like a virus."* The father from family C explained the addiction like: *"I realize from time to time how often per day I am using my phone without consciously making a decision to use it. It happens automatically like a habit."* It also created tensions between the parents and their children, because the parents observed how the children changed behaviour and reacted negatively when limits to their technology use were set by the parents. This could be seen e.g. in family B: *"She becomes really upset if she has to hand over her phone, and she does that as well if we just ask her to take some time off without it."*

Absorption

Absorption is when a person is engaged in an activity on a technological device, e.g. a mobile phone, and they are blocking out the world around them by focusing only on the device. These activities can be anything like e.g. engaging in a conversation online, playing games, browsing or looking at social media like Facebook. The father from family B described it as: *"…I go into my own little bubble…".* This created tension between the absorbed family member and the rest of the family members because the absorbed parent/child was not mentally present, and the others felt excluded, ignored, and were missing attention. The behaviour was described by all the families about at least one family member. The parents were also concerned about their children being absorbed into the interaction with e.g. the TV because they observed that their children became very inactive: *"When I see our son sitting in front of TV or a smartphone, I often feel sad to see this little, very active boy suddenly looking like a zombie without spirit, just in paralysis".* The way the absorbed participants behaved when interrupted could also cause tensions, for example in family A where the father responded angrily after the mother tried to get his attention several times because he kept being absorbed and distracted by his device: *"[…] and then he's like: 'what!?' And I say: I asked you six times, but you didn't respond, so I had to ask six times. But he says he heard me the first time."*

Preventing Tensions

We identified that trying to implement different strategies in order to prevent tensions can have the contradicting effect of causing tension instead. An example is family D's strategy before dinner: *"We plan the children's tech time with around 15 mins buffer time to e.g. make them come to the dinner table in time."* Despite giving their children extra time to avoid arguing with their children, sometimes tensions still happened: *"It's never enough for them. If they're in the middle of something important for them, then it's a huge conflict."* The contradictory effect is especially

seen when parents are trying to enforce rules that they won't/can't follow themselves, which we named *Hypocrisy*. The mother from family D explained how she broke her own rules: *"(An) example is using the phone on the toilet. I do that despite telling them not to do that. [My son] comes to check I don't. He notices the phone is missing."* Furthermore, the parents did not always agree on the rules which caused tensions between the parents. For example, in family A the dad said the following about his wife's rules for their son's use of technology: *"Sometimes I felt a bit angry when my wife put some strict rules for technology use to our baby. Sometimes he would come to me and I would give him iPad or phone even though I shouldn't give him that."*

The parents also used technology for practical uses such as a way to calm down or distract their children if they e.g. had a busy morning or were in the middle of doing chores etc. The mother from family C described a dinnertime example: *"[...] we allow him to watch and sometimes meanwhile I feed him, because sometimes he doesn't want to have dinner [...]"* This left the parents with inner tensions because they were giving their children access to technology, even though they didn't want them to use it too much. The mother from family A explained: *"I gave my son (the) iPad to calm him down. I don't like to do that. But it is (an) easy solution to have (a) calm child."*

Different Expectations to Family Time

In family A, the mom perceived family time as the parents giving all their attention to their son, however the dad perceived being physically present as enough even though he is absorbed: *"But the worst thing is that he perceived it as family time and he says like 'but I was at home'. Well, it doesn't really matter that you were at home if you are in your own bubble. It's the same for me as if you are at work."* Furthermore, the mother from family A told the father to play with his son, but: *"ok then he plays for one or two minutes very intensely and then he's again with the computer."* She did not regard that as proper family time whereas he found it sufficient. Different expectations were also found in family C, where the mom wanted to watch TV with the dad, however the dad didn't perceive that as "good" family time and therefore did not engage in watching TV, which caused tensions between the parents. The mom from family D also explained that her children perceived using time on playing e.g. with Xbox as family time which she did not agree with, however she tried to be understanding towards the children. In order to try and respect her children's desire for technology yet still restrict it, the children had a set time a day where they could use technology – but only together. The differences in opinions about family time and how their children should use technology caused tensions between both the children and parents as well as between the parents in family D. She explained that their issues about parenting and family time would cause the parents to argue later on: *"Sometimes we explode on each other and blame each other because of all the battles we have to take."*

Individual Use of Technology

As described by our participants, they used their technological devices for many different purposes like for relaxing and de-stressing from work/school or when they are bored. This individual use of technology created inner tensions because the participants were trying to respect each other's technology use, particularly when knowing it's for de-stressing or relaxing. However, it created a difficult situation when the partner/child wanted to get in contact with the family member using the technology, e.g. as the mother from family A describes: *"I'm trying to be very understanding and I know how he is and I know that it doesn't...whatever I would do, it would just make it worse, so I am trying to be calm."* Not only respect as seen in the previous quote, but also disrespect towards the family members' technology use can create tensions. The disrespect was seen when the family member trying to e.g. relax with the mobile phone gets disturbed by other family members. The mother of family D explained a situation with her oldest son, where she interrupted him while he was playing, and he said *"Leave me alone, don't talk you'll make me lose. […] I'm in the middle of a game, can't you see that?!".* The purpose of using technology was also seen to create tensions as it clashed with the parents' values about decreasing the amount of technology use in their children's lives: *"Even if the kids don't play with him at school, then they can play online after school because they have that in common. So, they still feel part of the class."* In the quote, the child gets a sense of belonging he might not otherwise get. The parents feel divided between the benefit for their son and their own values of decreasing their child's technology use.

Society has Changed

This source of tension covers different tensions related to technology being a big part of our lives now compared to when especially the parents in the study were children. There was a natural generation gap, where e.g. each generation didn't understand the level of interaction with technology that the younger generations experienced, which the mother from family D explained as: *"You can't, apparently, be 10 without a mobile phone and it has to be modern. It has to be a smartphone and it's better than mine."*. The participants also showed a sense of acceptance that society has changed, and they were struggling to find a balance, especially for their children when it comes to technology use. The parents explained how they wanted their children to interact less with technology but at the same time they didn't want their children to fall behind. Furthermore, the parents themselves also felt overwhelmed by technology, which dad from family C explained as: *"I feel stressed after online shopping, reading news or booking something online. The flood on options and input is hard to digest and control for me. Sometimes it rather feels*

frustrating than helpful to have all these options. It doesn't seem to simplify life but adds another stress factor." Having technology as part of their daily lives has become the norm, which mother from family B expressed as: *"I always need that phone by my side, not because I truly want it, but it's just a part of it now."* The father from family B elaborates on how technology is an integral part of their lives now: *"It's become too important without being important [...] Now people always need a phone and they can get upset if you don't pick up your phone and it's just wrong."*

DISCUSSION

In *figure 1*, we identified sources of tensions related to the families' technology use in our study. In this discussion, we aim to clarify the role of technology in the identified tensions, particularly if technology use is important for the creation of the tensions. We do this by using family theory literature and discuss it with our findings.

In *figure 2* we present a modified version of *figure 1*, where only sources of tensions related to family theory are displayed. Supported by family theory, it can be argued that technology is not the source for those tensions. Instead technology plays a mediating role in the creation of the tensions. As for the dots in the figure, each colour represents a topic in the discussion: Cold spot creating tensions are marked with green, spillovers are marked with yellow, de-stressing behaviour is marked with red, clashes of values are marked with purple, and blurring of arenas are marked with brown dots.

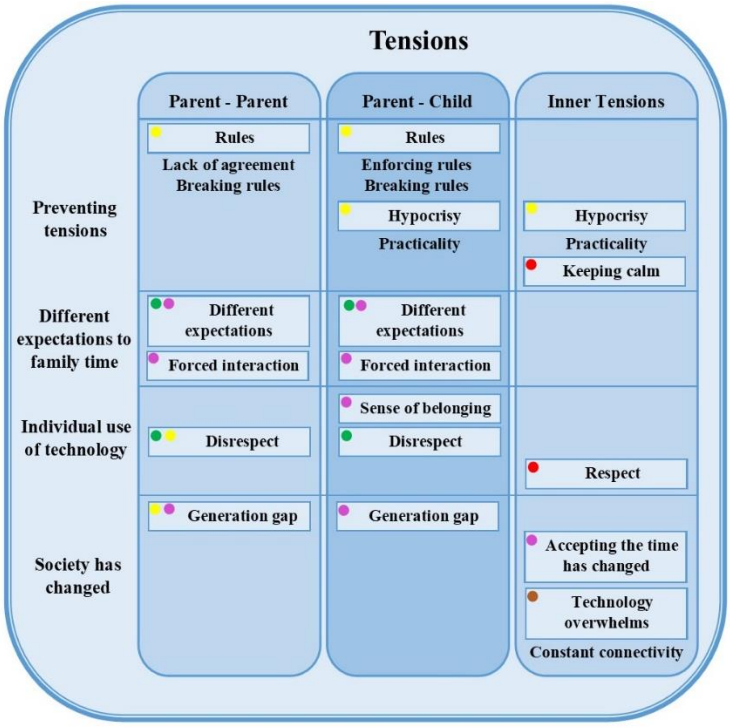

Figure 2: Sources of Tensions Related to Family Theory

Cold Spots as Sources of Tensions

As mentioned in the literature, in the daily lives of families there are daily stressors that can occur, such as parenting stress and breaking of rules [11], which all the participant families experienced at some point. Furthermore, there are hot spots and cold spots during the day. In the paper by Sevón, Malinen and Rönkä, the argument is that hot spots are more prone to tensions (or stressors) whereas cold spots are related to relaxing and de-stressing times of the day [11]. However, in our data it was not only hot spots that showed tensions which is in contrast to their paper. During the times that the participants wanted to relax with technology, they would sometimes get interrupted and as a result get agitated, creating tensions belonging in the subcategory *Disrespect* in the overall category *Individual Use of Technology* as presented in *figure 2*. It can be seen in family A, where the father sometimes responded with angry behaviour when interrupted in relaxing with technology. In this case, it's the fact that the cold spot, the relaxing time, is interrupted and disrespected that causes the tensions.

It could also be relaxing with the family that caused tensions as in the case of family C, where the parents disagreed whether watching TV was a good way to relax together, which caused tensions. Another example is between parents and children, where the children in family D believe game consoles are acceptable as part of family time, whereas the mother does not agree. Their clash of expectations was the source of the tensions as expressed in the category *Different Expectations to Family Time*. In both *Individual Use of Technology* and *Different Expectations to Family Time*, technology was often the topic of the tensions. The father of family A relaxed with technology, family C and D had disagreements about including technology in their family time. However, it was the clash of expectations that caused the tensions, not the technology use. In family A, the expectations to relaxing were broken as the father felt disrespected when interrupted, and in family C and D it was the disagreements about the involvement of technology in family time. In *figure 2*, the sources of tensions connected to disagreements in and interruptions of cold spots are marked with green dots.

Spillovers in the Private Arena

The literature particularly mentioned work-family spillovers, but in our data it was not overly present except for the father of family A responding with angry behaviour towards his family as a result of being stressed by outside factors and interrupted in relaxing. Because of this, he felt disrespected and it created tensions between him and the one interrupting him in relaxing.

Furthermore, examples of parenting stress that would spill over and become tensions between the parents, or even spill over into the personal arena and become inner tensions, was found in the data. In family D, the mother would experience parenting stress e.g. because the grandmother would express that the parents from Family D were bad parents, as they allowed their children to interact with technology more than the grandmother would allow. This stress spilled over to the parent-parent relationship, where the mom later would argue with the father about the parenting, creating both tensions

between the parents and inner tensions for the mother. Many of the examples involved technology where e.g. parenting stress came from denying access to technology or the opposite, going against their own beliefs and allowing access to technology. It was mainly the categories *Preventing Tensions* and its subcategories *Rules* and *Hypocrisy* that created the spillovers. Technology was simply the subject of the rules, but it was the enforcing or breaking of the rules that lead to the actual tensions and therefore spillovers. These sources to tension are marked with yellow dots in *figure 2*.

De-stressing Creating Tensions

A general tendency in our data was that our participants used technology to relax/de-stress. As mentioned before, getting interrupted while de-stressing caused tensions, however their behaviour when de-stressing also caused tensions with the other family members. In the literature, behaviour when feeling "overloaded" or reacting to stress generally involved being withdrawn or irritable, which created tensions [15]–[17]. Generally, the withdrawn behaviour, where they weighed their own de-stressing needs higher than the needs of the other family members, was found to be what created tensions in the families. It created inner tensions for some family members, who attempted to respect the other family members' de-stressing with technology. They wanted to *Respect* the other family members' time to relax, yet they felt a conflict inside of them as they also wanted the attention of the other family member. In the case of the mother from family A, she tried to keep calm as a strategy to prevent any further tensions (*Preventing Tensions).* Technology is the mean that the family members use to de-stress, but it's their behaviour and their priority of their own needs that creates the tensions for the other family members. The inner tension for the other family members is marked on *figure 2* as a red dot.

Clashes of Values

The two categories of tensions: *Individual Use of Technology* and *Different Expectations to Family Time* are also highly related to the research on individualism. The family members explained how they used technology for de-stressing and they wished for their family members to respect their needs. This could relate to Dencik, Jørgensen, and Sommer's discussion of the modern society where they discuss how the family's influence on the individual's choices is waning due to individualism [10]. To give an example of waning influence; the individual's ideas of how much time spent on technology is appropriate may not coincide with the family's ideas. This can create tensions between the family members as they disagree on the matter, leading to disrespecting each other's needs. Individualism could also explain other behaviours of our participants: In family A, the father was asked to play with his son and after he felt he had interacted enough with his family, he left to play games again. He justified his gaming behaviour to de-stress by having complied with the mothers' request for a few minutes, while it clashed with the mother's ideals for family member interaction. This could be explained through individualism as his values and ideals are not mediated by the family but by himself as an individual, causing them to differ from his wife's values and ideals. It becomes a clash of expectations. In all the families, it was often *Different Expectations to Family Time* that showed these clashes between individual values. It could also explain behaviour from the category *Society has changed*, where the clashes are met with a surrender of values in favour of the other family members' values. E.g. in family C and D where they accept that their children must engage with technology eventually as to not fall behind in society, despite wanting to restrict the technology engagement of their children.

Furthermore, the differences in values between parents and children when it comes to general technology use were found to differ. The children get their values based off their social circles instead of the private arena, which we found clashed with their parents' values, creating tensions. In family D, the eldest son also found a *Sense of Belonging* in technology use, which his parents felt conflicted about because it increased his technology use. In short, individualism has caused fragmentation in values and norms, creating differing expectations, which can cause tensions. The above sources of tensions *Individual Use of Technology, Different Expectations to Family Time,* as well as *Society Has Changed* are related to technology, but it's the clashes of expectations caused by individualism that are responsible for these sources of tensions. The sources of tensions and concrete tensions mentioned in this section are marked with purple in *figure 2.*

Blurring of Arenas

Another societal tendency that seems present in our findings is harriedness. Institutions can reach out to interact with individuals whenever and wherever [19], potentially ignoring the previous work/family division that people traditionally have in their lives [24]. The public arena's boundaries seem to be blurring as institutions can reach people outside specific timeslots and locations, causing a pressure to more efficiently coordinate the individual's time. Technology, particularly mobile technology, allows harriedness to exist in the daily lives of our participants as they can reach out and be reached at any point, which they also expressed in the data. It causes stress from the public arena to spill over into the private arena of the family, affecting both individuals and relationships within the arena. Related to harriedness is the source of tensions called *Constant Connectivity*, which is more focused on the pressure to respond immediately through technology when reached out to. The stream of information as well as notifications through the technology is overwhelming for the families, as seen in e.g. family C, and some even speak of a pressure they feel to always have a device at hand, so they can be reached at any time. The additional stress from this pressure creates further need for people to de-stress which

leads us back to the previous arguments for how de-stressing behaviour can create tensions as well. The pressure from harriedness (and constant connectivity) relates to our categories *Society Has Changed* and its subcategory *Technology Overwhelms*, which most families mentioned. On one hand, technology might play a part in stressing out people by allowing harriedness and constant connectivity into their lives. On the other hand, technology is also how they choose to relax because entertainment is easily accessible. *Technology Overwhelms* is more related to the pressure from society and the stress that comes from that pressure, which creates tensions within the family, than the technology use itself. This tension is marked with brown in *figure 2.*

Technology as a Mediator

As seen in *figure* 2, most of our findings can be supported by family theory where technology use is not creating these sources of tensions, but still plays a role. In spillovers it was often parenting stress that created the tensions, which then spilled over onto other relationships rather than technology use itself. The parenting stress could include e.g. rules about technology use, as in family D, however it was the rules and breaking of rules that were the direct sources to tensions.

It was also discussed that when the participants de-stressed during cold spots, it was not the technology itself but rather the interruption of the relaxation activity (which included technology), that caused tensions. This was related to individualism, and the priority of own needs. Furthermore, we found several examples that showed clashes of opinions and expectations, which created tensions. However, differences between the family members in terms of opinions and expectations are not exclusive to technology use. Technology played a role in the examples given in our study, but it seems the tensions could have existed anyway without the presence of technology.

On the other hand, in relation to stress it can be argued that technology plays a mediating role. Stress can lead to other tensions as it spills over, e.g. responding angrily towards other family members as the father of family A, but technology can also help relieve the stress. Most our participants used technology to de-stress, both adults and children. However, it also supported bringing more stress into their lives. Technology supports harriedness by allowing the public arena to reach into the private and personal arenas more easily. People can be reached no matter the time or place and are expected to respond. Through particularly mobile technology, the participants felt the pressure and stress from harriedness, e.g. the notifications being overwhelming as the mother of family D described or the pressure to always respond gets too much as the father of family B said. In short, technology has a mediating role in the families' lives: it helps them de-stress, but it also allows more stress into their lives through harriedness. The stress then has the potential to create tensions in the families as the stress spills over.

Technology Creating Tensions

Two sources of tensions seen in *figure 1*, could not be related to the concepts from family theory or related fields. These two sources are *Addiction* and *Absorption*, which are directly connected to the technology use of the family members in both our data and the literature [3]–[6]. *Absorption* could be seen when the family members were interacting with technology, which resulted in them disregarding people around them as they only focused on their device. Being absorbed caused tensions in the Parent-Parent relationships because of the missing attention, eye contact, and feeling of exclusion. The Parent-Child relationship was also affected by this as the parents were concerned about their children or spouse and the children missed attention from their parents. Furthermore, it caused inner tension as the family members wanted to stop being absorbed but didn't know how to.

Addiction was also identified in the data, where the participants felt a desire to check their phones, consciously or unconsciously. This created tensions in the Parent-Child relationships as parents were concerned about their children's passive behaviour. Furthermore, it created inner tensions, because just like *Absorption*, the parent didn't know how to stop e.g. checking their phone and use their time on other things, which were important for them.

As written, these sources of tensions affected all the intra-family relationships, and none of the identified family theory literature seemed to sufficiently explain the tensions connected to *Absorption* and *Addiction*. Therefore, we argue that *Absorption* and *Addiction* are sources of tensions caused by technology use. This is supported by the theory about tensions and technology use in families, which also found *Absorption* to be caused by technology use by the family members [3]–[6]. From these findings, we suggest a new framework containing the sources of tensions caused by technology use. This framework can be seen in *figure 3*, which we believe can become a solid foundation for further study into tensions specifically created by technology use in co-located families.

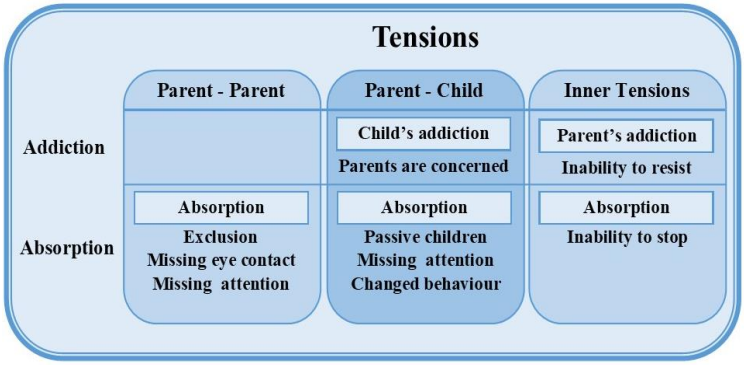

Figure 3 – Model of Tensions Caused by Technology Use

Limitations

The data for the study cannot be generalised due to the limited sampling size. However, the intent was never

generalisation but in-depth investigation, which can be used as inspiration and background for future studies.

The self-reporting diary approach has its limitation as the quality and quantity of the data varied with each family members' motivation to document tensions in written form. It was also mentioned by the participants that sometimes they simply forgot or didn't have access to the diary after the tensions occurred. Another limitation is the children – they didn't understand the task completely despite our efforts and the data we have from them is very limited. Therefore, the data we have on the children comes mainly from the parents' perspective. Additionally, the younger children were unable to express their feelings on their own.

CONCLUSIONS

Having done our empirical study and discussed the findings, we have found the various ways the relationships in the families are affected by tensions related to their technology use. The intra-family relationships (between parents, parents and children, and inner tensions) experience various forms of tensions when family members use technology while co-located with the other family members. Most of these tensions occur in the form of frustrations with other family members or stress, which can spill over onto other relationships in the private arena. There were also several findings of inner tensions as a result of e.g. rules regarding technology use or the person's own technology use. As can be seen, there are various sources from which tensions can occur when technology use is involved, and they affect the intra-family relationships.

In the findings that could be explained by family theory, technology is placed in a mediating role. As a mediator, it both enhances daily stressors by supporting harriedness, which in turn creates more tensions in the families through e.g. spillovers, but it also relieves stress and lets people relax by giving easy access to entertainment and socialisation. However, there were cases where technology is the potential source of the tensions rather than a mediator. In the two sources to tensions, *Addiction* and *Absorption*, the participants expressed tensions occurred due to the behaviour of the other family members' when using technology. Due to these categories both in our data and literature being directly connected to technology use, we suggest that they are caused by technology rather than mediated by it.

Future Work

As *Addiction* and *Absorption* did not place technology as a mediator but as the creator of the tensions in these categories, there is potential for further study into how these specific sources of tensions affects intra-family relationships.

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Challenging Absorption and Addiction in Families with Young Children

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ABSTRACT
Family members can be absorbed into and addicted to interaction with technology, causing them to e.g. ignore co-located family members. This can create tensions in the family, however it's difficult for the family members to change the situation by themselves. In this study, we used provocative design to design a system that would challenge this situation. Essentially, the system gives the family members a forced choice between using their phones or not when other family members are present. First, we found that by using the system, it was possible to interrupt absorption. Second, we found that when the family members' access to their smartphones was limited, it reduced their perceived addiction. Furthermore, we found that planned breaks away from technology had positive effects on their family life and the relationship between the parents as a couple.

Keywords
Addiction, absorption, technology, provocation.

INTRODUCTION
Technology influences a lot of aspects of our everyday lives, e.g. enables us to always be in contact with the outside world independent of time and place [1], [2]. This is affecting the time spent together as a family (family time) by erasing previously clear boundaries between the private arena (the family itself) and the public arena (the world outside of the family e.g. workplace, school, social life with friends) [1], [3]. Erasing the boundaries can lead to tensions in family time, as they are not able to take a break from the public arena [1].

However, the blurring of the arenas is not the only issue that seems to cause tensions in families. A study that investigated tensions connected to technology use in families found that personal technological devices like smartphones enable family members to create their own personal space [1]. Family members described this as a "bubble" or a virtual room for them to e.g. relax and de-stress after work or school [1]. However, they also found that being in a "bubble" can cause tensions in family life because of *Absorption* [1], [4]. *Absorption* is explained as a situation, where one is so engaged in the interaction with technology that he/she is not acknowledging other people who are physically present [1]. In the previous studies, parents also explain how they feel absorbed when interacting with e.g. their smartphones [1], [2]. For example, the simple act of receiving a message can start a snowball effect of interaction, where the parents want to quickly reply to the message and it turns into an ongoing conversation, taking time away from their co-located family. This causes e.g. tensions from other family members, who feel ignored [1], [2], [4].

Another source of tensions caused by technology use, which was identified in a previous study, is *Addiction* [1]. It is described as the urge to always, consciously or unconsciously, wanting to interact with technology [1]. In previous studies, family members explain how they feel addicted to technology, even when they are engaging in activities like having conversations with other family members [1] or sitting at the dinner table [5]. The parents also describe how their children negatively change behaviour (e.g. screaming and demanding technology) when the parents are trying to set limits to their use of technology. This creates tensions between parents and children, because the parents are worried about their children's well-being and the children can't get what they want [1].

Furthermore, the study also suggests, that *Addiction* and *Absorption* are not only affecting family time, but also the time the parents want to spend on activities for themselves [1]. The parents express how they sometimes wish to do other activities than interacting with technology, e.g. reading books. However, they feel addiction and absorption, which makes it very difficult for them to e.g. put their smartphone away [1].

As found in the previous studies, the family members feel that technology can create tensions in their family because of *Absorption* and *Addiction* [1], [2], [4]. Furthermore, the family members struggle to change the current situation by themselves [1], [2]. We create a system for this study that would challenge this situation. We use provocative design as an approach for designing the system. Essentially, it forces the family members to choose between using their smartphones or not. In relation to *Absorption*, we assume that whenever a family member feels ignored by an absorbed spouse or child, they would lock the smartphones. In relation to *Addiction*, we assume that those family members, who are perceived as the most addicted either by themselves or their family members, would unlock their phones. In this study, we aim to get a deeper understanding of our two assumptions about the family members interaction with the system.

THEORETICAL FOUNDATION
Tensions in Families
Sources to tensions caused by technology use in families with young children were identified in a previous study [1]. The

results of that study are presented in *Figure 1*. As seen on the horizontal axe in the figure, tensions in three different relationships were analysed in the study. First is the relationship between the parents in the family, which is called *Parent-Parent*. Second is the relationship between the parent(s) and child(ren) in the families, which is called *Parent-Child*. Lastly, there is *Inner Tensions*, which isn't a direct relationship between two family members. Instead it is tensions that start within the parents themselves that have the risk of spilling over onto the two other relationships. Furthermore, the two sources of tensions that were caused by technology use, *Addiction* and *Absorption*, are presented in figure 1, and are explained below.

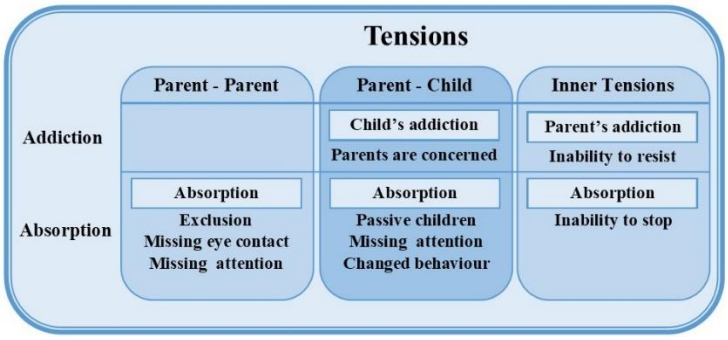


Figure 1: Tensions caused by technology use [1]

Addiction

Addiction can be characterised as the urge to always check new incoming information through technology (e.g. a notification or a message), or always wanting to interact with technology. The parents in the study felt that their children were acting addicted because they often asked for the technology and had a strong negative reaction when parents were trying to set limits towards the children's use of technology [1]. This created concerns for the parents about their children's well-being and also lead to discussions between the parents and children, which caused tensions in the *Parent-Child* relationship.

The parents were also frustrated with their own addiction to technology and explained how they consciously or unconsciously picked up e.g. their smartphone to check for new information, even though they didn't want to spend time on the phone [1]. Furthermore, addiction also made the parents feel that they had difficulties in prioritizing between spending time with technology and time on other activities that they found important e.g. reading a book or being together with family. This created *Inner Tensions* because the parents wanted to spend time on other important things, however they ended up checking e.g. their smartphones instead [1].

Absorption

Absorption can be explained as a situation when a family member is so engaged in the interaction with technology, that the person isn't paying attention or acknowledging the presence of other family members [1], [2], [6]. This can create tensions in the *Parent-Parent* relationship, because spouses of the absorbed parents can feel excluded from the activities that the person is doing with technology. Furthermore, *absorption* can make parents ignore their spouse or children, which can result in the feeling of missing attention and lacking eye contact. It also affects the *Parent-Child* relationship, because parents observe how their children are changing behaviour when being absorbed in the interaction with technology. They become passive observers to whatever is being displayed on e.g. the tv or tablets. Finally, it also creates *Inner Tensions*, because the parents know that they are being absorbed and it sometimes frustrates them, however, they do not know how to get out of the absorption again.

In conclusion, parents and children can both be addicted and absorbed when using technology, which causes tensions in the different relationships in the co-located family. Therefore, it can be argued that parents and children need to change their behaviour when interacting with technology if they want to avoid some of the tension caused by technology.

RELATED LITERATURE

Within the recent years, designers in the HCI community have had an increased interest in affecting and challenging behaviour [7] and sometimes even disrupting existing social and cultural norms through provocative design [8], [9]. Suggestions and considerations for the designers found in previous studies are presented in the following sections [7]–[10].

Motivation Through Design

Previous studies have suggested that in order to motivate individuals to change their negative behaviour, the designers should include certain considerations [7], which are presented below.

First, providing only information about the problematic behaviour might not change the negative behaviour, as the users e.g. can feel ambivalence between the convenience of continuing old behaviour versus the benefits of changing it [7].

Second, it can be beneficial for the motivation of users to utilise emotional persuasion, where the users can be influenced by their own emotional response [7]. UbiGreen, a system to provide energy feedback to users, uses emotional persuasion combined with positive reinforcement to motivate their users [7], [11]. UbiGreen displays a picture of a polar bear standing on an iceberg, which would grow, when the users change their energy consumption in a positive way [11].

Third, suggesting certain actions for the individuals to take in order to change their behaviour might also increase their motivation [7].

Triggering Dilemmas

The aim in provocative design is to challenge the user's normal routines, beliefs and make them reflect upon their actions by provoking them through an object [9], [10]. To provoke, the object can be designed to trigger dilemmas within the user [10]. A previous study suggests three different strategies for triggering these dilemmas: *Embodied symbols*,

Forced Choice and *Behavior Barriers* [10]. Below, the three strategies are explained with three examples.

The first strategy is *Embodied symbols*, which implies that the object needs to contain a symbol or clue that represents a conflicting concern for the user. An example of such an object is the "sugar gun", which is a lollipop shaped like a gun [10]. The lollipop symbolizes enjoyment of eating sugar and the gun symbolizes the unhealthy aspect of it. The second approach is *Forced Choice*. When using Forced Choice, the object should force the user to make a choice between two alternatives [10]. A crucial factor for *Forced Choice* is that the two alternatives must be mutually exclusive, so the user cannot choose both alternatives at the same time. An example of forced choice could be the Danish system for returning used cans and bottles. The system is placed in shops, and when you are returning your bottles/cans you can choose between getting the money from your deposit or donating the money for charity. The third approach is *Behaviour Barriers*, which means that the object is preventing the user from doing a certain activity without giving the user a choice [10]. KSafe is an example of such an object[12]. It is a box with a timer, where it is possible to keep small objects inside and then lock the box for a certain period. This creates a barrier, which is solely preventing the user from having access to the locked objects [10]. In the next section, we will look into three dimensions for designing provocation.

Conceptual, Functional and Aesthetic Provocation

When provocative design is used for challenging everyday practices, it is important that the design of an object is not so extreme that it will be rejected [8]. On the other hand, a core characteristic of the object is that it must be provocative, and therefore the object needs to be strange enough to fulfil this purpose and not just blend into the everyday routines [8], [9]. It is suggested to focus on three different dimensions of provocation [8], [9].

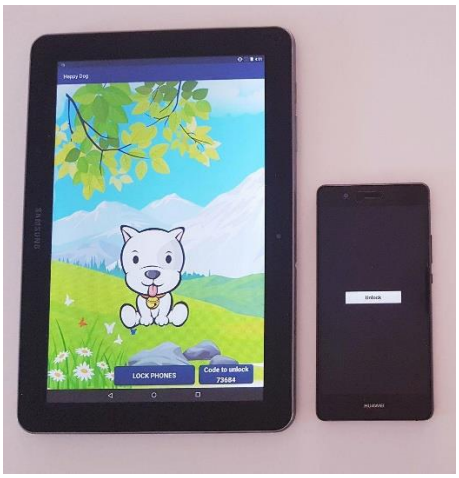
The first dimension is *Conceptual Provocation*, which is the aspect of the present world that will be challenged through the design. In Bardzell et al. [8], the *Conceptual Provocation* is about challenging the perception that spaces are often gendered. They developed a sound display system placed in the locker rooms at a gym. It played sentences from the opposite sex e.g. men would hear sentences that women said about men and vice versa [8]. In Raptis et al. [9], they design a provocative system called The Box, which is a system that can be placed on washing machines in the homes. The box displays a green light if there is cheap electricity and a red light if the electricity is expensive. The *Conceptual Provocation* here is the idea of western consumption of electricity, where electricity is perceived as always available and where the consumer doesn't need to know where the electricity origins from [9].

The second dimension is *Functional Provocation*, which deals with how the functionality of the object is provoking the users. In Bardzell et al. [8], the *Functional Provocation* is the functionality of the sound display system, and in Raptis et al. [9] it is the box with the *Forced Choice* of using the washing machine when the electricity is either scarce/expensive or in surplus/cheap.

The third dimension is *Aesthetic Provocation*, which is centred around the provocation by the visual looks of the system. In Raptis et al. [9], they designed the box with a retro, industrial look that did not easily blend in into the modern home of the families in their study. In Bardzell et al. [8], they found that the participants were not aesthetically provoked by the sound display system as it was not strange enough, which is also the reason why they stress that all three dimensions are important for the perceived provocation.

DESIGN

We relied on the theory about motivation through design by designing a provocative system that both suggests action for the users to take (lock/unlock phones) and uses emotional persuasion, which is explained in this chapter. Furthermore, we applied *Forced Choice* and utilised the three dimensions of provocation as guidelines for designing "The Happy Dog" system. A picture of the system can be seen in *Picture 1*.



Picture 1: The Happy Dog system

Conceptual Provocation

As explained before, the sources for tensions we challenged in this study are *Absorption* and *Addiction*. We challenged these by giving the participants the opportunity to lock all the smartphones in the household for 30 minutes at a time. The family members would then have the possibility to unlock their phones during that period.

Functional Provocation

The core functionality of "The Happy Dog" system was that when a family member pushed a button on the Tablet App, all the family members' smartphones would be locked, which would prevent them from interacting with their smartphones. The phones were locked for 30 minutes, and after those 30 minutes they would be automatically unlocked again, and the users were able to interact with their phones. During the 30 minutes, the user had the possibility to unlock their phone by entering a code into his/her phone. The code was displayed on the Tablet App, which meant that to unlock their phone, the user had to go to the tablet and get the code. Furthermore, the

code was auto generated every time a user locked the phones, which meant it couldn't be memorized by the users. Again, this was to force the user to find the tablet in order to unlock. By entering the code, the user would only unlock their own phone, but the rest of the phones in the family would continue being locked. Even though the user had the possibility to unlock their phone, it affected the mood of the animated dog displayed on the Tablet App. Depending on the number of times the code was used to unlock the phones, the dog would become sadder and eventually die. If nobody entered the code, the dog continued being happy. This is the *Forced Choice*: keep the phone locked for 30 minutes and the dog will be happy or unlock the phone and the dog will become sadder.

Aesthetic Provocation

The Aesthetic provocation in the Tablet App lay in the expression of the animated dog. When designing the dog, we found inspiration in the 90s Japanese digital toy Tamagotchi [13]. We built upon this idea by creating a family dog that could change mood depending on the family's actions, showing the consequences of the family's actions. We wanted the dog to have an expression that all the family members, including the children, could relate to and even connect certain emotions to, as suggested in the concept of emotional persuasion [7]. Therefore, we went for a naive and cartoonish design of the dog. The different stages of the dog's mood are displayed in *Picture 2*.

Picture 2: Stages of animated dog

If the Tablet App was appealing to the children as well as the parents, the whole family could understand the consequences of unlocking their phones, and by doing that we aimed for the whole family to be interested in the state of the dog. Furthermore, we chose to make a final stage where the dog would be dead. We wanted to really underline the forced choice by showing the consequences of unlocking the phone.

For the Phone App, we wanted a very boring and uninteresting look as a contrast to the normal appearance of apps on phones. Therefore, we chose to make a simple black screen to symbolize "Nothing important is going on here", as can be seen on *Picture 1*.

METHODOLOGY

The purpose of this study is to investigate how family members react in relation to absorption and addiction when challenged by a forced choice between using/not using their smartphones, when other family members are present. This section is dedicated to an explanation of the methodological choices made during the process of this study.

Pilot Study

Prior to the field study, a pilot study of "The Happy Dog" system was carried out. The purpose of the pilot study was to test the robustness of the system and two couples tested the application in their homes for three days each. Even though this study is focused on families with children, these two couples were considered to be suitable for the pilot study, as the purpose of the pilot study was merely to test the robustness of the system in a home setting with people who did not know the system. The pilot study revealed a few problems (e.g. application was working only on some types of Android phones), which were all addressed before the field study.

Field Study - Procedure

The field study of "The Happy Dog" system was done in the homes of three selected families. The procedure of the field study could be divided into three phases, which are described below.

First, an initial meeting with the families was established, where we helped install the application on the participants' smartphones and gave them a tablet with the other part of the system (as explained in the previous section). Afterwards, the basic functionality of the application was explained to the families and all the questions about the process were answered. The families were encouraged to contact us in case of any questions, doubts or problems with the system.

Second phase consisted of the period of time, where the three families were using the system in their homes. Family A used the system for 7 days and they locked the phones 9 times, mostly in the evenings. Family B had the system for 11 days, however they only used it for 9 days. In total they locked the phones 10 times, usually in the afternoon or evening. Family C had the system for 7 days, but they were interacting with the system for 6 of those days. They were locking the phones once a day, typically in the evening. None of the family members used the auto generated code to unlock their phones. *Table 1* shows a summary of the second phase for each family.

Family	Had the system	Used the system	Locked phones
Family A	7 days	7 days	9 times
Family B	11 days	9 days	10 times
Family C	7 days	6 days	6 times

Table 1: Summary of data from logs

During the third phase, we carried out in-depth interviews with the mother and father from each family. Details about the interviews can be found in the section called Data collection.

Participants

During the process of searching for participants, we decided to create a promotional video, where we introduced our application and invited people to participate in our research. This was done in order to reduce potential anxiousness about our study. The video was posted and re-posted on multiple Facebook groups.

There were three criteria for selecting the participants. First, the families had to live in or close to Aalborg, as face-to-face contact to the families was crucial. Second, they had to have at least one child in age between 2 and 12. The third and the last criterium was that the families had to use Android smartphones as the application prototype was developed for Android. It resulted in finding three families, which participated in our study. The *Table 2* presents the structure of the families and their age.

Family	Member	Age
Family A	Mother	32
	Father	33
	Son	3
Family B	Mother	31
	Father	30
	Daughter 1	12
	Daughter 2	7
	Daughter 3	1
Family C	Mother	43
	Father	43
	Son	4

Table 2: Description of participants

Family A consisted of three members: The mother worked as a supervisor at the university and the father was a chef. Both parents had smartphones, which they used daily to communicate with their friends and family. Furthermore, the father was often using his phone to relax after work by playing games and reading news online. Their son didn't have a phone, but he sometimes used his parents phone or family tablet to watch videos and play games.

Family B consisted of two parents and three daughters. The mother was a social and health assistant, while the father worked as a postman. Both adults and the oldest daughter had a smartphone, which they used on a daily basis for multiple purposes (e.g. playing music, games, Facebook, communication with friends). The middle daughter was occasionally using her parents' or her sister's phone. Furthermore, they had a tablet, which was used by all family members except the youngest daughter.

The last family, family C, was composed of three members, two parents and a son. The mother was a social worker and the father worked as a train controller. Both parents had smartphones and tablets, which they used daily to relax. Their son didn't have a phone nor a tablet but was from time to time allowed to use mother's phone and tablet to watch videos under supervision and play games.

As stated above, all three families had previous experience with using smartphones and tablets. This was important, as we didn't want to bring any new technology into their everyday lives.

Data Collection

There were two sources of data for this study. The first source was data logs collected from the system, where actions of each family member were captured during the field study. The logs contained information about when the participants locked the phones, when they unlocked the phones, who unlocked the phone, how many times they locked/unlocked the phones. This data was used for creating the summary of phase 2 (*Table 1*) as a support to the interviews, and it provided us with objective information about participants' behaviour.

The second source of data was in-depth interviews with the mother and father from all three families conducted at the end of their participation. Interviews were based on a prepared interview guide.

Data Analysis

All the interviews were later transcribed, and a method of open coding was applied, where predefined themes of *Absorption* and *Addiction* guided the process. Moreover, additional themes were identified during the process of coding. All the data was coded by one researcher and later re-coded by another researcher. For this stage of the study we used a software called NVivo.

FINDINGS

The following sections are dedicated to the presentation of our findings regarding the two themes: *Absorption* and *Addiction*. Furthermore, additional findings that were identified during the process of coding are also presented here.

Absorption

The family members could get absorbed in their smartphones when at home with other family members. As the mother from family A stated: *"It is quite difficult to get"* family members' *"attention, when there is a possibility to do something with the phone."*

In the interviews, the families explained how they used the "Happy Dog" system to get a spouse or parent out of the absorption. The mother from family A said: *"I locked the phones, because I wanted to talk to my husband."* Furthermore, their three-year-old child understood that he should use the application, when he didn't get a response from his father: *"I also think, that our son understood it, that when he wants father's attention, he should go and push the button on the tablet. Because one time he was saying: "Father, father." And then he just went to the tablet and started pushing the button to lock the phones and laughed."* It must be noted, that the mother from family A and her son locking the phones always resulted in the desired outcome, as the father from family A described his actions after his phone got locked: *"I was playing with my son or talking to my wife. They had my*

attention 100%." From the logs, it was also visible that he never used the code to unlock his phone.

Family members from Family A tried to provoke a behaviour change connected to absorption by using the application. The responses from absorbed family members were mostly positive, and people who were locking the phones achieved what they wanted to. They expressed it by stating: *"I felt the difference in my husband's behaviour, which was a big plus. I really liked his behaviour, when phones were locked."* or *"Surprisingly, he reacted very well. He didn't complain, he just put his phone down and actually came to us, so we could spend time together."*

On the other hand, we could also identify some inner tensions when somebody's phone was locked, as can be seen in the next quote from the father of family A, *"Sometimes it was quite annoying, when my son locked the phone and I was in the middle of something, which I wanted to finish. But I accepted, that I can't do anything with my phone for 30 minutes."* These inner tensions didn't affect their family life in any way, because the result of the locked phones was never an argument but an acceptance from the father's side.

To sum up, the participants got absorbed by their smartphones. This behaviour was challenged and changed by the use of our system. It provided the possibility for family members to take the absorbed family member out of their bubble and back to interacting with co-located family members instead of the smartphone. Furthermore, it is important to notice that the absorbed family members mostly reacted positively towards the system, even though it prevented them from interaction with technology.

Addiction

The second source of tensions, which we aimed to challenge, was *Addiction*. Some participants explained how they perceived either themselves or their spouses as being addicted, e.g. the mother from family B said: *"I have been very addicted to it [smartphone]."*

Our second assumption was that addicted family members would unlock their phones. However, the participants usually *"felt fine", "took it OK"* or *"smiled"*, when their phones got locked during the field study. This positive reaction also included the family members who perceived themselves as addicted. Furthermore, we can see from the logs that none of the family members used the code to unlock the phone. All the participants also stated that while their phones were locked by our system, they didn't check their phone frequently if the 30 minutes already passed, so they could use the phones again. On top of that, the family members actually *"completely forget about the phone […] also, when the 30 minutes were gone"*.

Some family members were *"quite surprised"* about their own behaviour, as for example the father from family A "*honestly didn't think, that* [he] *will be able to not unlock the phone for 30 minutes."* Some of our participants were also positively surprised that they *"didn't need the phone for so long."* The mother from family C said: "*it was nice to confirm, that we are not that addicted to it. So, it was a good feeling, that we can live without our phones for 30 minutes or maybe even more."*

Our participants were also astonished by the behaviour of their addicted spouses, e.g. in family B the father said, *"I was surprised how fast my wife got used to not picking the phone up."*

Furthermore, the mother from family B shared with us how she thinks this study lowered her addiction: *"I think I find it easier now, to let go of the phone. I am not that addicted to it anymore. I can drive to the school without the phone and do something without having the phone on me."*

Participants, that perceived themselves as addicted to the smartphones were surprised about their own behaviour when the phones were locked. With the system challenging their perceived addiction, they realised that they could do just fine without the phones for 30 minutes. This realization was something that they weren't aware of before the system was introduced in their homes. Furthermore, they explained how they were not even in a rush to interact with the phones again after the 30 minutes. In one case, the study even decreased the negative behaviour perceived as addiction.

Constant Connectivity

We found that not only was *Absorption* and *Addiction* challenged in this study, but the system also challenged the possibility for family members to always be in contact with the outside world independent of time and place, the so-called Constant Connectivity [1]. Through our data we could see that this was challenged each time the phones were locked, where the participants were not able to communicate with the outside world as they were used to. The father from family A stated that there was a situation where the phones were locked, but he checked his phone frequently anyway, to see if it was already unlocked again: *"Once my son locked the phone, when I wanted to call my father. So, I was waiting for it to unlock and I was checking."* In this case, the loss of connectivity caused inner tensions for this participant. Usually, he would call his father immediately but at the time it wasn't possible, and he thought *"it was quite annoying."* The effect of our application was in this case postponing his need to use the technology.

On the other hand, the mother from family C felt *"free"*, when the phones were locked. The mother from family A shared this feeling and explained a bit further: *"Sometimes, when I am doing something, and an e-mail comes or a message or some stupid notification, I can get a bit stressed. Because I am doing something with my son and the sound interrupts, what we are doing. And I want to continue the activity, but I also have this feeling, that I should check, because maybe it is something important. But it usually isn't. But I still check and then I feel, that I need to respond to the message or e-mail right away, and sometimes I simply hate it. It was nice to have 30 minutes with no interruptions."* Both mothers enjoyed the break from the constant connectivity.

Constant connectivity also affected how the families were planning when to lock the phones. Especially the mother from family A was concerned about the loss of connectivity, when she explained: *"the only time, I really need my phone is, when I talk to my parents. I do it every day. And I locked the phones always after our conversation, so I was sure, that they will not want to reach me, while the phones were locked."* As it can be seen from the previous quote, some of the participants were used to being reachable by the outside world all the time and didn't feel completely comfortable when this was challenged by our study.

Improved Family Time

Another effect of our system was, how it changed the family time during the 30 minutes when the phones were locked. Family members stated that they *"played more all three together"*, *"had more uninterrupted time together"* and *"talked more during the dinner."* Furthermore, the father from family A expressed, that *"Even though it was only 30 minutes a day, I think it gave us time for the family life, which wasn't interrupted by the technology."* It seems that most of the participants agreed that the quality of their family time was affected by their use of smartphones, even if they didn't realise it. The father from family B tried to explain: *"it just became nice to be together, but you were not thinking that it was because of the phone. Because the phone takes up a lot of space, and yet so little, that when it is gone then everything is just normal."* This indicates that our design inspired by forced choice affected the participating families and improved the time they spent together as a family.

However, it was not only family time that got improved by our system. We also identified changes in the relationships between two parents. The father from family B said, that the system *"is very good for couples"* and that *"it is a good way to learn how to just be together. E.g. just lay and watch television together, and watch an episode of a series, where both of us are focused."* The system helped them to focus only on one thing at a time, which had a positive influence on their relationship. When the smartphones are too accessible, it is more difficult for them to get undivided attention from their spouse.

Therefore, it could be concluded that both family time and relationships between parents were affected in a positive way by our system.

Planning Together

When designing the system, we wanted to give the possibility to lock the smartphones to all family members. That was also one of the reasons why we designed the Tablet App as a central system for the whole family. Our first assumption was that when a family member was absorbed in the interaction with his/her phone and another family member wanted his/her attention, they would lock the phones. This was also the case in family A as described in the previous part. However, in most cases in all three families, they either decided together as a group to lock the phones, or the one who locked the phones paid attention to the activities the other family members were doing on the phones before locking them. The father from family B described the situation of locking the phones like: *"We did that together. It was like "Now we all agree that we would lock the phones", and then one of us locked the phones."* It was very important for them to get a consensus, when they could lock the phones. It could be argued, that all three families were planning in one way or another when to lock the phones, because they wanted to prevent the possible tensions. The mother from family A explained her planning process: *"I was locking the phone, when I was sure, that my husband is not doing anything, he can't interrupt. I didn't want to make him nervous."* Furthermore, the mother from family C added: *"I always had to ask him* [husband]. *Can I lock it now? I always wanted to make sure, it is OK."* This showed respect for the other family members' time and interaction with their phones.

On the other hand, sometimes family members could feel disrespected when a person decided to lock the phones without discussing it first with the other family members. The father from family B described a tense situation, when they didn't agree on locking the phones: *"When you came home, and you did not even look at us, you just said "We will lock the phones now", and you did not even ask what the rest of us was doing."* This kind of situation could potentially create tensions in the families.

In conclusion, our system affected the participating families in a way that they started to actively plan to spend their time together without using their smartphones.

Reflections on Technology Use

In this section, we sum up some of the reflections our participants had about their technology use because of our study, and how it affected them or their everyday during the field study.

All three families stated that they talked about their technology use during the study more than usual. The father from family A said: *"After the experiment I understood, that I should give my family more attention instead of looking all the time in my phone."* He reflected upon how his behaviour with the phone affected the time he spent with his family. Furthermore, he added: *"We talked with my wife about the fact, that we could have much more time together, if we didn't use our phones."* The same pattern was also identified in family B, when the parents discussed that they didn't even realize how much time the phone use took from their family time. Therefore, it could be argued that our system assisted the families in thinking and reflecting upon their technology use, as well as realizing how much time they actually spent with interacting on the phones.

Family C also reflected on their phone use during this study. The mother from family C shared with us an interesting thought: *"I remember we talked about it, that it is not difficult to get away from the phone for 30 minutes, but it would be more difficult, if we had only 30 minutes to use the phone."* Family C didn't feel that they were addicted to the

smartphones and were not surprised that they could survive without the phones for 30 minutes. However, even people who considered themselves as not as attached to their phones couldn't imagine not having their phones for a longer period of time.

Reactions to Provocation

According to the above findings, the participants reacted on the conceptual provocation by e.g. not unlocking the phones. However, they didn't get provoked the way we assumed. Instead, in most cases the participants reacted positively or at least were accepting that their phone was locked.

In relation to the functional provocation, some of the participants did feel provocation, when they had to go and find the tablet in order to lock the phones. The father from family B explained the following: *"We would properly lock the phones more times, if we could lock them from our phones, because when we needed to go to the tablet, we just did not use it as much as we wanted to"* and continues *"If you could do it from the phone, it would be more used. It is 100% for sure"*.

For the *Aesthetic provocation*, the participants referred to Phone App's design as *"Closed"*, *"Game over"* and *"Locked"*. Furthermore, father from family B elaborated: *"If there had been all sort of drawings and figures you would have been curious, but this does not appeal to anything. It is really boring to look at. And you just know that this is No go"*. The participants described the Tablet App as *"Cute"*, *"Happy"* and *"Relaxing"*. When asked about the motivation for not unlocking the phones, the participants answered that the *Aesthetic provocation* did affect their decision. They expressed that *"I didn't want the dog to be sad"* and the mother from family B explained *"...With this (pointing at dog) you know you have to make somebody happy. So, it's all about not killing the dog. So, it has that effect. So, you have it in the back of your head."*. However, the animated dog was not the only reason the participants gave for why they didn't unlock their phones. They also expressed how they "*did not unlock the phones because of [their] family, not because of the dog."* The last reason given by the families was because they wanted to be "good participants" for the study. The mother from family C explained following: *"I wanted to help to this experiment."*

As stated, the participants reacted to the *Conceptual provocation*, however not in the way we expected. Furthermore, they got provoked by both the *Functional* and the *Aesthetic provocation*. The animated dog played a role in their decision for not unlocking the phones, however it was not the only reason. Their family and their participation in the study affected their decision as well.

DISCUSSION

The discussion is devoted to the results presented above. We aimed for challenging *Absorption* and *Addiction* and by doing so, we wanted to understand how family members reacted when they were faced with a forced choice between using/not using their phones. We had two assumptions about family members' interaction with the system: 1) We assumed that the participants would lock the phones whenever they felt ignored by an absorbed family member, 2) We assumed that those family members, who were perceived by either themselves or their spouse as most addicted to their smartphone, would unlock their phones. However, quite surprisingly for both us and our participants, those two assumptions were not clearly confirmed by the data. This will be discussed in the next two sections.

Appropriating the System

In relations to Absorption, there were few examples where the system was used when a family member was absorbed. As stated in the findings, the family members successfully took the absorbed family member out of their bubble created by smartphone, which *"gives families more quality time together"* (e.g. playing games together, talking). Therefore, it could be argued that our system had a positive effect when dealing with absorption and on their family time.

In all other cases, the families unexpectedly appropriated the system by planning together when to lock the phones. Locking the phones became a family activity and when the phones were locked, the families devoted that time to being together with their family. This had the positive effect of improved family time. Furthermore, it was not only affecting the family as a whole, but also the relationship between parents as a couple. They started *"Being together"* and had an increased focus on the shared activities they were doing.

Through the *Functional*- and *Aesthetic Provocation* we aimed for creating a shared system that appealed to the whole family, which was successfully achieved. But instead of using the system whenever there were tensions related to a family member's individual use of technology, the families took a much more positive view on the system's functionality. They perceived locking the phones as a family activity which increased the positive feelings towards the system.

Reduced Addiction

Addiction was found in the previous study [1] and our participants used the word addiction towards their own or their spouse's interaction with the smartphone. However, when our system was introduced into the families during the field study, it resulted in some interesting findings regarding *Addiction*. Firstly, all family members, including those who were perceived as addicted, accepted or even reacted positively when their phones were locked. This was confirmed both during the interviews and from the logs, where it could be seen that nobody unlocked their phones. Secondly, the participants didn't look impatiently at their phones when the phones were locked. Instead, they used the time together with their families, as explained in previous section. Thirdly, the family members, who were perceived as the most addicted, were pleasantly surprised by their own behaviour during the field study. Both themselves and their spouses explained how they were surprised that they could *"survive"* without the phones for the 30 minutes.

Therefore, we can state that our second assumption, that the addicted family members would unlock their phones, was not confirmed. Instead, the system had the following two effects on the families. First, by limiting the family members access to their smartphones, their perceived addiction towards the phones was reduced. It can be concluded that the easy access to the phones had a strong effect on the perceived addiction of the family members. That is also confirmed by the reflection of the participants, where they state that the phone *"takes up a lot of space"* in the families, however when the access to the phones was limited, then *"everything just becomes normal"*. As stated, the participants didn't pay much attention to their phones when they weren't able to use them.

The second effect was that, through the system, the participants were able to gain insight into the addicted behaviour. Our study helped the participants, who didn't perceive themselves as addicted to confirm, that they were not addicted. The participants, who were perceived as addicted, were surprised that they were able to accept the phones being locked. Some of them even stated that after the study, they realized that they were able to be without their phones for longer periods of time. This behaviour change needs to be researched further in a longitudinal study, where the long-term effects can be determined.

It must be noted that there are discussions in society today about how addiction towards smartphones affects people in a negative way [14]–[17]. One example is from Apple [14], who explained at their yearly conference, how they wanted to reduce addiction by e.g. making it easier for users to get an overview over the time they spent on the interaction with their smartphones [14]. It can be argued that showing information to the users about their smartphone usage might only have effects on those, who are already aware of their perceived addiction and who are taking initiative on their own to reduce it [7]. In He et al., they suggest that if the aim is to motivate individuals, who are either uninformed/unwilling or who are struggling to change their problematic behaviour by themselves, other strategies need to be implemented (e.g. giving the users specific actions to take) [7]. This is also confirmed by the results in our study. Some participants didn't realize that their addicted behaviour was problematic until the system was introduced into their family. Others did express how they perceived themselves as addicted to the smartphones; however, they were not able to change their behaviour by themselves. It was not until they could use our system to take a specific action (lock the phones) that their perceived addiction was reduced. Therefore, it can be argued that if the aim is to reduce perceived addiction to smartphones, it is not enough to only visualize smartphone usage to the users and then leave it to the users to alter their problematic behaviour by themselves. We discuss specific strategies to reduce tensions later in this discussion.

Tensions in Family Relationships Reduced

In this section, we discuss the framework from the previous study shown in *Figure 1* about the tensions caused by technology use in families [1]. The framework was used in this study as a theoretical foundation. We look into the changes in tensions, which were identified during our study and could be connected to the participants' use of our system. In *figure 2*, another version of the framework is displayed, however altered according to the findings in this study. Those fields that are marked with green dots in *figure 2* are types of tensions that were affected positively during the study. New types of tensions identified in the study are marked with red dots. Furthermore, tensions which are marked with yellow dots are tensions that was not affected during this study.

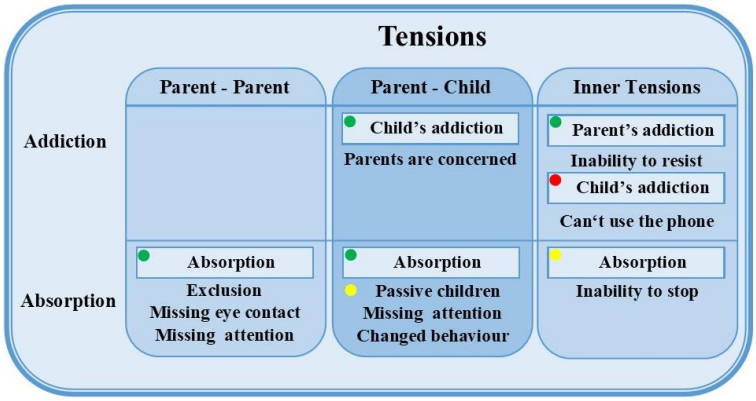


Figure 2: Tensions affected during the study (inspired by [1])

In connection to addiction, the previous study identified tensions in the *Parent - Child* relationship, where the parents were concerned about their children being addicted [1]. Furthermore, the parents felt *Inner Tensions* because of their inability to resist using their phones [1]. In this study, we identified two tendencies, where the tensions caused by addiction were reduced. Firstly, tensions in the *Parent – Child* relationship were lowered, when the children, in some cases, were taking the initiative to lock the phones. This indicates that the children wanted to lock the phones, and their perceived addiction towards the phones were not as present in those cases. Because of this, the parents were not as concerned about their children's addiction during our study. Secondly, as discussed before, some of our participants expressed that they felt their addiction being diminished during our study, hence their *Inner Tensions* were not that strong either.

On the other hand, the use of our system also created a new type of tension, which could be categorized as *Inner tensions* in *Children's addiction*. This specific tension is called *Can't use the phone*. It is added in *figure 2* and marked with a red dot. It could be explained as tensions, which an addicted child felt when their phone was locked. This tension was seen in Family B, where the oldest daughter was eagerly waiting and frequently checking, when her phone was unlocked, so that she could use the phone again. These tensions were not identified in the previous study [1], which suggests that the usage of our system amplified or caused these tensions. Furthermore, it also indicates that tensions caused by technology use is a complex matter, as children in some cases wanted to lock the phones, and in other cases were frustrated while their phones were locked.

In connection to absorption, the previous study found tensions in all three types of relationships. First, in the *Parent-Parent* relationship the previous study suggests that tensions occur, when one parent feels excluded or is missing attention from another parent [1]. In our study, these tensions were significantly lowered when using our system, especially in family A as the mother from family A was locking the phones, when she wanted some attention from her husband, who was absorbed in the interaction with the phone. She also explained that locking the phones led to the desired interaction with her husband, hence reducing the tensions.

Second, the previous study identified tensions in the *Parent-Child* relationship, where children were missing attention of their parents [1]. It could be argued that these tensions were diminished during our study. A good example is from family A, where the child wanted to get attention from the parents and succeeded by locking their phones through our system. Another tension recognised in the previous study was connected to parents, who were concerned because their children were too passive when absorbed in the technology [1]. Our participants were not talking about this type of tension during our study. The parents never used our system to get their children out of the absorption. Therefore, this issue needs to be studied in further research.

Third, *Inner Tensions* connected to absorption were also found in the previous study [1], where parents felt that they were not able to stop interacting with their phones but kept e.g. reading posts or playing games even when they really wanted to do something else instead. This type of tension was not altered in any way during our study, as our participants didn't use our system to help them stop their own absorption.

Provocation Leading to Tensions in the Future

The reactions of our participants to our system were mostly positive. However, there were some situations, which could potentially create tensions in the families.

The families were usually planning together when to lock the phones and all the family members had to agree to that before the phones were locked. On the other hand, when the phones were locked by a family member without asking for approval, the other family members felt disrespected, which created tensions between the family members. This issue of disrespect creating tensions in families was also identified in a previous study [1]. It also created inner tensions for the disrespected family members, because they tried to not react negatively towards the person who locked their phone. This could potentially lead to new tensions, which would be easier to identify in a longitudinal study. The inner tension could build up and maybe lead to a spill-over onto other relationships [1], [18], where the person feeling inner tensions reacts negatively towards other family members. The person then spills over tensions from themselves onto another family member, creating new tensions.

Strategies to Reduce Tensions

Our study together with previous research suggests that many people are feeling tension in connection to technology use in different ways and degrees [1], [2], [4], [6]. In order to change this situation, we suggest certain strategies based on our study can be implemented. One example could be short, planned breaks away from the technology, as it was proven to have positive effects in the families in our study. Another possible strategy could be to reverse the situation by planning when to use the technology instead. It must be noted that this strategy needs to be further investigated in longitudinal studies with more families.

Furthermore, in our study it was shown that the participants were not able to make the change on their own. We found that our system helped them to alter the negative behaviour, as the participants didn't have to make the change on their own but as a group (family) instead. Furthermore, the system provided the important push for the participants, which resulted in changed behaviour during the study. Therefore, these aspects of our system could be used as inspiration for designers to reduce tensions caused by technology use in the future.

Participants React to Provocation

In this last section, we will discuss the findings in relation to the three dimensions of provocation: *Conceptual, Functional* and *Aesthetic.* First, as stated above, the families didn't get provoked by our Conceptual provocations in the way we assumed. However, although the data does not confirm our assumption, it does not mean that our provocation failed. As stated by Raptis et al., when using provocative design, the purpose is to understand: *"what is real and not what is true"* [9, p. 10]. This means that through provocative design, we want to gain insight into different realities experienced by the participants in connection to the specific research area [9]. In our study, we did indeed gain a more in depth understanding of *Absorption* and *Addiction*. Furthermore, we gained insight into how *Absorption* and *Addiction* were reduced during our study and how the system was appropriated.

In relation to the functional provocation, some participants did feel provoked, when they needed to find the tablets in order to lock the phones. They suggested that locking the phones through their own phones would have increased their use of the system. Even though this is an intuitive argument, it could potentially lead to participants getting absorbed and distracted by their phones, because they would need to interact with their phone to lock the other phones. Furthermore, as discussed before, our participants found it easier to change their behaviour, when the activity of locking the phones was perceived as a family activity. This aspect would not have been implemented, if the participants could lock the phones through their own phones. This supports the suggestion by Raptis et al. about claiming designer authorship when using provocative design, as the purpose of the provocation is not necessarily to cater for the users' needs [9].

Lastly, the participants did feel provocation by the aesthetics of the Tablet and the Phone app. They confirmed our intentions with the design of the two app's, where they perceived the tablet app as naïve and cartoonish, and the phone app as boring and not interesting. Furthermore, as presented in the findings, the participants expressed three reasons why they didn't unlock their phones. First, they didn't want to make the dog displayed on the tablet application sad. Second, they didn't want to make other family members sad or angry. Third, they wanted to be perceived as good participants, which is similar to the findings by Bardzell et al. [8]. This indicates that even though *Aesthetic Provocation* did indeed provoke the participants to not unlock their phones, other motivational factors also influenced this decision. In this case, the family members had influence on this decision. One could consider that if the system was implemented in a completely different context, e.g. in homes with a single person, the motivation for not to unlock the phones might not have been as strong.

Therefore, we suggest that designers, who use provocation, not only consider how their system can be provocative according to *Conceptual*, *Functional* and *Aesthetic Provocation*, but also that the provocation might have stronger effects, when participants interact with each other, as seen in our study.

Limitations

Duration of the field study

We do acknowledge that the duration of the field study was not ideal. Preferably, we would opt for a longer study where the novelty effect of our system would disappear, and the families would get more used to the application. It would give the participants a chance to develop clear routines of how they interact with the system and to appropriate the system to their personal needs.

Data only from parents

Another limitation to this study is the fact that we don't have data from children. We interviewed only parents from each family and didn't talk directly to the children. That was caused by the fact that most of the children were too young to express themselves. We do have some data about the children behaviour from the interviews with parents. However, we believe that approaching children directly would give us valuable insights from different point of view.

CONCLUSIONS

In this paper we present and discuss our field study, which aimed to challenge *absorption* and *addiction* towards technology use in families with small children. We challenged this by designing a system called "The Happy Dog" inspired by provocative design. The system provided the possibility for family members to lock all the phones in the household. The family members then had the choice between unlocking their phones or keeping the phones locked. After 30 minutes the phones were automatically unlocked again.

We had two basic assumptions about the family members' interaction with the system 1) We assumed that the participants would lock the phones whenever they felt ignored by an absorbed family member, 2) We assumed that those family members who were perceived as the most addicted to their smartphone, would unlock their phones.

Our first assumption was confirmed only in few cases where ignored family member used our system and the absorbed family member was successfully taken out of the absorption. However, most of the times the families appropriated our system to their specific needs by planning together when to lock the phones.

For the second assumption, our findings showed that none of family members unlocked their phones. Instead they accepted or even reacted positively towards their phones being locked. Furthermore, in one case the perceived addiction was lowered during our study.

As a final note, we argue that implementing short breaks from technology could potentially limit the tensions related to technology use. This is supported by our data, where participants reported that planned breaks away from technology had positive effects on their family life and the relationship between the parents as a couple.

Future Work

For future work, it is important to study this topic on a bigger scale with more families involved through longer periods of time. Furthermore, in order to explore and get more in-depth knowledge about the theme of accessibility of the technology as a cause of tensions, we suggest using provocation by e.g. restricting the time they can use the technology to only 30 minutes a day.

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