Haptic Lullaby

Research & design of a vibrating smart mattress that helps young children sleep

Graduation Project
MSc Design for Interaction

Marjolein Schoorl

February 2022

Title
Research & design of a vibrating smart mattress that helps young children sleep

Author
Marjolein Schoorl

MSc Design for Interaction
Faculty of Industrial Design Engineering
Delft University of Technology

Chair
Dr. Derek Lomas
Design Aesthetics
Human-Centred Design

Mentor
Dr. Gijs Huisman
Human Information Communication Design
Human-Centred Design

February 2022, Delft

TU Delft

Foreword

I remember the first COVID lockdown kicking in, interrupting the Interactive Technology Design (ITD) project I was working on with Yuan Gong, and how disappointed I was to not finish what we started. This graduation project has given me a second chance to discover the fields of haptic vibrations and sleep, and to combine it with a target group I like designing for and working with, children. The Haptic Lullaby was my final step in the journey to become a Master Design for Interaction graduate and there are several people without whom this project would not have been possible.

Firstly, I would like to express my gratitude to my supervisors Derek and Gijs.

To Derek, for giving me the opportunity to take off where we left the project during ITD, for all the guidance you gave me during my graduation, and for providing the resources to execute the project. Your enthusiasm in our meetings, and emails with interesting products and articles encouraged me to take the project further. I also want to thank your family for helping me with testing my early prototype.

And to Gijs, who I think is great in balancing the high energy of Derek with practical, down to earth tips and ways to implement the feedback you both gave me. Your feedback was always valuable and you helped me greatly to improve my writing, also during my internship for Laura, when you contributed in writing the work-in-progress paper for the World Haptics Conference.

Then there are many people who supported me throughout my Masters and who I would like to thank.

Laura A Dima, for showing me the world of interactive art and how design and art can flourish together. The prototype session during this project with you and Amy motivated me to start prototyping.

All my friends in Delft, who have lighted up my student years with their crazy, but amazing and beautiful personalities. A special thanks to Caro and Steef. Our online morning meetings positively forced me out of bed in this strange COVID period where working alone at home became the boring standard. And to all my other friends from around Lisse, who I have known long before going to Delft, for your lasting friendships that I can always trust and rely on. A last special thanks goes out to my family and boyfriend, who always support me and lovingly cheer me on from the sideline.

Table of contents

Executive summary

Young children often have problems sleeping. Some are afraid of the dark. Or wake up multiple times during the night. Another just does not want to go to bed or lays awake for a long time. Whatever the reason, a lack of sleep makes the children tired during the day. For parents, their child's wellbeing is important, so they want them to sleep well and be energised during the day. A lack of sleep or low quality sleep does not only have a negative influence on daytime functioning, but also on a child's cognitive development or behaviour. When a child wakes up often during the night, it influences the wellbeing of the parents, as they sleep worse too. Something a lot of parents do is walk with a stroller till their baby sleeps. Driving around in a car is done with older children. Both involve rhythmic motions and vibrations. Inspired by those phenomena, this graduation project explores if and how vibrations can help young children fall asleep, and a product is designed around that.

The final design concept is the Haptic Lullaby, a smart mattress that uses vibrations to help children between 1 and 5 years old fall asleep. The mattress consists of materials that ensure the vibrations are transported throughout the whole product, while also feeling soft and comfortable when lying down. Whichever position the child prefers to sleep in, they will feel the vibrations. Research indicated that a lullaby-like vibration works best when felt through the mattress. The combination of sound and vibrations together create a sleepy experience. One of the options to start the vibrations in the Haptic Lullaby is through an app on the parents' phone. This allows for remote control without entering the child's bedroom. Another option is to turn on the smart function of the mattress. With sound and movement sensors, the Haptic Lullaby measures if the child is awake or not, and it will turn on the vibration when lots of sound and/or movement is detected. When everything is quiet again, the vibrations are turned off.

The graduation project's goal was thus to design a vibrating sleep product for young children to help them fall asleep more easily. What was designed in the end was not only the product itself, but moreover a methodology on how to design and evaluate such a product. Which context factors are relevant? What kind of issues arise in a vibrating product for young children? These kinds of questions are addressed during the project. As there is very little research done on the sleepiness of different vibrations, an initial model of characteristics and factors that determine the sleepiness of a vibration is offered. Also new is the ranking of thirteen different vibrations and vibration patterns on their sleepiness. Further research is needed to validate this ranking with a bigger sample size. During the project, the assumption is formulated that what feels sleepy for an adult does not differ much from what children perceive as sleepy. Research results indicate that this assumption could be true. This implies that future design validation and research on sleepy vibrations can be done with adults instead of children, which is easier to conduct. Further research with a bigger sample size and a more controlled research setting should validate this assumption.

The thesis furthermore communicates a vision of what possibilities are for a haptic, vibrating sleep product. Its research activities contribute to the fields of haptics and child research, and have value for companies who want to design research based sleep products.

Glossary

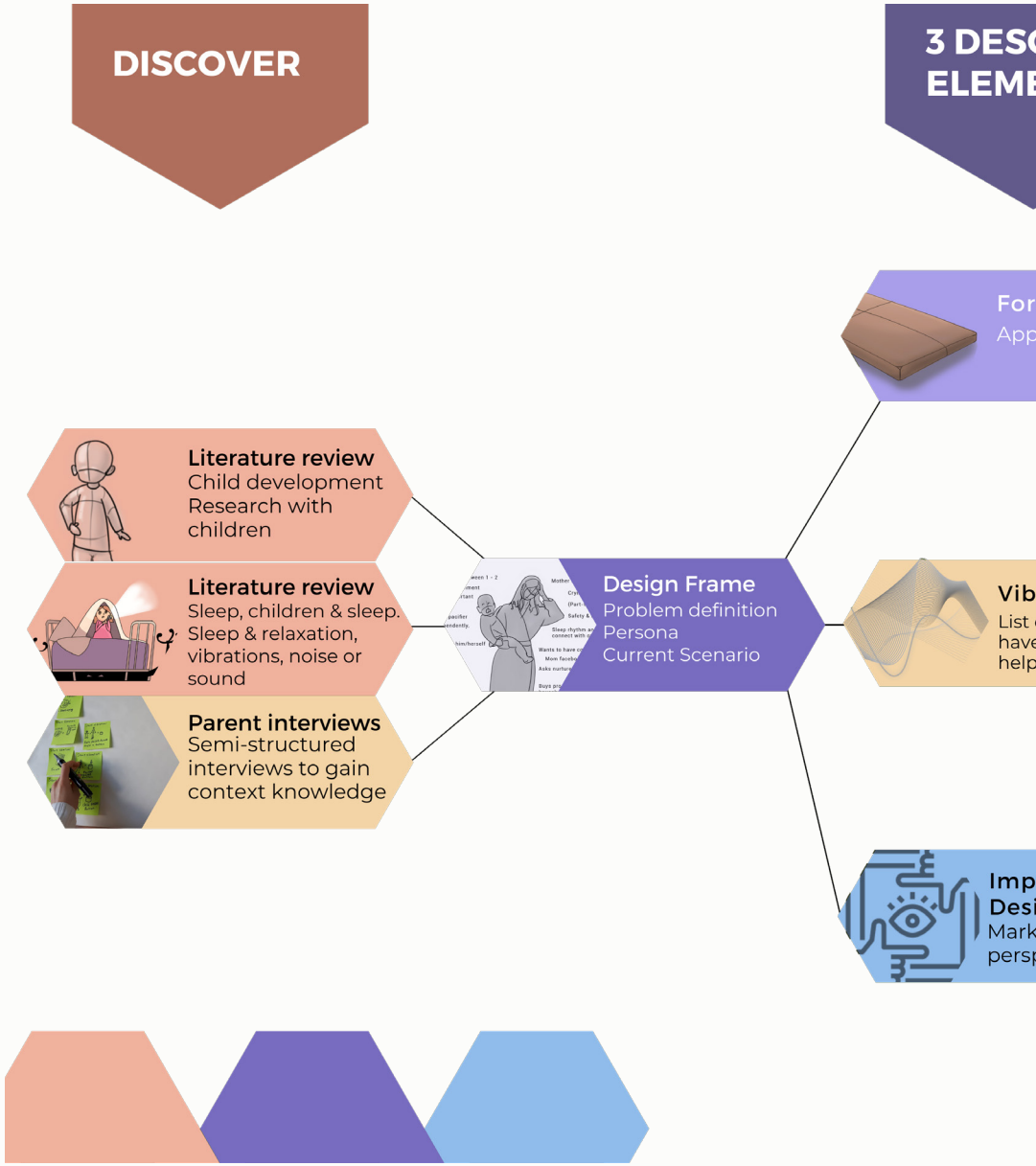
- Binaural beats - a type of relaxing music. To two frequencies that differ slightly in frequency, for example with 5 Hz, are combined. Your brain processes it in such a way that you hear the difference as a tone.
- Haptic Lullaby - name of the final product
- Haptics - Multidisciplinary field of science that studies and develops experiences of touch. The field includes haptic technology, art, product and interface design, but also psychology when looking at haptic perception or communication.
- Sleep better / improve sleep - when these formulations are used in the report, an improvement in either sleep quality, sleep quantity or reduced time needed to fall asleep is meant.
- Sleep hygiene - the rituals and practises that someone has related to day and night rhythm and sleep. Good sleep hygiene practises promote sleep, while bad ones obstruct sleep.
- Sleepy vibration - A vibration that helps to fall or stay asleep. Also used to describe vibrations that participants found suitable to fall asleep with or that felt sleepy for them during this project.
- White, pink and brown noise - three related types of audible sound or music that claim to improve sleep.

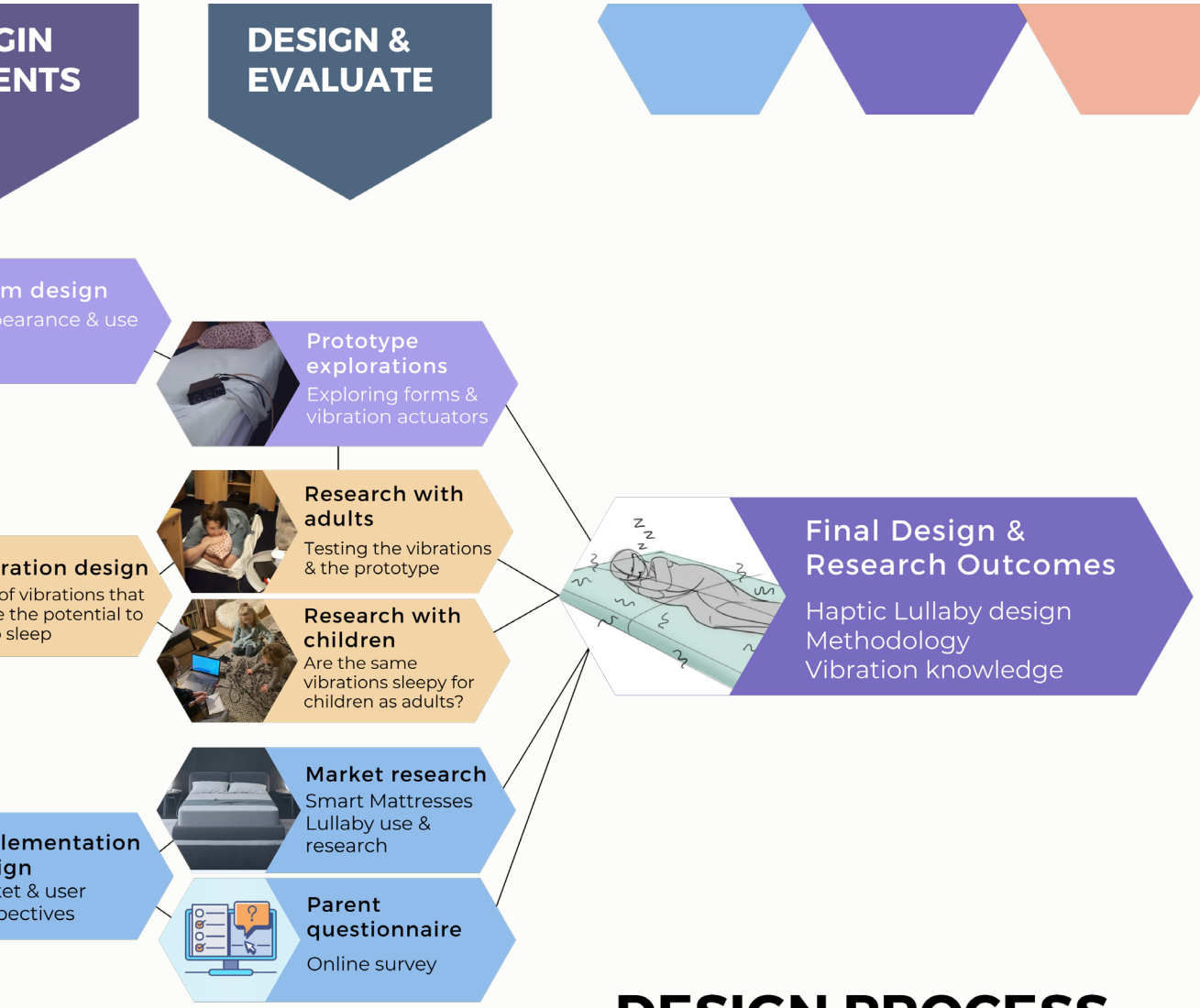
Design Process

The Haptic Lullaby was researched and designed in three main phases: discover, three design elements and evaluation & final design.

The project kicked off with the discover-phase, in which context research was conducted. This research consists of three parts: 1) literature review, 2) analysis of the current sleep product market, and 3) context research through interviews with parents. An in depth understanding of the context of children and sleep was gained. Other outcomes were a list of potential sleepy vibrations or vibration modes and a visualisation of the current scenario. Interview insights resulted in product requirements and wishes and in two personas.

After the first context research phase, the project segmented into three design activities. These were the vibration design, form design and implementation design. The vibrations are the essential design element of this graduation project, and the main focus of research. With the list of potential sleepy vibrations coming forth from the context research phase, a research setup was made to assess their sleepiness for adults. This research could not be executed without a working prototype. Therefore the form design activities had to advance. First explorations were done on different vibration actuators in combination with different types of materials to decide which material-actuator combination is most suitable for prototyping. Then a decision had to be made on the overall shape of the product prototype. For several reasons, a smart mattress was selected as a product concept. Alongside this choice, considerations were made regarding the future use scenario.





DESIGN PROCESS

The last phase of the project focused on evaluation & final design. Prototype explorations had led to a prototype usable in tests with adults. These tests were the input for research with children. During both tests, the sleepiness of several vibrations were rated. Through an online questionnaire opinions, needs and wishes from parents were gathered on the Haptic Lullaby product. Lastly, some additional market research was done on smart mattresses and lullabies. All these activities led to the final research outcomes and final Haptic Lullaby design.

01 Introduction & problem definition

Children below five often have problems sleeping. Some are afraid of the dark. Or wake up multiple times during the night. Another just does not want to go to bed or lays awake for a long time (Galland, 2010). Whatever the reason, a lack of sleep makes the children tired during the day. For parents and caretakers the child's wellbeing is important, so they want their children to sleep well and be energised during the day at school. A lack of sleep or low quality sleep can not only have a negative influence on daytime functioning, but also on a child's cognitive development or behaviour (Galland, 2010). When a child wakes up often during the night, it influences the wellbeing of the parents, as they sleep worse too (Galland, 2010). It does not matter how high end and expensive your own mattress is as a parent, if your child wakes you up during the night, you will still sleep badly too.

According to Galland et al., establishing a good sleep hygiene is a solution to sleep problems (Galland 2010). A good sleep hygiene is achieved by having regular bed and wake times, consuming healthy food and drinks, exercising enough and implementing consistent bedtime rituals. However, even when sleep hygiene is well, sleep problems can occur and it can be difficult to find out why the child is not sleeping well, or to overcome the unwillingness of the child to go to bed. Something a lot of parents do is walk with a stroller till their baby sleeps. Driving around in a car is done with older children. Studies have indicated that rocking vibrations during sleep can be beneficial (Perrault, 2019). Inspired by this phenomenon, this graduation project came to life, resulting in the Haptic Lullaby product design. The research and design activities were done with Dutch children between 1 - 5 years old as a target group. Why this age range is chosen will be explained in chapter 2.2

.

For ease of writing, the word parents will be used in the report. However, children taken care of by other caretakers than their parents, for example by one parent or non-parent caretaker(s) are not excluded. The children and their parents or caretakers are important stakeholders of the Haptic Lullaby. Children are the users, while parents are the main stakeholders. They are the ones buying the product and including it into the household rituals. Children between 1 - 5 years old are very young, so they need their parents in the process of getting ready for bed. Furthermore, it is the role of the parents to establish a healthy sleep-wake routine for the children, which also includes daytime sleep at this age. Other stakeholders are grandparents, often babysitting their grandchildren; siblings; babysitters; daycare employees, who have to put the child to bed during the day and deal with a tired child if he/she slept badly during the night; and for the oldest children of the target group teachers, classmates and school friends are also stakeholders, with whom the child has to socially interact during the day, even when he/she is tired.

A main opportunity is the will of parents to get the best for their children. If a product helps children, parents are likely to be interested. Moreover, new parents easily spend lots of money during the first few years of their child's life. For example, UK parents on average spend 10.000 pounds on baby preparation and first year expenses (Loveday, 2019). Another clear example is the amount of money going into baby showers, which usually cost between $100-$1000 dollars (Dunn, 2021), gender reveal parties, first birthday celebrations and other "first time" events of a child's life.

From this problem definition and scope, the following research questions came forth:

- Main question: Can a vibrating product help young children fall asleep more easily, and if yes, how?

- Sub question 1: What are relevant context factors of young children with sleep problems?

- Sub question 2: Which vibration(s) is/are or vibration pattern is most sleep inducing for young children?

- Sub question 3: What kind of product shape and interaction matches with those vibrations and the users?

These questions will be answered through research and design activities in two main phases: the discover phase, where literature research, product market analysis and a semi-structured interview with parents will be presented; and the design phase, where research and design activities are divided into three design elements. These elements are: the form design, implementation design and vibration design. Together they inform the final design of the Haptic Lullaby and they form the basis for several future research directions.

02 Discover phase

2.1 Introduction

Designing a product includes gaining an in-depth understanding of the user, current products and problem context. For this graduation project, the context of children and sleep thus had to be investigated. The context naturally involves the parents of the children, who bring them to bed every evening. But what do parents exactly do when they bring their child to bed? Or when their child can not sleep? What does science know about sleeping well? Is there scientific knowledge that indicates what kind of vibrations could promote sleep? And lastly, which products are currently on the market to help people sleep? The discover phase investigates these among other questions and can be divided into three parts:

1) Literature about children, sleep,
and vibrations relating to sleep;
2) Current sleep product market;
3) Context of children and sleeping.

Together these three parts form the design space of this graduation project. The gathered information informs product requirements and explains important factors from the design problem: bad sleeping children between one and five years old. Design decisions at later stages of the project are made with the context research in mind. The first design element coming forth from the three researches is a list of potential sleepy vibrations and vibration patterns. Secondly, three context themes were found and described.

2.2 Literature review

Introduction

The literature review can be structured into a few themes and topics. These are: sleep and sleep of children; factors that influence sleep; and research methods with children. All the gathered information together deepens the knowledge on the problem definition described in chapter 1. It also helps to understand the problem complexity.

Importance of sleep

Sleep is an essential activity for humans. At night our brains process events of the day and prepare us for the next. Inadequate quality or quantity of sleep can have a negative impact on daytime functioning (Galland, 2010). Sleep is not only important for adults with busy work schedules, but from an early age onwards. Sleep problems in early life have for example been linked with later behavioural and emotional problems (Galland, 2010). In children sleep problems can also lead to overweight or obesity and negatively influence maternal well-being and family functioning (Galland, 2010).

Sleep of adults follows cycles that consist of four stages, shown in figure 1. Specific brain activity characterises each stage. An adult first goes through three non-rapid eye movement stages, before entering the rapid eye movement phase, in which we tend to dream the most (Suni, 2020). The third phase, called slow-wave sleep, delta sleep or deep sleep (Suni, 2020) is where the restorative function of sleep happens (Garcia-Molina, 2017). Two main processes together regulate sleep onset and waking time: process S and process C. The first process has to do with the time a person is awake, while the

second involves someone's daily rhythm and is parallel by changes in your core temperature (Waterhouse, 2012). The quality of sleep is mainly dependent on two factors: the continuity, also called sleep efficiency, and the depth of sleep, for which deep sleep is most important (Garcia-Molina, 2017).

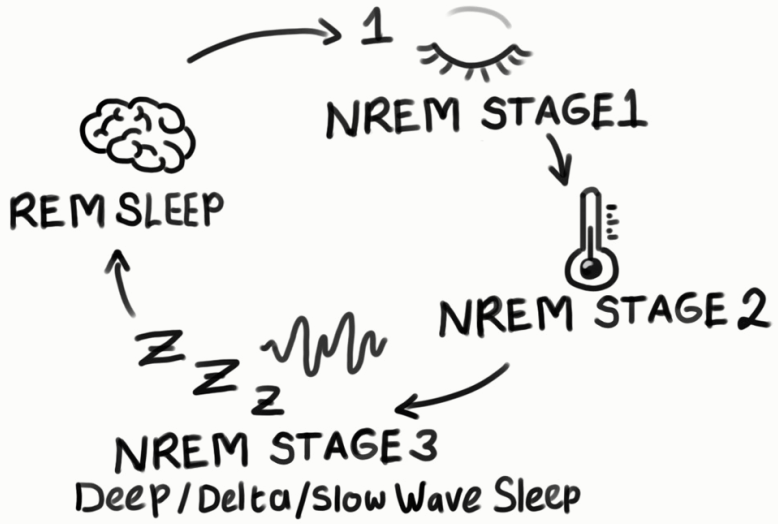


Figure 1: Sleep cycle

Sleep problems of children

The sleep of children differs from adults, not only in the time spent in each sleep cycle, but also in the total time slept per day (Thorpe, 2015). Especially babies and toddlers have multiple sleeps during the day. Newborns spent way more time in REM sleep (about 50%) than adults. This slowly changes until a child turns 5. Around that time he or she has similar sleep cycles as adults (Suni, 2020).

It can be quite a challenge to put young children to bed. Common sleep problems are bedtime resistance, delayed sleep onset and frequent night waking (Galland, 2010). Litsenburg et al. indicate that older children suffer more from sleep onset delay, insufficient sleep duration and daytime sleepiness, while younger children suffer from bedtime resistance, sleep anxiety, night awakenings parasomnia, and sleep-disordered breathing (Litsenburg, 2010). Sleep problems are furthermore quite frequent in toddlers. Twenty to thirty percent of them take more than an hour to fall asleep (Feldman, 206). One of the possible solutions to a bad sleeping child is to follow good sleep hygiene practises (Galland, 2010). Someone's sleep hygiene consists of their sleep practises or habits. Good sleep hygiene promotes a consistent day-night rhythm and avoids actions that obstruct sleep (Galland, 2010). Apart from poor sleep hygiene, causes for a bad sleeping child can be: daytime napping outside daily practice; too early bedtimes; caffeine-containing food or drinks; and physical discomfort or illness (Galland, 2010). Another study found a correlation between daytime activity and sleep quality. A lack of activity during the day leads to sleeping problems (Nixon, 2016). Some environmental factors are important for sleep quality as well, like light, temperature, sound, vibration, and oxygen density (Kimura, 2017). These factors are thus important to be aware of and keep consistent when conducting sleep research during this graduation project.

Since sleep practises of children differ from those of adults, and children are not able to keep them consistent without help of their caretakers, the Haptic Lullaby should be designed with the specific needs and sleep habits of children in mind.

Sleep and sound vibrations

In general, there has been little to no research on the possibility to help people fall asleep with feelable vibrations. There are however a multitude of hearable vibration types that claim to be able to help people sleep. Music is a well known example of this, and studies have proven its effects (Karvurmaci, 2019) (Lai, 2006).

Other types are still common, but a little less known. Examples are white, pink and brown noise. However, there is no conclusive research on those sounds. From white noise it is proven that it can help mask sounds (LaMotte, 2021). This can be especially helpful for nightly workers who have to sleep during the day. But the immediate effect of white noise on sleep quality is still debated. Nonetheless lots of people use it to fall asleep. So what is it? White noise got its name as reference to white light. From white light it is common knowledge that it contains all colours of light. White noise is built up in a similar manner, but with audible sound. It consists of frequencies humans can hear, so between 20 and 20 000 Hz, all in the same amplitude or intensity (Castro, 2013a). In pink noise the intensity changes a little: when the frequency increases, the power per hertz decreases. This makes the lower frequencies louder than the higher ones (Castro, 2013b). Brown noise contains even more of those low, bass frequencies (LaMotte, 2021). The effects of the three different colours of sound seem to differ, although research findings are again not conclusive. Pink noise for example seems to be able to improve memory and prolong sleep when played during sleep (LaMotte, 2021), and all of them could help fall asleep by being part of your own special sleep ritual. Other research highlighted negative impacts of the noises. The noises could lead to hearing damage when played at a too loud volume for a long time (LaMotte, 2021), or to more disruptive sleep, even though the time to fall asleep is shorter (Geddes, 2020). Lastly, sleep experts have concerns that not switching off your auditory system for the whole night will have a negative impact (Geddes, 2020). However, there are studies done on auditory stimulation during sleep and its effect on slow waves. As mentioned earlier, slow wave sleep happens during the third stage of a sleep cycle. Multiple studies found that auditory stimulation increases slow wave activity during sleep (Tononi, 2010) (Garcia-Molina, 2007), of which one also indicated an improvement in memory consolidation (Garcia-Molina, 2017).

A special kind of auditory stimulation is binaural beats. Binaural beats consist of two auditory stimulations with slightly different frequencies. The result is a tone similar to the frequency difference (Wahbeh, 2007). Binaural beats have the ability to enhance brain activity. Depending on the difference in frequency, a different kind of binaural beat can be created, targeted to enhance specific kinds of brainwaves (Rishika, 2021). Listening to binaural beats during sleep helps to sleep more soundly (Rishika, 2021).

Sleep and other vibrations

As mentioned before, very little research has been done on feelable vibrations and sleep. A few cases were found that show vibrations are a viable direction to improve sleep. For example, two studies tested Whole Body Vibrations (WBV) in a bed prototype. One of these beds was inspired by the phenomenon of feeling sleepy on a riding train. The vibrations of the train, which have a low frequency, make people fall asleep during the ride (Kimura, 2017). The mechanical bed was found to decrease sleep latency because of its vibrations, the sensible and insensible ones (Kimura, 2017). Another study with a vibrating bed showed an increased sense of comfort and

an improved sleep quality (Utami, 2018). It was furthermore found that low-frequency vibrations below 2.0 Hz, and smooth vibrations without jerking, helped best to induce sleep (Kimura, 2017). Lastly, one study showed that low intensity, low frequency vibrations are associated with low arousal, which could help with sleep. However, they were also associated with low valence (Mazzoni, 2015). Looking at the complete research field, most Whole Body Vibration research has been done on its effects related to exercise and therapy, and not on sleep. There is thus a research gap that the Haptic Lullaby can tap into.

A different type of vibration that has been studied is Beat Frequency Vibration (BFV). BFV is the resulting vibration pattern of two vibration frequencies that are combined, or superposed (Himes, 2021). A preliminary study suggests that BFV could be beneficial for sleep by decreasing sleep latency, reducing conscious awareness, and increasing sleep drive expression during the deeper sleep stages (Himes, 2021).

Other papers have looked at rocking vibrations and sleep. Perrault et al. applied gentle rocking vibrations during whole nights and during naps. The vibrations promoted deep sleep and memory consolidation in healthy sleepers during the night (Perrault, 2019), and shortened sleep latency, increased time spent in non-rapid eye movement (NREM) sleep, and enhanced sleep spindles when applied during a 45-minutes nap (Perrault, 2019). One of their findings is also proven in the study of Bayer, who found that the transition from waking to sleep was smoothened by slow rocking vibrations. The duration of N2 stage sleep was also increased (Bayer, 2011).

In summary, the described literature on auditory vibrations and sensible vibrations shows the potential of vibrations for sleep, that it is a feasible direction to do more research in. Because secondly, the literature shows there is a research gap for which specific vibration frequencies, amplitudes patterns or combinations of vibrations can contribute to sleep.

Sleep and relaxation

Several sleep products or sleep meditation methods on the market claim to help you sleep by making you relaxed. The question arises: are sleep and relaxation connected? If yes, this would be helpful for product validation, as it is easier to describe if something is relaxed than if it makes you sleepy. Looking at literature, there are indications that relaxation can contribute to improved sleep. Breathing exercises result in a relaxation response, which calms the mind and relaxes the body (Newsom, 2020). The relaxation response is the opposite of the stress response (NCCIH, 2021) The slow and deep breaths taken during relaxation exercises create a feeling of wellbeing and lower your heart rate and blood pressure. All these changes can help you fall asleep (Newsom, 2020). Breathing exercises are not the only techniques to help relax. Others are progressive relaxation, autogenic training, guided imagery or visualisation, biofeedback-assisted relaxation, and self-hypnosis (NCCIH, 2021). According to the U.S. National Center for Complementary and Integrative Health, these techniques themselves do not directly help you sleep. However they do improve your mental health (NCCIH, 2021), which is part of your sleep hygiene. Neuendorf et al. conducted a literature review on mind-body interventions and sleep, and found suggestions that relaxation techniques can be useful to improve sleep (Neuendorf, 2015). Another study showed improved sleep after progressive

relaxation techniques, but no improvement in daytime functioning (Means, 1999). So in conclusion, relaxation is not a one-on-one measurement for sleepiness or a guarantee for better sleep, but it contributes to good sleep hygiene and is the opposite of stress, something that definitely doesn't help you sleep.

An interesting study has been done on vibrations and relaxation. The application of a maternal heartbeat vibration in a product called Mimo seemed promising for relaxation in infants. The infants showed shorter recovery time from discomfort after diaper change and cried for a shorter period (Chen, 2015). Other comforting techniques are skin-to-skin care, playing audible music and aromatherapy (Chen, 2015).

Age group 1 till 5: the development of a child

Doing research with children comes with a particular set of challenges. More so when studying sleep and children, because their sleep patterns are different from adults. The targeted age range during this graduation project is from one till five years old. People that have sleep problems at a young age are likely to have emotional problems, like anxiety, or behavioural problems, like aggression, later in their lives (Litsenburg, 2010). An early intervention at a young age could therefore help a person their whole life. However, within this age group of 1 -5 there are still a lot of differences that need to be considered. These differences will be discussed in this section.

Children develop a lot from the time they turn one till the time they become five year olds. Somewhere between one and two years old, the preschooler turns from a baby into a real toddler. From age four or five, children in the Netherlands will go to school for the first time in their lives. The development of a child can be broken down into multiple aspects, or lenses. There is 1) physical development, what can a child purposefully do with their body?; 2) perceptual development, what can a child perceive from its environment?; 3) cognitive development, what kind of mental thinking can a child do?; 4) language development, how much can a child talk and how complicated is their grammar?, 5) self/personality development, is the child aware of the difference between you and I? And who am I?; and 6) social-emotional development, how does the child interact with others? And which feelings can the child have and understand? (Bee, 2004). In the epilogue of their book, The developing child, Bee and Boyd (2004) give an overview of child development across ages on these six developmental lenses. When they describe a child of twelve months, a child can typically crawl on their own, stand

without help, just or just not walk on their own, discriminate facial expressions, achieve simple problem solving with their actions, and is about to speak their first words. A pivotal change that has occurred is understanding object permanence. When a child understands object permanence they know an object cannot suddenly disappear from existence, even when it is out of sight (Piaget, 1954). Shortly after becoming one year old, the child will gain self-awareness and will start to play with peers. The child is on an emotional level easily scared of strangers, and their empathy is egocentric (Bee, 2004). Lots of things change when a child goes from just being a toddler to being a preschooler, almost ready to go to school. A five year old can climb the stairs one step at a time, hop and skip, play ball games, has grown from four-word sentences to using past tense, plurals, passive sentences and tag questions, and is able to use symbols (Bee, 2004). A child's self-definition consists of comparing his or herself with others based on age, size and gender and by the age of five or six the self-definition will be elaborated with physical properties or skills. Gender stability has been formed and the child is in the process of achieving gender consistency. The child becomes less attached to the parents and has empathy for someone else's feelings. Playing has transformed from simple pretend play into cooperative play, which can have multiple turn-taking steps, and sociodramatic play. Friendships have started to form. On cognitive level, perspective talking, an understanding that things can be false or true, that others have a mind and feelings as well and an understanding of the concept of conservation of number and quantity has been developed.

Still there is a huge gap between a five year old preschooler (or in Dutch: ''kleuter'' in the "kleuterklas"), and a six year old elementary schooler (in the Netherlands: groep drie van de basisschool). As Bee and Boyd say:

> *"There seems to be widespread recognition that a 6-year-old is somehow qualitatively different from a 5-year-old: more responsible, more able to understand complex ideas."*
>
> (Bee, 2004)

The targeted children for this graduation report are therefore maximum five years old, and not six. The chosen age group is already quite different on developmental level, but would be too big if age six or up was included. Lastly, age five marks the end of sleep cycles that are dissimilar from adults, thus adding to the reasons why five is the maximum age. Below the age of one year old, the child is a real baby, not able to talk or communicate much beyond crying or laughing. Studying or testing prototypes with babies is therefore much more complicated. Furthermore, including babies would enlarge the developmental range of children greatly. To keep a focused, defined design space, babies were therefore excluded from this project. It could very well be that the final vibrating product is also suitable for users beyond the studied age group, but that will not be within the scope of this graduation project.

User research with young children: methods and considerations

As prototype research with children was planned for this graduation project, literature was searched on how to best conduct research with children.

Firstly, differences between doing research with adults and children should be explained. Most apparent is the different use of vocabulary (Punch, 2002). Children from one year old cannot speak full sentences yet, and up till five year old children will still have a more limited vocabulary than grown-ups. But that is not the only thing that differs in language. The words children use to explain the same aspect can be different, they also use their vocabulary differently (Punch, 2002). Together these two aspects of language lead to a problem understanding each other correctly. Clarity of language is an obstacle working both ways (Punch, 2002). A second difference is that children have been through less experiences in their lives. This means they have less knowledge of or insight in how something will feel, work, look like, etc. Explaining their experiences is therefore more difficult. Lastly, children will typically have a shorter attention span than adults.

On top of those differences, there are several factors that complicate research on or with children for the adult researcher. One has to do with the fact that the researcher is not a child anymore. This means that he or she will never be able to completely immerse themselves in and understand the world of a child (Punch, 2002). Alongside this understanding problem, the children also know, maybe unconsciously, that they live in an adult-dominated world (Punch, 2002). Answers or reactions children give to adults during research will thus be fitting in an adult-child relationship and are usually inclined to ensure the adult will look positively on the child. Children are also not used to being taken seriously by adults (Punch, 2002). The child will do this instinctively, because they need adults to get what they want in life (Punch, 2002). Furthermore, a careful consideration should be made on the location of the research. Performing research at a school could give children the feeling that there are wrong answers, even if there are not (Fargas-Malet, 2010). However at home the parents would probably want to be present, which also influences the child's answers (Fargas-Malet, 2010).

For all research that involves children, researchers should be aware that their caretakers must give permission for their participation. It is however also important to look at the willingness of the child to participate, and at their level of comfort and distress. Verbal clues are clear indications, but attention should be paid on body language as well. Especially for children who don't talk yet, this is important. With these clues, a form of "assent" can be given by the child (Fargas-Malet, 2010).

Important for the researcher to overcome all these differences and to get "assent" from the children is to build up a relationship of trust (Punch, 2002) (Fargas-Malet, 2010). Starting with familiar and non-threatening topics helps to gain trust (Fargas-Malet, 2010).

The mentioned differences and difficulties lead to the question: how should researchers adapt their methodology doing studies with children? Several papers have proposed an answer to that question. Gielen summarises several papers that focus on co-design and context mapping with children (Gielen, 2015). Two of the insights

2.2

gathered are to provide clear language, add examples and to place the children in the real context you want them to comment on or design for. Other interesting findings have been summarised by Gielen in table 1.

Table 1: Co-design challenges with children. (Gielen, 2015)

case nr, domain	subject	author&year	title	main findings
1. cognitive skills	language and abstraction levels	Evelinde van Dorp, 2010	Contextmapping an abstract future with children	Researchers can't influence the levels of abstract thinking of children during Contextmapping sessions. With abstract topics, they should provide clear language and examples.
2. cognitive skills	abstract thinking versus direct experience	Evita Ooms, 2010	Nature experience of children with physical disabilities	If children lack sufficient abstract thinking skills, bringing a group of children in the concrete circumstances they are to reflect on is an alternative. Group discussion is stimulated through providing them with shared tools for documenting.
3. social-emotional skills	shyness	Kasia Tabeau & Anna Sosinowska, 2010	Involving shy children in Contextmapping research	Shy children can participate in Contexmapping if they can also do some individual assignments. In mixed groups, talkative children can help others overcome their shyness. Shy children want to be able to foresee when they will be asked to speak.
4. social-emotional skills	adopting an open attitude	Mathieu Gielen & Fenne van Doorn, 2011	(as yet unpublished)	Icebreakers help children to understand and adopt an open attitude towards creative exercises. Icebreakers that involve repeated instances of direct spoken exchange of ideas within a group are most effective.
5. motivation	competition and creativity	Asli Deniz Özakar, 2010	Harnessing children's creativity in Contextmapping activities	Especially boys (aged 10-11), who tend to look for competition, are more motivated and produce more creative outcomes when mild competition is included within the Contextmapping task.
6. global exploration of Context-mapping with children	children's fears	Kasia Tabeau, Anna Sosinowska and Enrico Wasch, 2007	Kinderen en hun belevingswereld (in Dutch only; meaning 'Children and their world of experience')	Compared to an online survey, a Contextmapping study enables children do express deeper and richer experiences on their fears. The most personal experiences are shared through talking-while-creating but not expressed in the artefacts they make.

According to Punch, researchers should combine research methods traditionally used with adults with techniques more adapted to children. In this way you prevent research methods that are only fun, not generating any useful data (Punch, 2002). So which methods are suitable for use with children? Examples from the papers of Punch and Fargas-Malet et al. are the following:

- Drawing technique. Very useful to get creative and engage the children actively. Also good as a warm-up activity (Punch, 2002). Compared to interviews gives the children more time to think and reflect (Fargas-Malet, 2010). Limitations: ability to draw and limited range of visual images. Tip: ask why did you draw this? instead of what is this? (Punch, 2002)
- Photographs. Fun, visual and relatively easy. Copying friends is harder (Punch, 2002). Suitable as prompts and shows own experiences, beliefs and emotions (Fargas-Malet, 2010). Limitations: seasonal events or highly situational photos are easily included. Desire to make photos the child wants to keep (Punch, 2002). Tip: let the participants look over the photos first, so they can remove "bad" ones (Fargas-Malet, 2010).
- PRA (participatory rural appraisal): spider diagrams and activity tables. In an initial research stage this is very useful to define important elements of the researched aspect. Limitation: follow-up research is needed to discuss the findings of the PRA (Punch, 2002).
- Participatory techniques. Charts and diagrams: enables self expression. Ranking stimulates discussions. Q-methodology is a ranking exercise with the option to analyse non-textual data (Fargas-Malet, 2010).
- Diaries. Provides insights into everyday life and rituals. Limitations: level of literacy of the child (Punch, 2002). Life story books can be used to let a child think of past experiences and therefore talk about themselves. Another common method are diaries with tasks about certain topics or activities (Fargas-Malet, 2010).
- Worksheets. Good for gathering detailed information, but very dependent on level of literacy (Fargas-Malet, 2010).
- Use of stimulus material or prompts. Options for this are written text, pictures, feelings, faces or cards. Pictures help to facilitate communication about difficult topics (Fargas-Malet, 2010).
- Observation. This method is best used with very young children, before they can take part in interviews or become aware of the researcher's presence (Fargas-Malet, 2010).
- Questionnaires. An option for children are self-completion questionnaires. Pros: relatively quick, potential to reach large sample size, standard data. Difficulties: level of literacy needed, scary to answer face-to-face with strangers, difficult to answer, give an answer even though the child doesn't know, dependent on biases (Fargas-Malet, 2010).

There is also the option to combine the methods explained above. The unequal power balance that an adult researcher has with a participating child can be reduced by combining visual and written methods. Combining methods can also allow multiple children to participate in a research at the same time. This however makes it more difficult to discuss everything that comes up during a session. Therefore observations should be added (Punch, 2002).

2.2

Image 2 gives an overview of important factors researchers have to take in mind when doing research with children. Research during this graduation project that involved children was set up with the information of this chapter in mind. The gathered information made it possible to choose a fitting method, namely observation, for the children of one year old that can not talk yet. Thoughts were put into the location of tests and the effect of having a parent present or not. For children between one and five years old strangers can easily be scary (Bee, 2004). Therefore the child will trust the researcher more and feel more comfortable if a parent or caretaker is present. Conducting research at their own home in either the living room or bedroom is preferable, so that the test is done in the real context, making it easier for children to imagine and place the product.

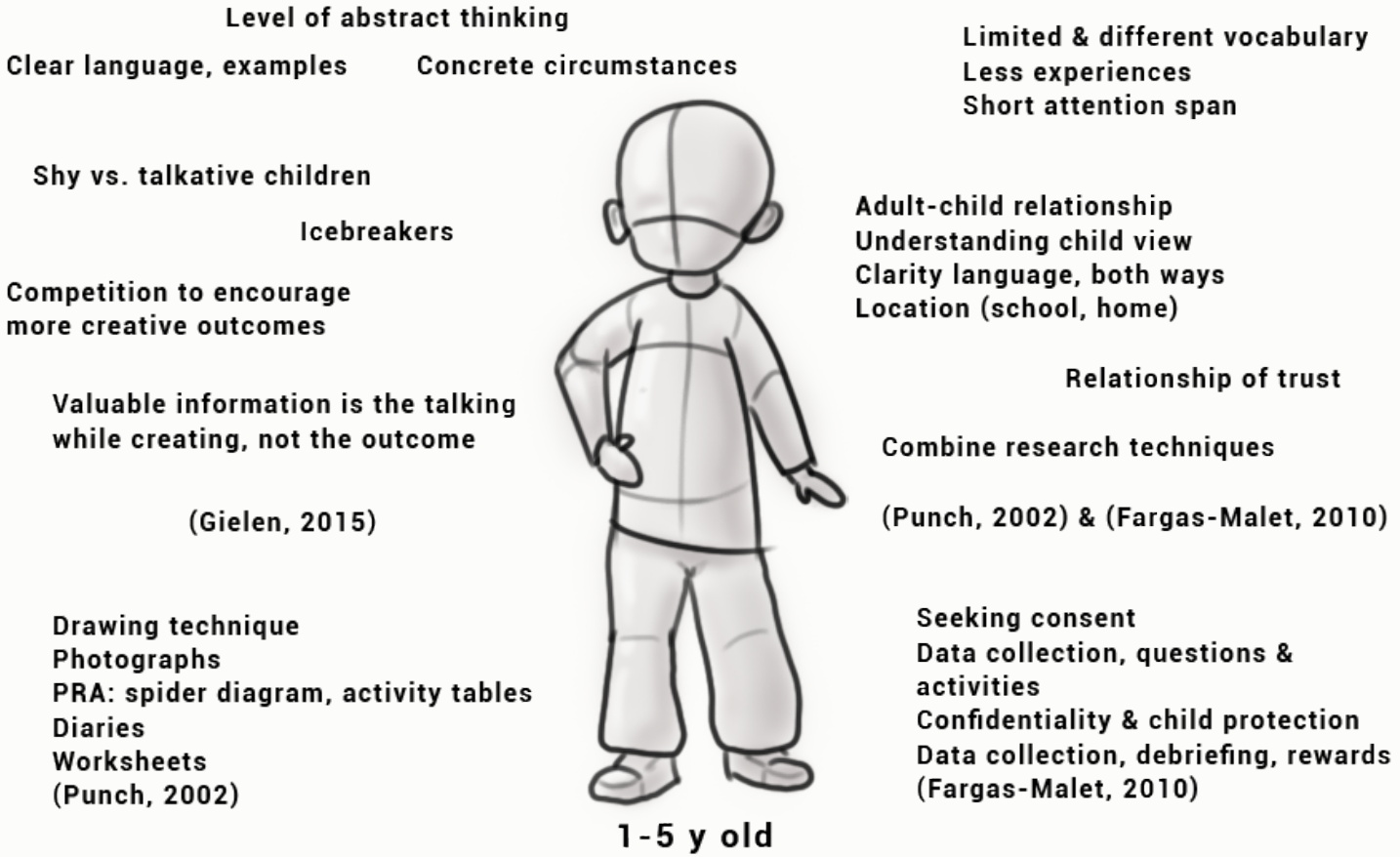


Figure 2: User research with children, important factors

2.3 Current product market

Introduction

Diving into the current sleep product market not only helps to see gaps in the market, but is also insightful when forming a view of the context of children and sleep. First, products were searched that target children specifically. Then smart sleep products and sleep products with interesting interactions were added. Products are called smart products when they include digital, connected, responsive and intelligent elements in their design (Raff, 2020). These products often measure at least one variable from the environment or user, and adapt their product function(s) or output accordingly. Products were found by searching for articles that for example list "the best sleep products of 2021" or by using search terms like "child sleep product", "smart sleep product", "interactive sleep product", "(smart) relaxation product" or "child bedroom product". However, of most products their scientific basis was unclear. Philips is a company that researches and tests their products thoroughly. So therefore an overview was created of all Philips health products that relate to sleep.

Environment

One product category of the market focuses on controlling physical factors of the bedroom environment, for example light intensity or temperature. Products like light blocking curtains, sleep masks, earplugs, blankets, sleeping bags and night lights belong to this category. Some products that fall into this category also use pressure as a sleep strategy. Especially for children who have a Sensory Processing Disorder (SPD), a tightly tucked blanket or a weighted blanket can make them calm and ready to sleep (Grandin, 1992). Weighted blankets are also used for adults with a SPD.

Figure 3: Sleepy environment products

2.3 Comfort & sleep position

Other products promote sleep by adding comfort or improving your sleep position. Examples are pillows and mattresses.

Figure 4: Pillows and mattresses

New to this area is the market of smart mattresses. These mattresses have extra functions that adapt to the user. An example is the Eight Sleep Pod Pro mattress, which has smart functions like temperature control on both sides of the bed, using sensors to track biometrics of the user and adapt accordingly, and GentleRise Smart Alarm, which wakes you up with gentle vibrations and temperature change (Eightsleep, 2022). The sensors in the bed also track your sleep and an app is provided that shows insights to the user. The 360° smart bed of Sleep Number includes responsive air technology to adjust the firmness of the mattress to user and sleep position (SleepNumber, 2022). It also comes with an app that shows your sleep cycles. The pressure adjustment, temperature control and sleep tracking functions are present in the ReST Smart bed too (ReST, 2021). Most of these mattresses use special materials or material structures to improve comfort, support or cooling alongside their other smart functions. An interesting example is the Purple mattress (Purple Innovation, 2022).

Figure 5: Eightsleep, ReST mattresses, Purple and Sleep Number

Day-night rhythm

A large group of smart sleep products focuses on scheduling the day-night rhythm to improve that aspect of the user's sleep hygiene. The products in this category that are targeted at children usually take shape as some kind of smart clock plus lamp combination. For adults there are lights as well, for example the Philips Wake-up Light, but other product forms like apps or diaries exist too. The apps and diaries aim to track your habits or even sleep cycles and change your behaviour in such a way that your sleep rhythm improves.

Figure 6: Day-night rhythm products

Breathing & relaxation

According to literature, breathing techniques can help to relax, easing the process of falling asleep (Oers, 2019). The Somnox is a great example of a smart product that uses breathing support to help you fall asleep. The scientific background of the Somnox lies in the Autonomic Nervous System (ANS) of our body and consists of three parts. The sympathetic nervous system regulates someone's "fight or flight" response, while the parasympathetic nervous system does the opposite and is active in rest (Oers, 2019). The enteric nervous system is the third part of your ANS, works independently of the other two systems and is responsible for digestion. Over-activation of your sympathetic system disturbs the balance of your ANS, leading to a higher heart rate, shallow breathing and thus to sleep problems (Oers, 2019). The Somnox tries to activate the parasympathetic system by slowing down the user's breathing pattern when they breathe along with the Somnox robot. During a first user research of the company, the Somnox helped 54% of the participants fall asleep quicker, and 84% indicated it helped them relax during the month of testing (Oers, 2019). The Somnox also uses music and the feeling of affection people get when holding the breathing, organic shape to decrease stress.

Moonbird is also a product related to relaxation. It is a handheld device that expands and retracts according to a breathing rhythm, just like the Somnox. The aim is to provide focused, calm breathing meditation in an intuitive way.

Figure 7: Somnox

Figure 8: Moonbird

2.3 Rocking babies

Another product category focuses on babies and sleep. When parents want their babies to sleep, they often walk around rocking their baby on their arm. Baby rockers and swings provide similar movement, using the rocking vibrations to make the babies fall asleep.

Figure 9: Baby rocker and swing

Sounds & music

Other parents go for a walk with a stroller, in which the vibration of the wheels over the pavement make the child sleepy. What could make this experience even more sleepy? According to the next product category sleepy music and noises. Multiple products use heartbeat, nature, rain or ocean sounds. Or lullaby music, white, pink or brown noise. All these different sound options aim to calm a child down, speeding up the transition from wake to sleep. Different form options exist on the market. From a device on a stroller, to a plush toy, night lamp, clock, or (speaker) box: it all exists. However, most of these products are plush toys if children are targeted. Examples can be seen in figure 10.

Figure 10: Sound & music products

Movement & vibrations

Furthermore, several products were found that include movement or vibration in a different way than rocking or sound. These are a massage device, a vibrating pad that can be placed under a mattress, and a vibrating bassinet called BassiNest, that also uses white noise alongside its vibrations. From the website of HALO, the producer of the BassiNest, it is unclear if the effects of the vibrations have been researched or not (Halo, 2022). Another interesting product that clearly conducts research on its vibration effects, is the Apollo Neuro. Their research focus lies on reducing stress and Heart Rate Variability (HRV). If someone has a high HRV, the speed of their heartbeat adapts quickly. For example, during exercise or stress your heart should start to beat faster. But when reading a book, your heartbeat should calm down again. HRV is related to the parasympathetic and sympathetic systems that the Somnox also referred to. Therefore it is often used as a biometric to measure someone's stress level. The Apollo Neuro uses HRV as input for its smart vibration functions, and researches how their vibrations can increase HRV (Apollo Neuroscience Inc., 2022).

Figure 11: Left to right: massage product, vibrating pad, the BassiNest and the Apollo Neuro.

Communicative products

Most of the products above have some output that the children feel, hear or see. A last category of products has output for parents when their child sleeps. Firstly there are baby monitors, which almost all parents have. Lots of different options exist here. Some with sound, others with video and sound, some you can talk back to your child, others not. Music, tunes and lullabies are also common. New high-tech versions even include night vision temperature or humidity data of the room, motion sensors, and breathing, temperature and heartbeat of the child (Toompas, 2020).

Figure 12: Baby monitors from Philips

2.3

A special kind of baby monitor is the Owlet Dream Sock, which does not only have the goal to tell you if your child sleeps or not, but to track all kinds of vitals. Parents get an overview and analysis of their child's data in an app. The app also includes a digital sleep coach (Owlet, 2022).

Figure 13: Owlet baby monitor sock

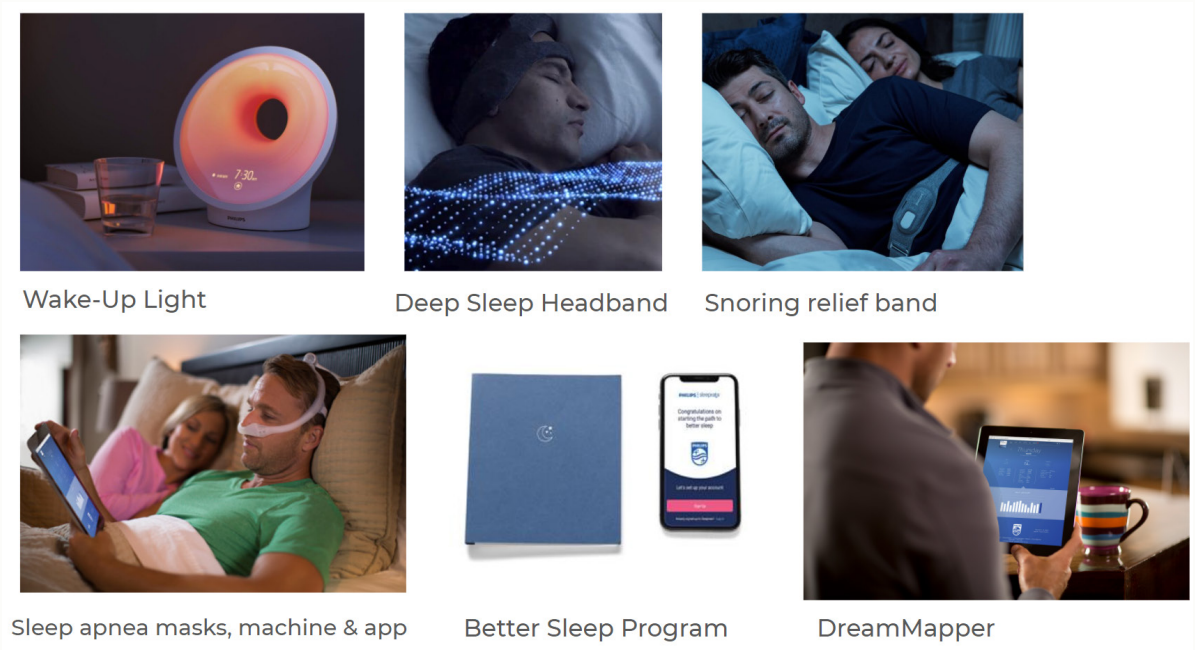


Figure 14: Sleep products by Philips

Philips sleep products

A well known company that specialises in smart products and technology is Philips. One of their departments focuses completely on health and sleep is a big part of their health product portfolio. Figure 14 shows all their sleep health products. The Wake-up light has been mentioned before, and their Better Sleep Program and DreamMapper are examples of sleep diaries and sleep tracking products. Two other products of Philips, the Snoring relief band and Deep Sleep Headband use vibrations in their design, however very differently. The Snoring relief band vibrates before snoring starts to guide the user to a side sleeping position in which they will not snore. The Deep Sleep Headband uses sound waves that are non audible for humans to enhance brain waves during deep sleep. The enhanced waves increase sleep quality. The Deep Sleep Headband is not on the market yet, but is to be released soon. Lastly, Philips has a product that improves breathing for people with sleep apnea. The product includes a mask plus a machine and can be combined with the DreamMapper app.

Product market analysis

There are many different ways in which these products try to improve sleep. Therefore the sleep strategies from the current product market were derived and summarised. The following strategies were found:

- Control day/night rhythm
- Vibrations
- Pink/white/brown noise
- Pressure
- Sleep position / comfort
- Daily routine / tracking habits
- Air & breathing
- Temperature

Table 2 shows per product category which of these strategies are most often used, with an example product alongside it.

However not all found products are based on scientific research or knowledge. The next step was thus to make an overview in which the found literature was matched with the products. Which products make sense looking at literature? And which links between products and theories or literature can be made? The outcome can be seen in figure 15.

Table 2: product strategies per category

Product category	Sleep strategy or strategies in the category	Example
Environment	Control day/ night rhythm; temperature; pressure	 Night light
Comfort and sleep position	Sleep position/ comfort; temperature;	 Pillows
Smart mattresses	Sleep position/ comfort; temperature; pressure; control day/night rhythm; daily routine/ tracking habits	 SleepNumber i8
Day/night rhythm	Control day/night rhythm; daily routine /tracking habits	 Philips Dream Mapper
Breathing and relaxation	Air & breathing	 Somnox
Rocking babies	Vibrations	 Baby swing
Sound and music	Vibrations; pink/white/brown noise;	 Plush toys with sounds
Vibrations and movement	Vibrations	 Apollo Neuro
Communicative products	Newer high tech versions: temperature; air and breathing; tracking habits	 Owlet Dream Sock

2.3

The result is a visual that shows different aspects of the large sleep research field and product market, and the connection between several of those aspects. For example, lots of literature emphasises the importance of a good day-night schedule and multiple sleep products match with this. From the idea that your sleeping environment has to be good, several directions spread. There is the option to control environmental factors or to increase comfort, but also to provide a feeling of presence with breathing or heartbeat or to soothe someone to sleep with sounds.

The overview helps to understand the complexity of the context and to break it down into these elements, relationships and into themes. Together with information discovered during the parent interviews, three themes would be found. These themes will be explained as part of the interview conclusions in chapter 2.4.

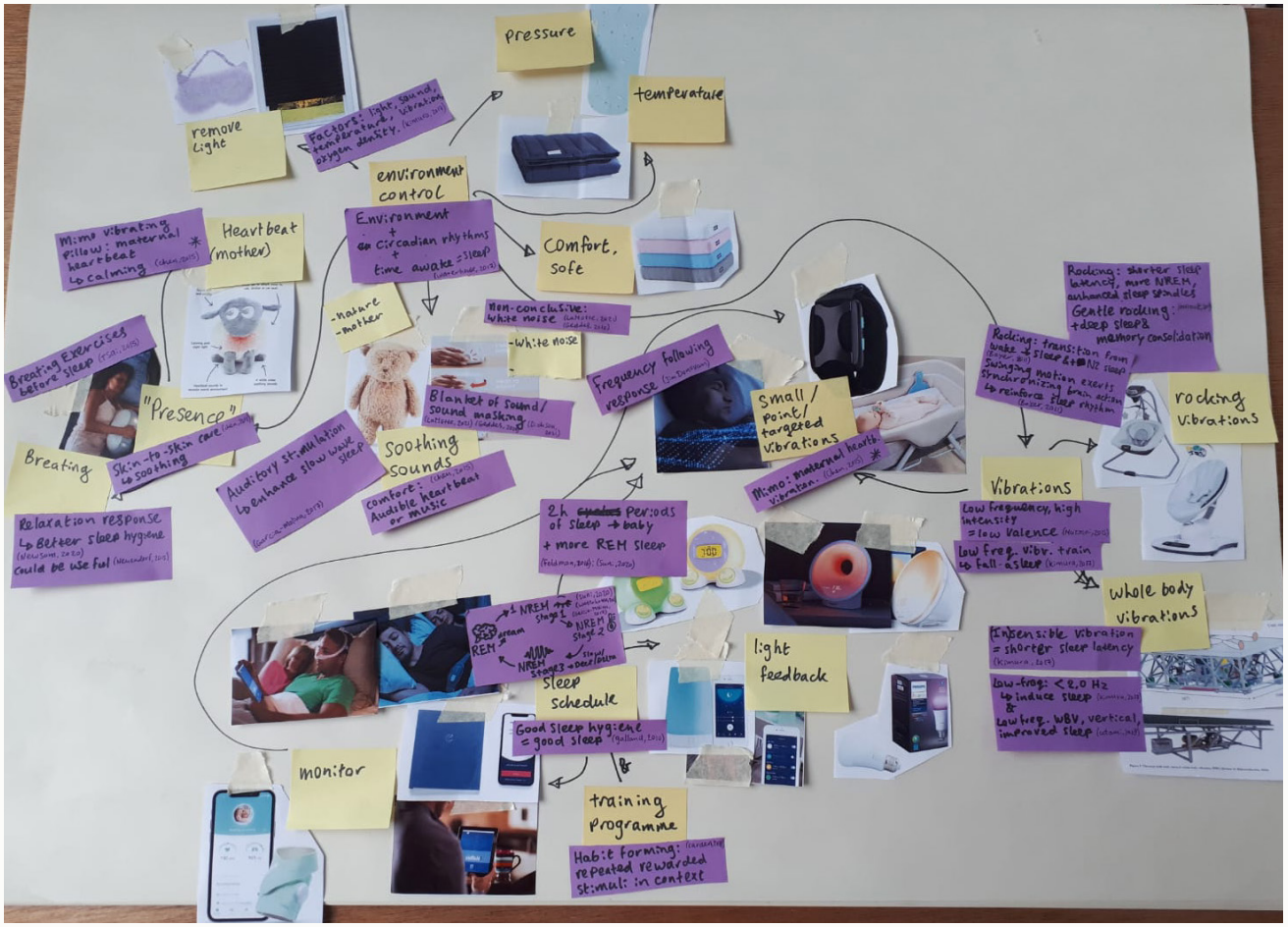


Figure 15: Market + literature overview

2.4 Context research: Parent interviews

Introduction & research questions

The product plus literature overview and the three themes already give a valuable view into the context of children and sleep. However, to be able to understand problems within the context real personal experiences should be added. Since I am not a parent myself, the best way to gain an understanding is to hear the experiences of parents themselves. Interviews were planned with the goal to explore and gain knowledge of the context of children's sleep (problems) and the process of putting children to bed. Aspects like habits, problems, needs and wishes of the parents were of interest. Parents are also the most important stakeholders besides the children for the Haptic Lullaby and therefore important to take along in the design process.

The research questions guiding the interviews were the following:

1. What are relevant context factors considering children and sleep(problems)?
2. Which sleep problems do parents/caretakers face when putting a child to bed?
3. What are common sleep rituals that parents have when putting their children to sleep?

Method

The context research consisted of semi-structured interviews of about 20 minutes. Both online and in person interviews were possible, either decided by the participants or dependent on the distance from the home of the researcher. Within these interviews the parents were asked to perform a short timeline (drawing/writing) exercise to document and talk about the process of putting a child to bed. The questions to lead the semi-structured interview can be found in appendix 1. They are in Dutch because the participating parents were Dutch. The questions were centred around the following themes: child sleep rituals, child sleep problems, child bedroom context.

Participants

A total of eleven interviews were held with Dutch parents of children mostly aged 1 - 5. Some participants had slightly older or younger children. The parents were recruited through a call for help on Facebook. Their children preferably had sleep problems, though this was not a strict condition for participation, as the goal was to understand the whole context of children and sleep. Three families had a slightly difficult sleeping child or children and two had (a) very difficult sleeper(s). Nine of the participants were mothers. In the other two interviews both the father and mother participated. The children themselves did not take part. The participating families had either one, two or three children, of which most two children (six out of eleven), and the least one child (two out of eleven). If a parent had multiple children with one or more older than 5, they were asked to focus on the child(ren) within the targeted age group. The study information can be found in appendix 2, and the consent form template in appendix 3.

2.4

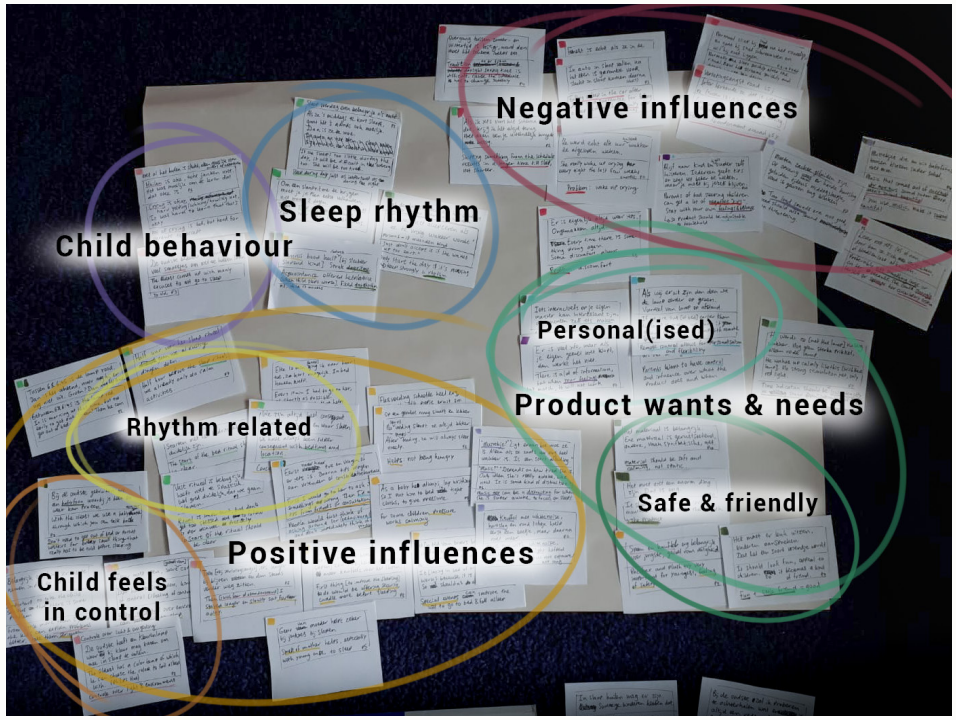


Figure 16: First clustering of the statement cards

Hypotheses

Before the interviews hypotheses were formed alongside the research questions:

H1. Parents of children with sleep problems will have tried out different methods and/or products to improve the situation.
H2. Parents have certain habits/rituals they perform with their child(ren) when putting them to bed.
H3. There are different problems regarding sleep at different ages of a child.

Results

To analyse the interview data, statement cards were made according to generative design research methodology described by Sanders and Stappers in their Convivial Toolbox (Sanders, 2012). During this process, a translation was made from Dutch to English. The statement cards were then placed into clusters. The first clustering, see figure 16, created a nice overview of the gathered data, but the clusters themselves seemed obvious and not very insightful. It mainly shows some negative influences on child sleep, some positive influences, and product needs and wishes of parents. Therefore an iteration was made. The second clustering, see figure 17, resulted in better clusters with more in depth insights.

For example, the cluster named “expected sleep” gives a new view on the aspect of sleep rhythm. It informs that not only clear, fixed rituals in a scheduled rhythm improve sleep hygiene, but that for children it is also important to know when this ritual will start. Parent participant 2 said: “It is important that the start of the bedtime ritual is clear too. For example, I tell my oldest child: in five minutes the clock hand is at the top and then you will go to bed. Or before he was learning to tell time, we would set a kitchen timer.” Parents indicated that knowing when bedtime will start makes their children less reluctant to go to bed.

Another interesting cluster is that of “special/new sleep”. That structured rituals and rhythm is important was very clear. However sometimes, a change in the bedtime rituals was what helped a child sleep. Products that seem to work during the first use or first week of use, but slowly lose their effect over time belong to this cluster. But also events that make sleep for the child special. A good example

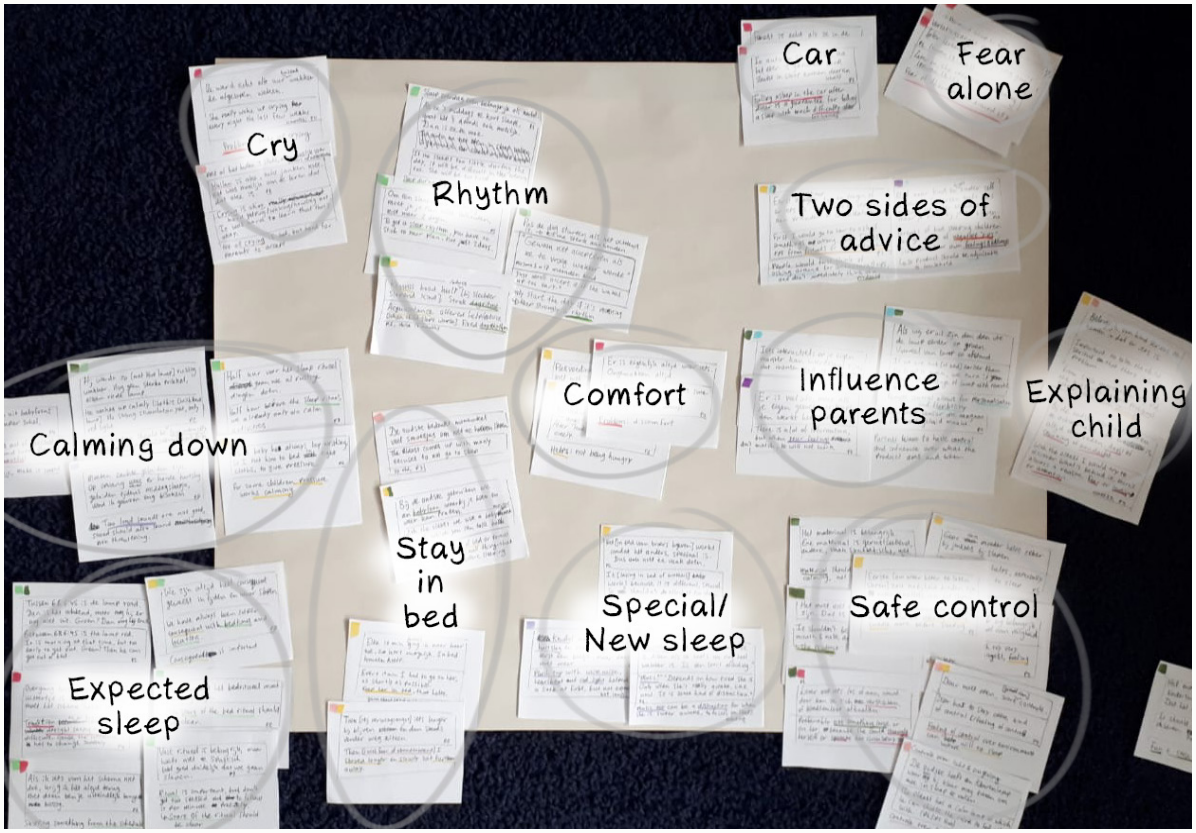


Figure 17: Second clustering of the statement cards

was given by parent participant 5, whose youngest child occasionally did not want to go to bed. This mother told me: "Sometimes I would let her choose in which bed she wanted to fall asleep. In which bed do you want to stay over? One of your brothers' beds? It will be our little secret." The mother explained that this worked well, because it was different and special, a little party. Therefore she did not allow it very often, it should stay special. In conclusion, sometimes new stimuli or events can help children fall asleep, as long as it is not too disruptive. The bed choice worked because the child could choose herself.

The statement cards that form the cluster "stay in bed" all indicate that calming down a child that wakes up during the night can best be done without getting the child out of bed. In this way, it is still clear that it is bedtime, not wake time.

"Safe control" has two different explanations. One explanation is from the perspective of parents, who want to have control over the output or functions of sleep products to make sure they are safe for their children. The second is from childs' perspective. Children do not control when their bedtime starts, or which rituals going to bed consists of, their parents mainly do. However, some feeling of control over this process can help them to feel safe. Therefore many bedtime rituals include small elements that the children suggested to their parents. Things like "He wants to choose the colour of the light with which he goes to bed" or the fact that the child can choose a bedtime story show this.

The "explaining child" cluster means that from age two à two and a half, when the child starts to speak full sentences, they also gain the ability to explain why they can not sleep, what is wrong or keeping them busy. "Two sides of advice" has to do with the contradiction that parents like to hear how others deal with sleep problems of children, but that they also get negative, unwanted advice by parents who judge them for having a bad sleeping child.

2.4

The titles of the other clusters can be taken literally for what the cluster contains. The complete interview notes can be found in appendix 4, the timelines in appendix 5, and the individual statement cards can be found in appendix 5.

The insights from the statement cards and clusters are listed below. General insights that contain information probably obvious for parents, but new for me as a non-parent were added as well.

Insights about children and sleep:
- Structured rhythm and rituals are of high importance.
- Fear of abandonment around age 1,5 is one of the most problematic phases.
- Parents don't think very quickly about buying a product to improve sleep, but first change behaviour and rituals, or ask around for tips.
- Toddlers also need (at least one) sleep during the day, not only babies.
- There is a difference in the daily structure between mothers who give breastfeeding vs. giving a bottle; with breastfeeding parents feed on demand and with bottles you feed at regular times.
- From age 2 à 2,5 children gain the ability to explain what's wrong.
- For most children the following applies: after a busy day with irregularities, falling asleep is harder.
- Other parents can be very judgemental when you have an extremely bad sleeping child.
- Not only the ritual or rhythm itself, but also a clear start and end of the bedtime ritual is important.
- Bedtime rituals are decided by the parents, but the child also wants some control. "She really wanted the door open." or "He likes to choose the colour of the lamp to fall asleep with."
- There is something about new, special events that can actually help a child fall asleep, even though they break the normal rhythm. New products that only work for a short period of days also fall into this phenomenon.

Product related insights:
- Parents want to have influence on/ control over the product.
- Products will only be used if they fit with household rituals. So there is a need for personalisation.
- Not only physical safety is important for parents, but also the ability to give a safe and soft feeling to their child.
- Before a certain age no plush toys or other stuff is allowed in bed, because of the risk of suffocation.

From the interviews, especially from the timeline exercises, a generalised current scenario could be made. This scenario summarises actions parents go through when putting their child to bed, or when their child wakes up during the night, as well as their emotions. The scenario, see figure 18, is from a parent's perspective, who has a bad sleeping child and follows one evening from the moment the ritual of getting the child ready for bed is started till the child falls asleep. The top row shortly describes the actions of the parent(s). The middle row is focused on sleep product touch points and the bottom row is a graph about the emotions of the parent(s). The y-direction shows how positive (above the line) or negative (under the line) emotions are, and the x-direction is the time. The graph splits into two lines at the point where the parent has to return to the bedroom of the child because the child cries. Parents indicated that the process of calming the child, leaving the room and having to return when the child is afraid of being alone often has to be repeated multiple times. The emotion graph shows that during these iterations, the emotions of the parents become more negative, as they get desperate to get their child to sleep. The relief is therefore also greater when the child finally does. It is this cycle where most opportunities for product interventions lie. If the amount of cycles can be reduced, the parents' emotions get less negative. Another option is to prevent the cycles from happening altogether, by intervening before the child starts to cry or by comforting the child without the need for parents to enter the bedroom. These two options not only prevent the negative crying cycles, but also the negative end result an exhausted parent whose whole evening is gone.

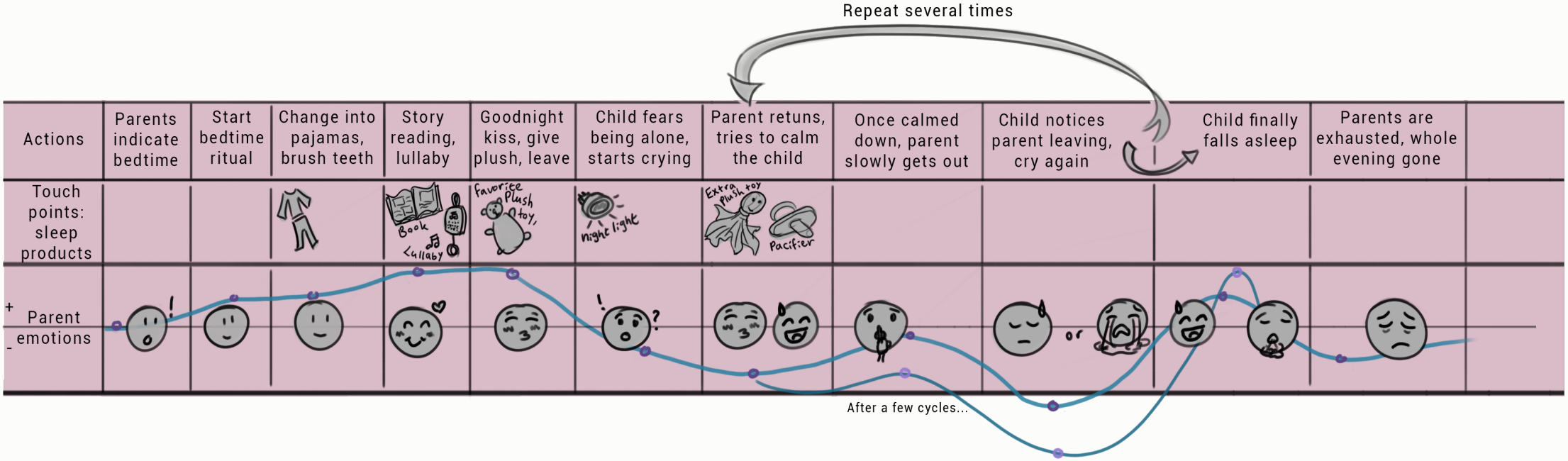


Figure 18: Current scenario

2.4 Conclusions

From the results, several conclusions could be drawn. First of all, product requirements could be formulated, see table 3.

Table 3: Product requirements

The product should...
...help the children fall asleep more easily ...have a calming or relaxing effect on the children ...be strong, so children cannot break it ...be safe during sleep, so children should, for example, not be able to strangle themselves or cut down bloodstreams ...feel friendly and safe for the child ...have a soft touch, so children cannot hurt themselves and the product feels relaxed/sleepy ...be non-intrusive to the sleeping children. When they sleep, the product shouldn't wake them up. ...fit within the household and their rituals/habits ...be made of breathable material ...feel comfortable to lay on or hold ...be safe to use without chance of overheating electronics ...include vibrations that you feel more than hear, or that sound nice and sleepy

Secondly, three context themes were discovered when the knowledge from the interviews was combined with the product-literature overview of chapter 2.3. The themes consist of aspects that recurred across and within the interviews, and that have a relationship with the current product market and literature too. The three themes are the following:

1. Environment control
There are several products that have the strategy to control the environment in order to improve sleep. Examples are light blocking curtains and sleep masks. Literature shows that specific environmental factors can improve or disrupt sleep. From the parents' perspective, this theme has to do with parents adjusting and personalising the environment in such a way that it is most suitable for their child.

2. Structure/Rhythm of sleep and sleep rituals
The second theme highlights the importance of a healthy bedtime ritual that generally follows a set structure or rhythm. Literature about good sleep hygiene contributes to this theme. A lot of parents said something about how strictly they follow their structure and what their rituals are. Looking at the product market, the indication of sleep or wake time is especially present in products of Philips, but also in some other products. Examples are the Philips Wake-up Light, or a clock that has an awake or sleeping face.

3. Presence (of a person)
The third theme, presence, needs some more explanation. It is based on the fear of abandonment phase parents indicated for children around 1,5 years old, but holds true for other age groups as well. It means that children feel safer and therefore sleep better when they have the feeling that they are not alone. Especially having their mother around can be important. A heartbeat vibration in the Mimo pillow, different sounds in a plush otter or the voice of a parent through a baby monitor; these kinds of products give a feeling of presence to a child. Add to these products the literature that shows benefits of (maternal) heartbeats and skin-to-skin care, and the third theme comes together.

Whatever sleep product design would come out of this graduation, it had to deal with these three themes. The themes show an overarching layer of the project complexity, while specific insights like parent quotes and the current scenario present an in depth, small scale layer. The three themes will inform future design decisions and together with the other insights from the literature review, current market analysis, and parent interviews they form the design space of the Haptic Lullaby project.

Figure 19: Three context themes

2.5 Personas

The method of personas is often used in design processes to empathise with the user, reduce complexity and guide design ideation or design decisions (Dam, 2021b). Therefore the information from the parent interviews was incorporated in two personas. The personas also inform the project by making clear who will be designed for. It gives the designer an overview of important behaviour, needs and wishes. Personas thus help to make design decisions that benefit the future user.

The first persona is a mother of one young, bad sleeping child (1 - 2 years old). She is new to parenting, so often asks for help from friends and family. She has also joined a mom facebook group, since some people close to her tend to judge her for having a bad sleeping child, which she is sad about. Products have to fit household rituals, but moreover have to match her own feelings and beliefs. She is usually the one of the couple to bring the child to bed.

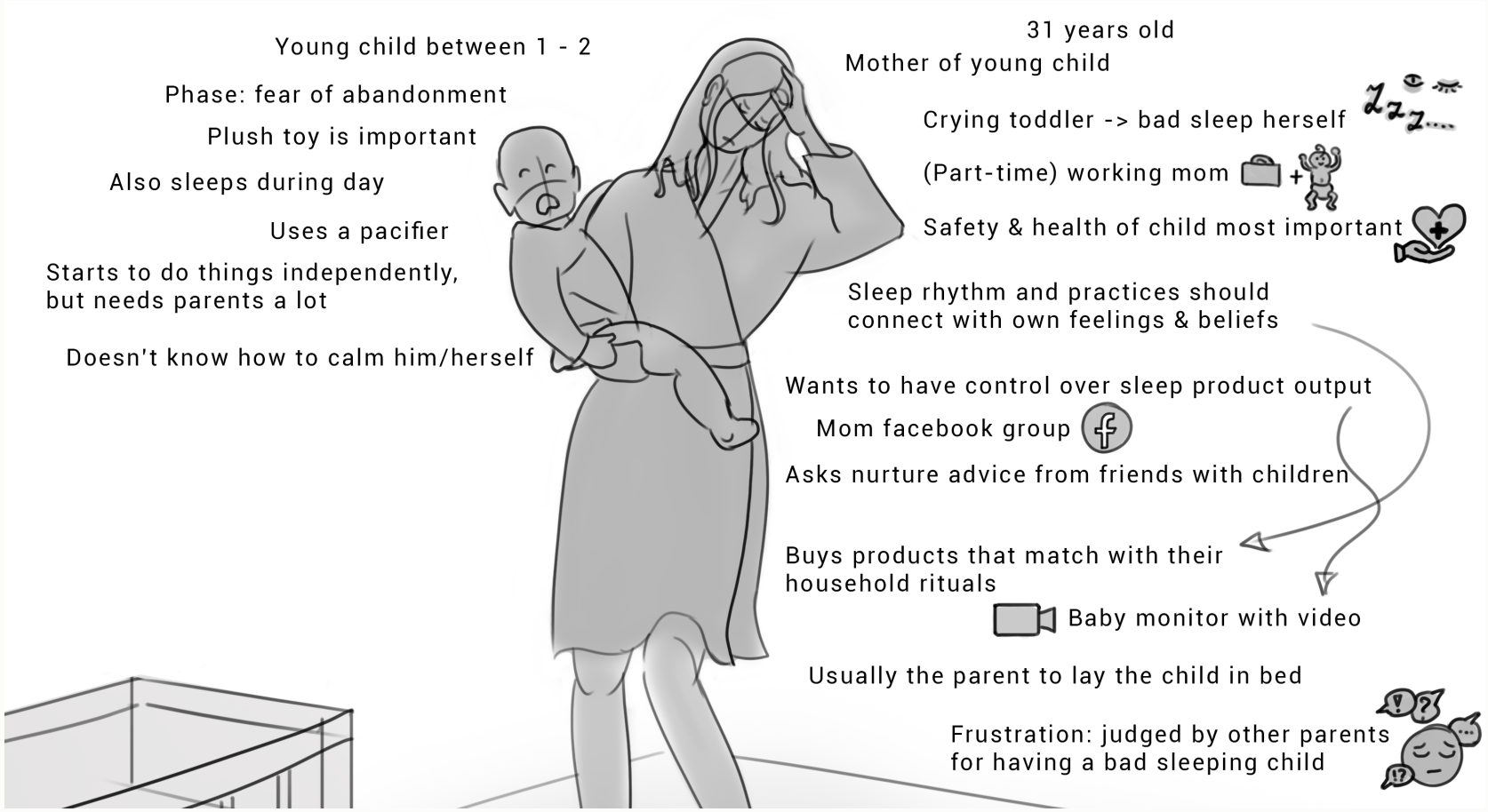


Figure 20: First persona

The second persona is a mother of two children (1 and 3 years old), of whom the youngest sleeps much worse than the eldest did at that age. She is frustrated by this and wonders why. For most things she relies on her experience with the first child, so she asks less for help from others. Products now have to be more practical than first, since having two children requires more. They also still need to fit with her rituals and beliefs. The oldest starts to gain the ability to explain why sleeping is hard, or what the problem is. Daddy usually brings the oldest to bed, and she the youngest.

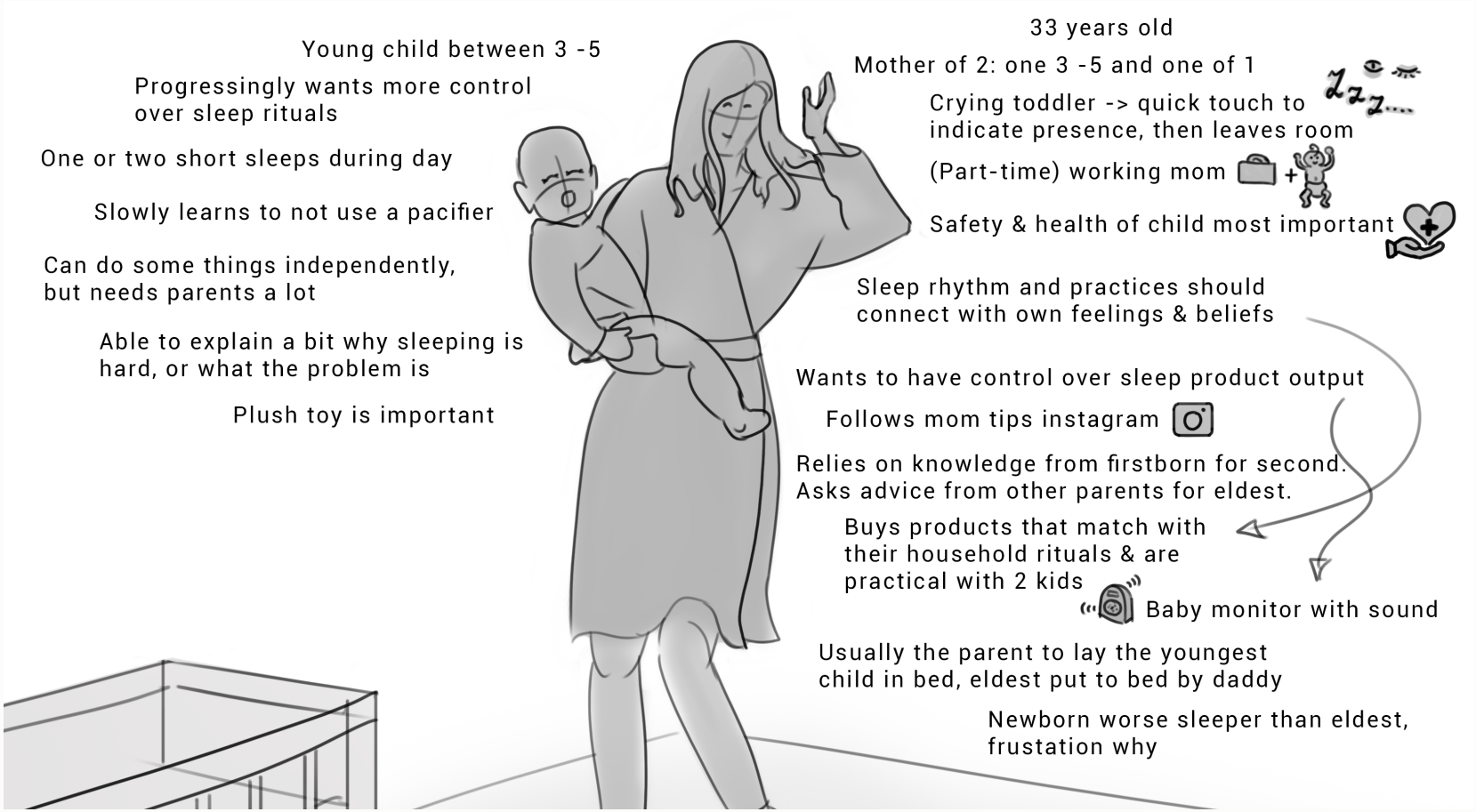


Figure 21: Second persona

2.6 Design Space

The design space, see figure 22 consists of insights from the literature research, product market review and parent interviews. The insights were combined, summarised and added to the context visual made for the design brief of this graduation project, which can be found in appendix 19. The inner circle includes important factors belonging to the context close to children, while the ring around shows factors more loosely related or less important to children and sleep (problems). All elements were categorised into parts of the design space: the physical, emotional, social or developmental context. These parts together show the complexity of the design space and the design problems inside it. To keep the project manageable and focused, the decision was made to not focus on how (sleep) habits can be formed or changed with a product, but on the question how vibrations can help sleep. The vibration itself is the main design element and contribution of the Haptic Lullaby. Another choice that was made after making the design space visual is to stay within the context of a child's home, leaving out daycares or other locations where children might sleep.

The fact that sleep is something private and personal can also be concluded when looking at the visual. Most of the factors were placed in the context most close to the children. This is quite logical, because most sleep rituals regarding children are social interactions with the people they are the most close with: their parents.

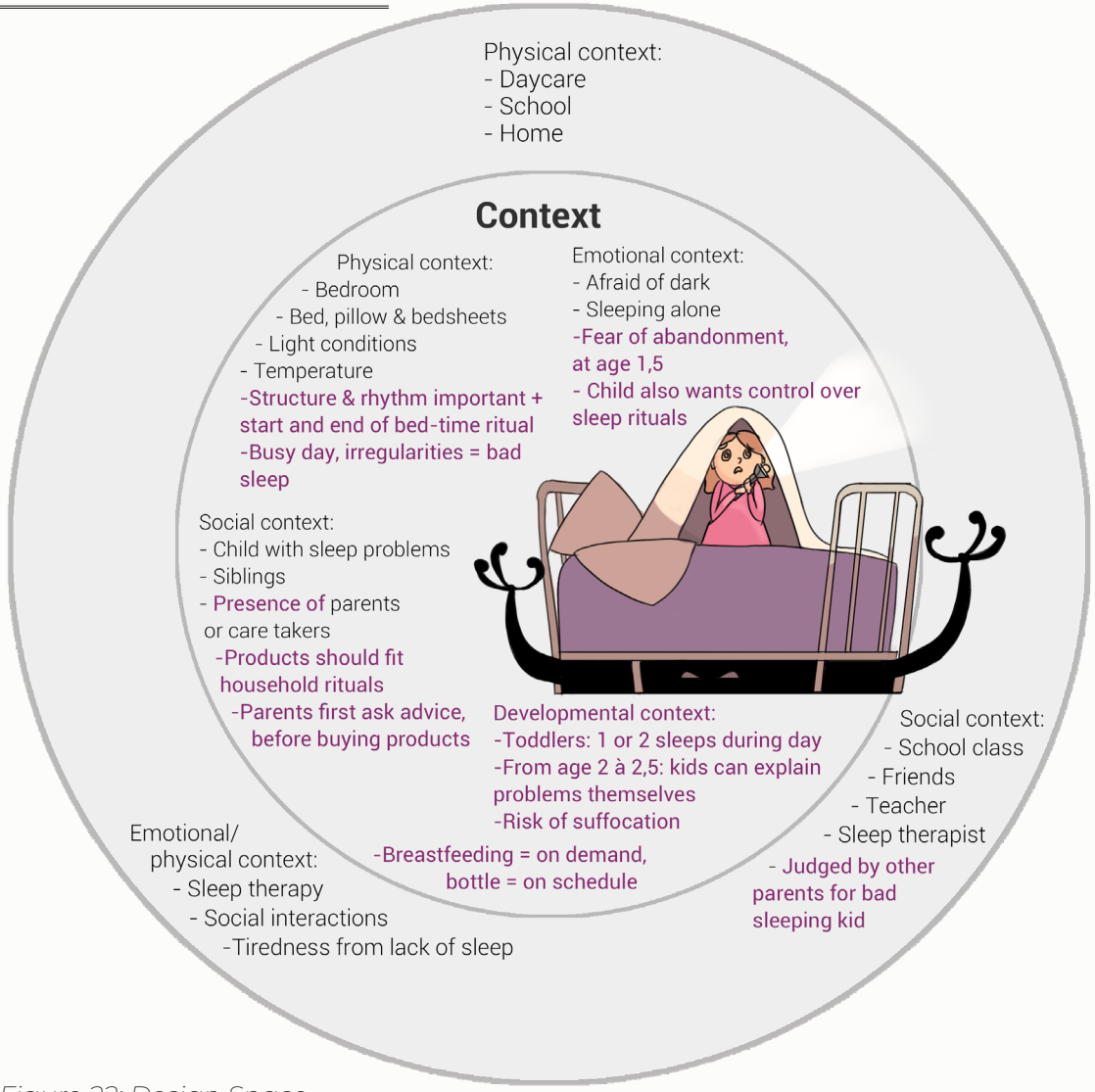


Figure 22: Design Space

Now that the design space has been formed and relevant background information on vibrations, sleep, current products and the user context has been gathered, the design of the Haptic Lullaby product can be started. The design process can be divided into three parts: the form design, implementation design and vibration design. Before exploring how the Haptic Lullaby will be used in the implementation chapter, and how possible vibrations can be tested in the vibration chapter, a form had to be designed for the Haptic Lullaby. The next chapter, describes how iterative prototype explorations lead to a form design and a prototype ready for testing.

Design Element 1: Form Design 03

3.1 Introduction

In this chapter the design process of the first element of the Haptic Lullaby will be explained: the form design. Three iterative prototype explorations were done alongside a design ideation on several concepts. Combined they led to a prototype design that can be used during user tests.

To explore possible product forms, materials and interactions, prototype explorations were done. The research questions that led the explorations are:

- What is the effect of location on the body on how vibrations are perceived?
- What kind of sound accompanies certain vibration frequencies?
- How can vibrations be felt throughout a product?
- What is the effect of different materials on the feeling of a vibration?
- What are possible vibration patterns that could help fall asleep?
- Which single frequency vibration is most sleepy?
- What product form suits the context and allows for feeling a vibration while trying to fall asleep?

These questions were explored in three iterative prototyping phases. With each iteration, the explorative activities became more targeted, testing out specific elements of the research questions. For each phase different prototypes were made. Explorations one and two were self tests. The third exploration was done with two other designers.

3.2 Prototype explorations

First exploration, self test

The first prototype exploration was meant to test different locations on the body: how does the experience of the vibration change per location? To test this, a simple prototype had to be made that can be held and placed freely on a body, and of which vibration characteristics like frequency and amplitude could be modified easily. Therefore a suitable actuator and product material had to be selected.

Many different actuators can produce vibrations. In a lot of products like your phone or tablet, small vibration motors give tactile feedback. Vibration motors come in all kinds of types and forms. However not all types have the possibility to independently alter the frequency and amplitude. For example, in one of the most common types, Eccentric Rotating Mass motors, a non-symmetric mass is rotated, producing movement that causes a vibration. The only controllable parameter is the speed of the rotation. Therefore amplitude and frequency of the vibration can not be set separately (PrecisionMicrodrives, 2021). Linear Resonant Actuators and speakers are based on the same principle (PrecisionMicrodrives, 2021).They produce air (sound) waves when a mass or cone moves back and forth because of a changing magnetic field (Seydel, 2017). The frequency and amplitude can be set separately.

A special kind of speakers are called tactile transducers or bass shakers. These speakers are specialised in playing low frequency sounds (Ouellet, 2017). Common applications of bass shakers are home theatres, game applications (virtual reality, racing simulators, game chairs, controllers) and special effects in amusement parks.

Because the frequency and amplitude of a bass shaker is very easy to modify, and many different options are available on the market, a small bass shaker was selected for the first prototype. The exploration with this prototype consisted of a self-test. Different vibrations were placed on different locations on the body, like hands, upper leg, lower leg, arm, neck, back and belly. Very clear was that the same amplitude was not suitable for every location. This is in line with scientific knowledge on the intensity of our touch sense over the body (Schott, 1993), see figure 23.

The vibrations for example had to be stronger when placing the bass shaker on your back, compared to placing it on your belly. Any location close to the head was perceived too intrusive, and not calm enough for sleeping. This still seemed the case when put under a pillow. The audible sound was also too loud. The locations most suitable for sleeping, judged on comfort and calm or relaxed feeling, were the back, belly, chest or hands.

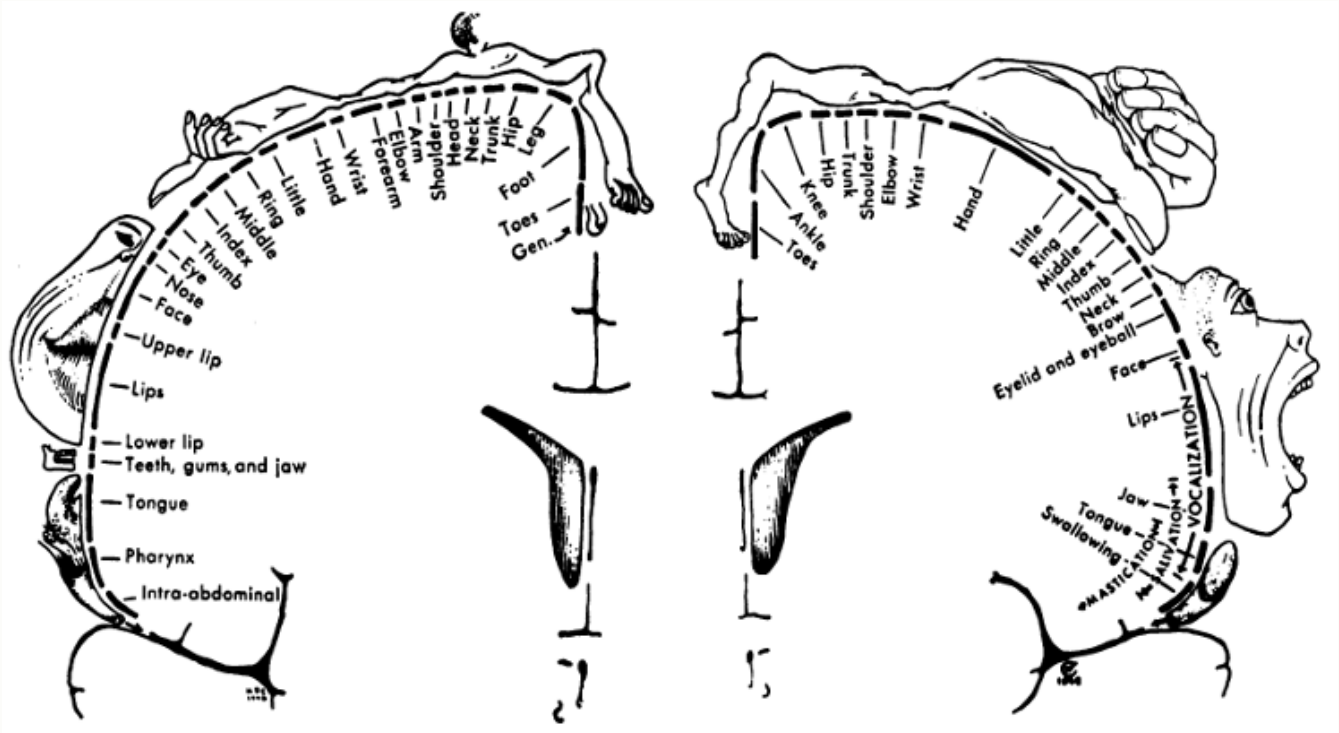


Figure 23: Homunculus, showing the size of brain areas related to our Somatosensory and Motor systems (Schott, 1993)

3.2 First exploration, self test

The follow-up test consisted of encapsulating the bass shaker in different kinds of foam, and playing several vibration patterns. The combination was then placed on the locations that felt most relaxed during the first exploration, so beck, belly, chest and hands. As sensitivity of the touch sense differs between these locations and different materials dampen the vibrations in a different way, the amplitude of the vibrations was adjusted per location and per material. Two foam types were used: a hard, non-flexible styrofoam and a soft, flexible foam. A combination of the two was also tested.

The used vibration patterns were two types of white noise, one pure white noise and one white noise plus womb sound combination, a heartbeat and a single frequency of 40 Hz. The frequency of 40 Hz was selected, because multiple literature sources show interesting benefits of this frequency. It seems to have a positive effect on the brain of people with Altzheimer's disease (Olson, 2021), and could enhance working memory when listened to as binaural beats (Jirakittayakorn, 2017). For each material plus vibration combination the following qualities were described and rated: what the vibration felt like; relaxed/sleepiness; pleasantness of the feeling; what the accompanying sound or noise sounded like; and noise pleasantness. These findings were reported in an excel table. Remaining remarks were noted down in a separate column. The complete results can be found in appendix 7.

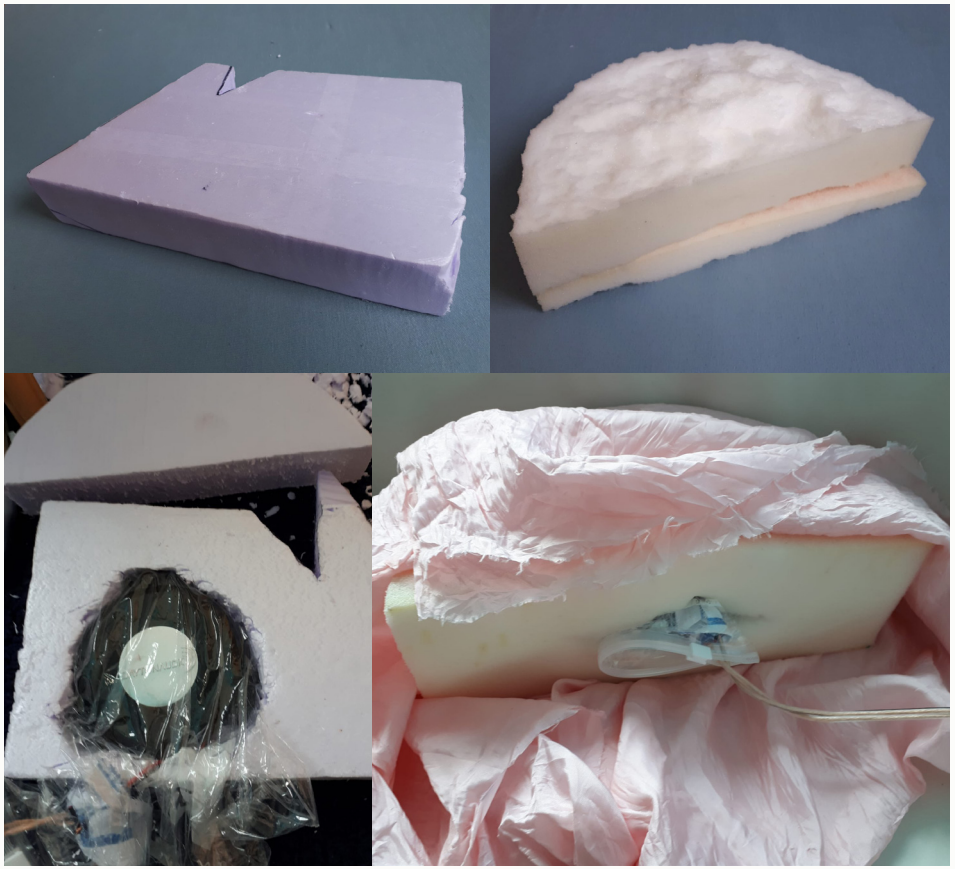


Figure 24: Top: Hard & soft foam. Bottom: Bass shaker in foam.

Iteration on prototype explorations 3.2

Different conclusions can be made from the prototype exploration. Looking at material properties, the soft foam dampened the vibrations a lot more than the hard foam. The hard foam diffused the vibrations quite well over its surface, making the vibration feelable throughout the piece. The hard foam was however, contrary to the soft foam, unpleasant to hold. Therefore a combination was made to test if this will result in the best of both. It was concluded that there is the possibility to get the pleasant touch of the soft foam and the diffused vibration of the hard foam, if the thickness of the soft layer around the hard foam is optimised more. The vibration that scored highest on pleasantness, both to feel and hear, and on sleepiness was the pure white noise. However, the difference between the vibrations was not big. From this exploration, new research questions arose:

- Are diffused vibrations more pleasant in a product than point vibrations?
- If yes, how can vibrations be felt throughout a product? How can the vibrations be diffused?
- Does the type of actuator that produces the vibrations have an influence on how a material diffuses a vibration?

These questions were added to the research questions mentioned earlier in 3.1 and explored during the third prototype exploration.

To answer these questions, a prototype session was planned with artist Laura A Dima and fellow student Amy den Dekker, who also, just like me, had done an internship for Laura. Laura is an independent artist who has worked a lot with silicone. In Laura's studio in Amsterdam, more shapes and materials could be explored, and the initial findings about vibration location on the body and vibration patterns could be validated with the opinions of Laura and Amy. Furthermore, a different kind of actuator was brought along: the Lofelt L5 actuator. This is a very small haptic voice coil actuator. For the prototype session, one L5 actuator was soldered to the Atom Echo, a small Bluetooth speaker, in such a way that it replaced the speaker of the product. This actuator was included in the test to understand how a different actuator influences the feeling of a vibration through a material. The materials that were used in the exploration can be seen in figure 25.

Figure 25: Prototype materials

3.2

To experience how silicone affects the vibrations, the DaytonAudio bass shaker was first placed underneath one of Laura's artworks, The Finger Rub Rug, as can be seen in figure 26. This mattress sized work consists of 1300 realistic looking silicone replicas of the fingers of the artist's partner. When exhibited, the artwork is placed in a dedicated room with specially designed sound. A heating structure and heartbeat vibration is placed under the mattress. Visitors are left alone in the room and are free to explore the artwork how they want (Laura A Dima, 2022).

It was clear that the vibrations did not travel far through the silicone. At the end of the fingertips directly above the bass shaker the vibration could be felt, but already quite soft. Feeling further from the bass shaker, the vibrations were quickly not felt at all.

The bass shaker was then placed on other artworks and leftover pieces of silicone, and the same result was achieved. The silicone seemed to isolate the vibrations. However, the result was different when the Lofelt L5 actuator was used. For this actuator, the vibrations were felt stronger through silicone than for the bass shaker.

Another interesting result from the session was a relationship between prototype shape and vibration feeling. It was noticed that the form influences how a person prefers to hold the prototype, and also how much noise is produced when the prototype lays on a table. Round or cylinder shapes allow for holding and hugging. These shapes also produce less sound when laid on a table. This can be explained by the size of the area that touches the table, which is smaller than for a square or rectangle.

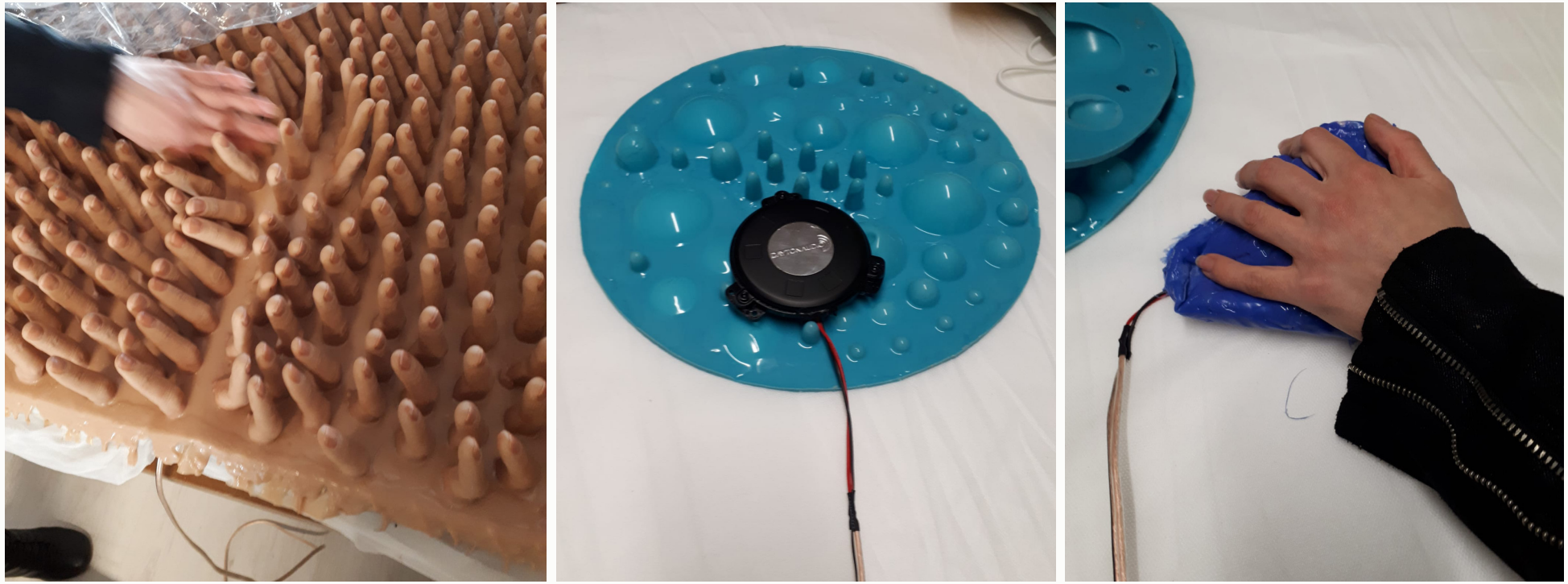


Figure 26: Left: The Finger Rub Rug; middle: the DaytonAudio on a silicone artwork; right: feeling the Dayton wrapped in silicone

Looking at the different foam types that were used, a relationship can be found between density and vibration strength. The bass shaker was placed in or encapsulated with the different types of foam and the higher the density of the foam, the better the vibrations were diffused throughout the material. Harder foam also led to more sound production. The only foam that was different was the memory foam. The memory foam is quite soft, but diffused the vibrations really well. It was also relatively silent. However, for the Lofelt L5 actuator this relationship was not true. When the Lofelt was placed inside the memory foam, the vibrations were much less feelable than with the bass shaker. An interesting observation was that Laura and Amy instinctively held the vibrating materials against their chest. They liked to hug the vibrating prototypes. During the exploration, it became clear that the feeling is more pleasant if the vibrations are diffused throughout the whole form than if the vibrations are a one point vibration.

The prototype exploration led to some ideas for designing and testing. Firstly, the idea came up to use an old MP3 player to play vibrations during user testing, as this is smaller and easier than a laptop. Secondly, inspired by the presence theme, the idea came up to record parents' voices and play those vibrations during user tests with children. Lastly the design idea came up to "mask" ugly sounds of nice feeling vibrations with other sound vibrations if that turned out necessary after more user testing.

Figure 27: Amy holding a prototype exploration.

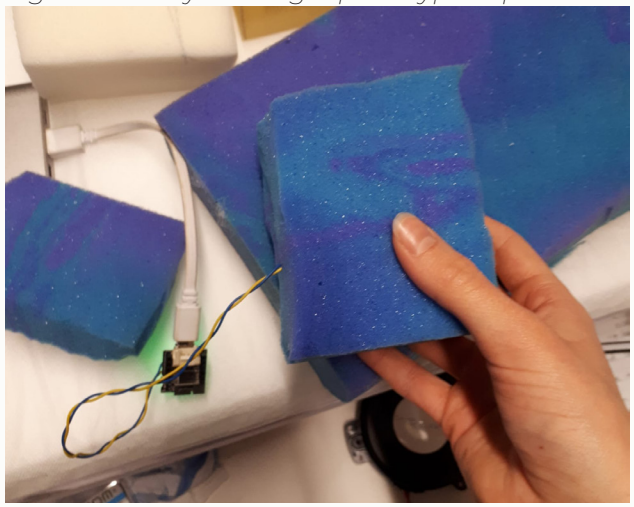


Figure 28: Lofelt L5 in memory foam

3.3 Design ideation

With the insights from the prototype explorations in mind, a first ideation phase could be started. Different product shapes and forms were brainstormed (see appendix 8), as well as possible vibration modes. The vibration modes will be explained in more detail in chapter 5.2. Interesting wishes or ideas for sleep products that parents mentioned during the interviews informed the ideation, as well as the diverse forms and functions of products on the current market. From the brainstorm on product forms, three were selected and detailed further. They were selected on the requirements that the form had to be easy to prototype and test during the rest of the graduation project, and they had to have the potential to fulfil the product requirements listed in chapter 2.4. For example the requirement that a child should not be able to strangle him/herself was important, because testing should be done safely.

The first concept is a smart child mattress, made in such a way that the vibrations can be felt throughout the whole mattress. In whichever way the child decides to lie down, they will experience the soothing vibrations. The mattress is powered by a cable plugged into a power socket. The concept is shown in figure 29.

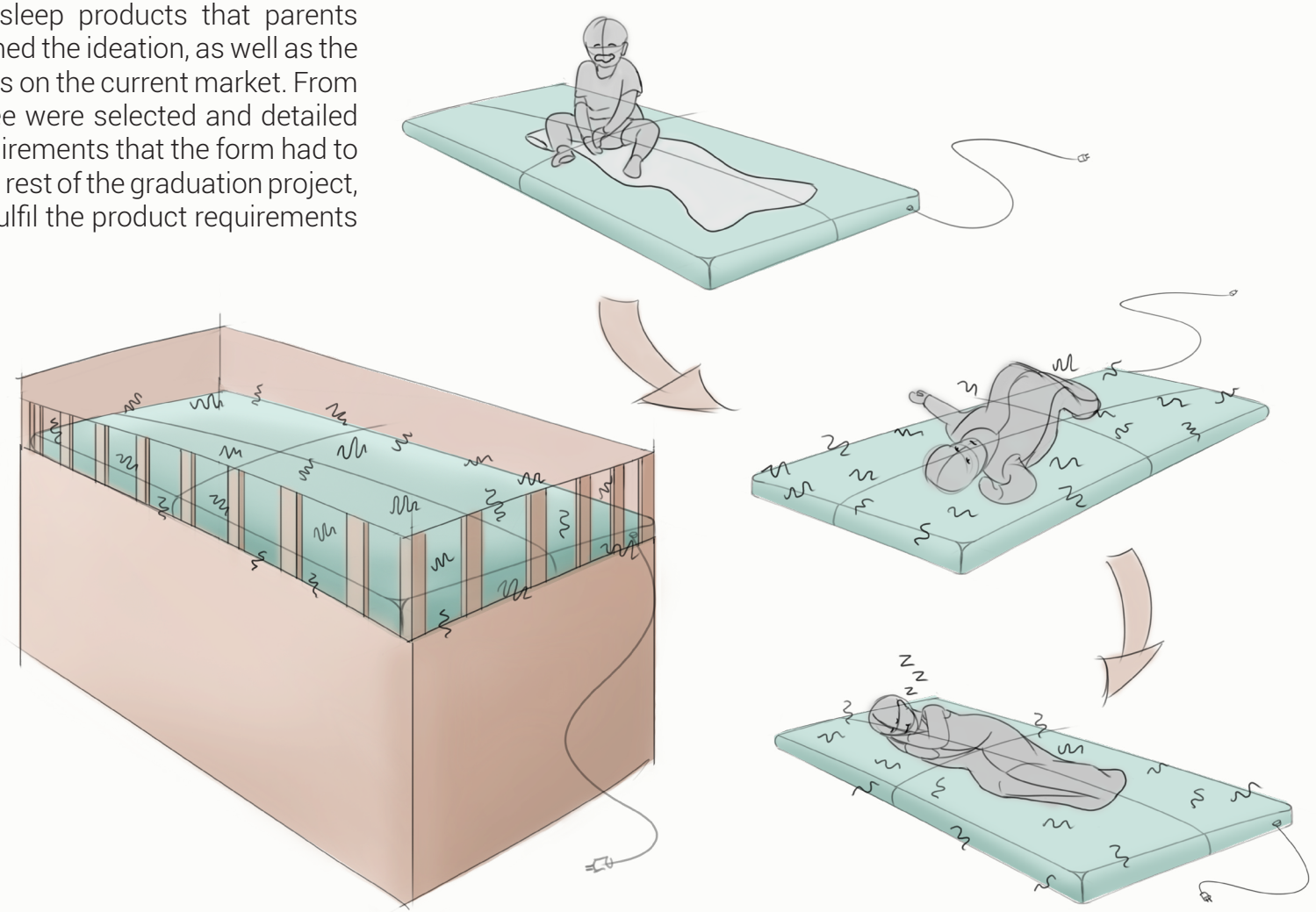


Figure 29: Concept 1: Smart mattress

The second concept consists of a vibrating pad that is placed under the mattress of the child. In this way, no new mattress has to be bought. The vibrations will be more localised, instead of through the whole bed. The pad is also powered by plugging its cable into a power socket. The concept is shown in figure 30.

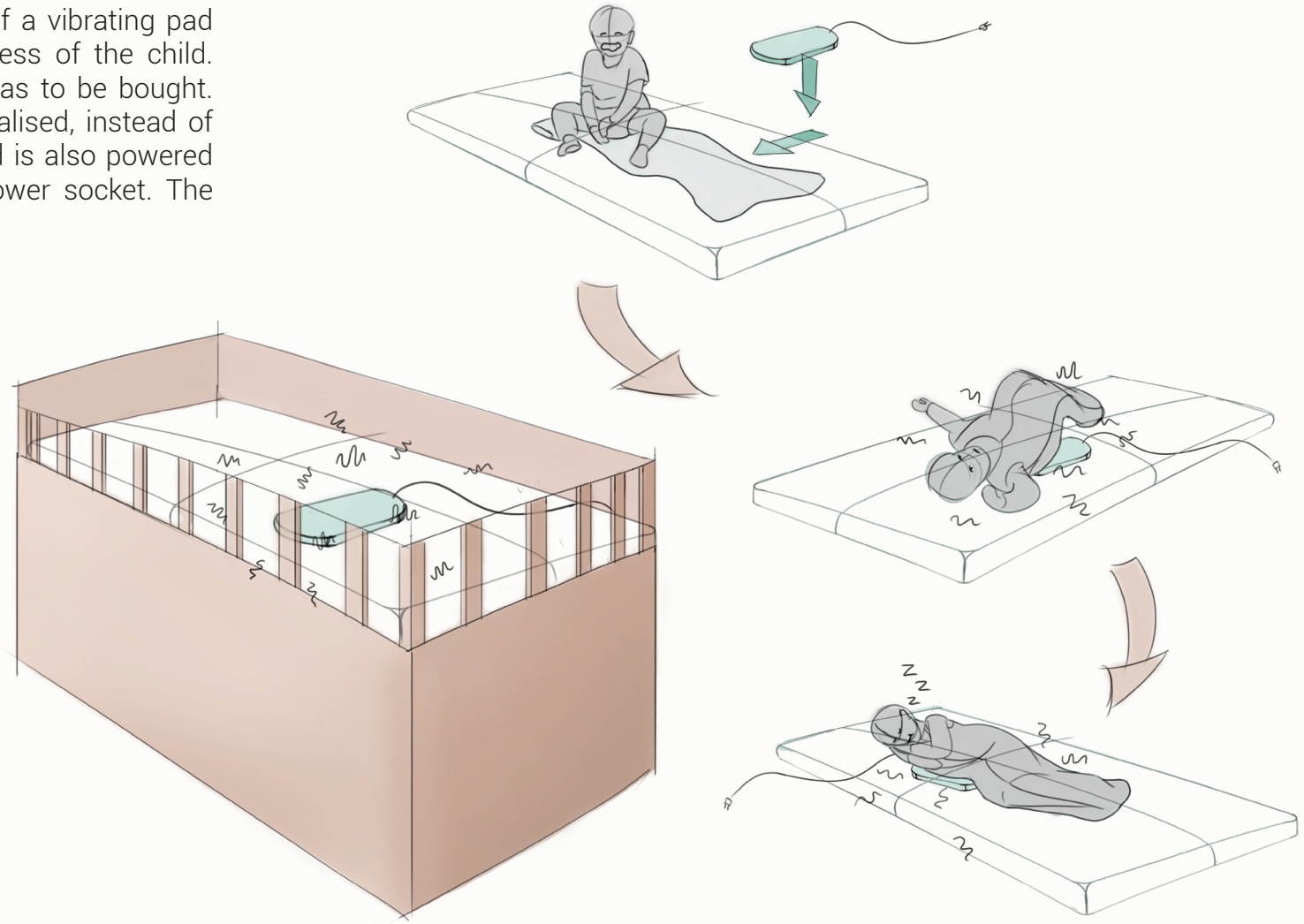


Figure 30: Concept 2: Vibrating pad

3.3

The third concept is a vibrating plush toy. Two form options are considered: a recognisable animal form that is typical for the product category of plus toys, so for example a bear; and a more abstract, organic shape that looks like a bean. The second is perfect for holding and cuddling, while the animal shape is a comfortable known shape for children. The concept is shown in figure 31.

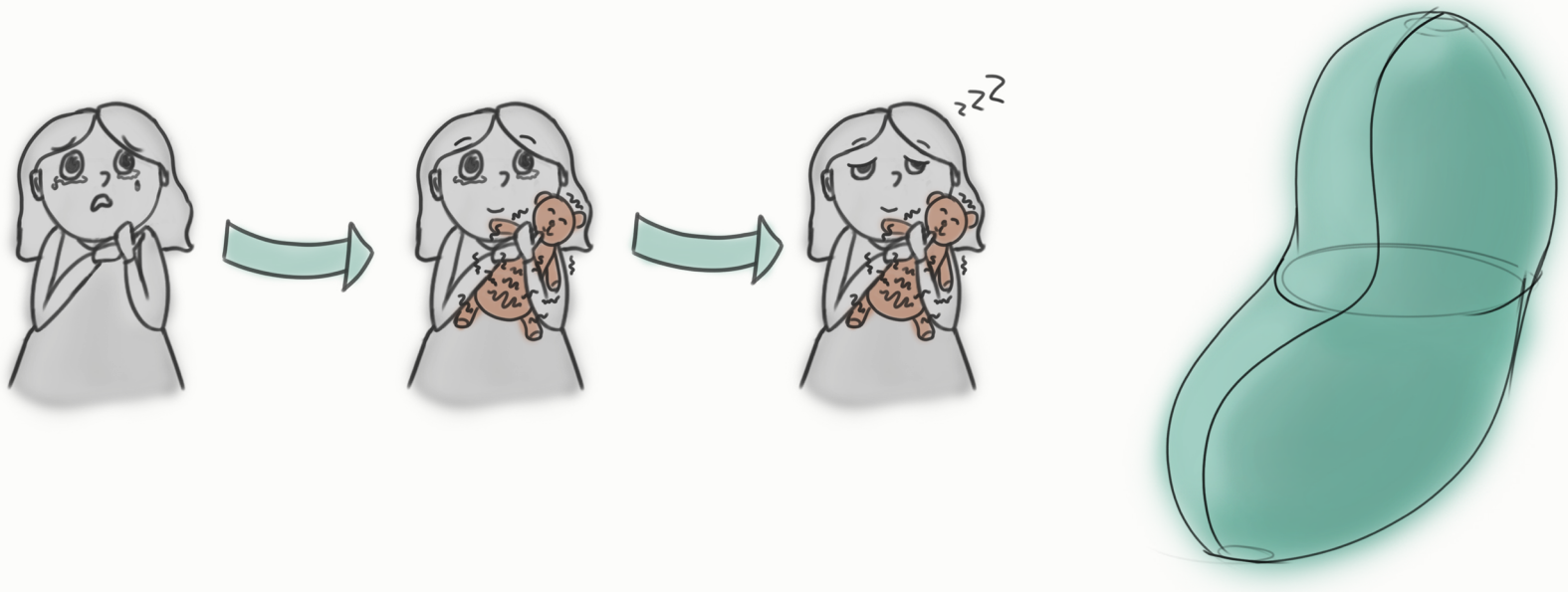
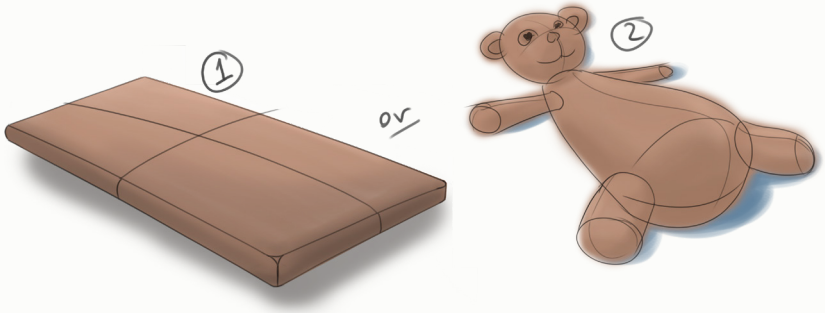


Figure 31: Concept 2: Plush toy

From the three concepts two were selected: the plush toy and the smart mattress. These were selected because of two design considerations. Firstly, they are the most different in product interaction and form, and secondly, they are still easy to prototype and test with children. Furthermore, concept 2 was also the least inspiring or interesting. This is validated with parents in an online questionnaire, see chapter 4.2. Here it came forth that the pad concept is the least desirable and valuable for parents. A comparison was thus made between the smart mattress and plush toy forms, see table 4.



The most important aspect of both concepts is the vibration itself. Therefore a form choice that narrows down the project and product complexity makes sense. The mattress concept is less complex, because it cannot be transported to different use contexts like grandparents, daycare, school, sleepovers, etc. The mattress also has little to non complex interactions with children, so the effect of the vibrations will be central in prototype tests. With the plush toy, there is a risk that the interactions and emotional connection of a child with the plush will overshadow the vibration experience. In addition, the product market of smart plush toys is already highly saturated, while not a lot of smart mattresses have been made yet. The market of smart mattresses is new and growing, following the trend of smart homes. Lastly, this product form is suitable for a diversity of children, since the vibrations can be felt in every sleep position. All these considerations led to the decision to focus on the smart mattress concept. This concept form not only reduces complexity, but explores new product values and research areas as well.

Table 4: Concept comparison

Smart mattress	Plush toy
- Less interaction with child - Either "lifeless" or: + surrounding presence + All sleeping positions - Only in own bed + No risk of suffocation - No emotional connection for child + Easy to implement + Suitable for different body types + New, open product market	+ More interaction with child + Little friend → presence - Can be lost in bed + Transportable to other locations - For young age: risk of suffocation + If favourite plush: emotional connection - Hard to replace favourite plush toy - Not every child likes the same plush - Highly saturated product market

3.4 Prototyping for user tests

Now that the form of the Haptic Lullaby has been chosen, some prototype design choices could be made. The hard foam diffused the vibrations best during the prototype explorations in chapter 3.2. A diffused vibration suits the product shape best. Therefore a piece of hard foam of 60 x 120 cm was bought, which is the same size as a soft foam baby bed mattress from Ikea called PLUTTIG. This soft foam mattress was put on top of the hard foam after the pilot test, see chapter 5.3, to provide more comfort. The fact that bass shakers work well was discovered during the prototype explorations. Nevertheless, only one type was tested, namely the Dayton bass shaker. Thus two other bass shakers were self tested before one was put inside the prototype: one from the brand ClarkSynthesis and one from Reckhorn (see figure 32). A comparison was made between the three in terms of produced feeling and produced sound, see table 5.

Figure 32: different bass shakers

Table 5: Bass shaker comparison

Sound source	Feeling	Sound	Conclusion
ClarkSynthesis	Very soft when not under hard foam. Much better under the foam. Feeling is better than daytone for single frequency and white noise, less good for lullaby and more music like sound files. Very large bass shaker.	Lower than daytone for single frequency based files and white noise. More sound at lullaby & binaural	Okay option for specific sounds, very big.
Reckhorn	softer feeling compared to sound. Worse ratio than the daytone.	more sound than the daytone when the shaker produces the same level of feelable vibration.	Least good option
Daytone	have to turn up volume more than with others. Nicely small.	40 Hz annoying sound. Otherwise good.	Apart from the 40 Hz the best option. Small too.

In conclusion, the Dayton bass shaker was still the best option, so this one was put into the prototype. The bass shaker can be controlled with an amplifier to which devices like a phone or laptop can be connected to play audio files. After the pilot test, a soft cotton mattress cover was put over the foam sheet and PLUTTIG mattress with the bass shaker inside it, to give the prototype a more finished look and keep everything together. The prototype can be seen in figures 33 and 34. With this prototype, user tests could be conducted.

Figure 33: Prototype for testing

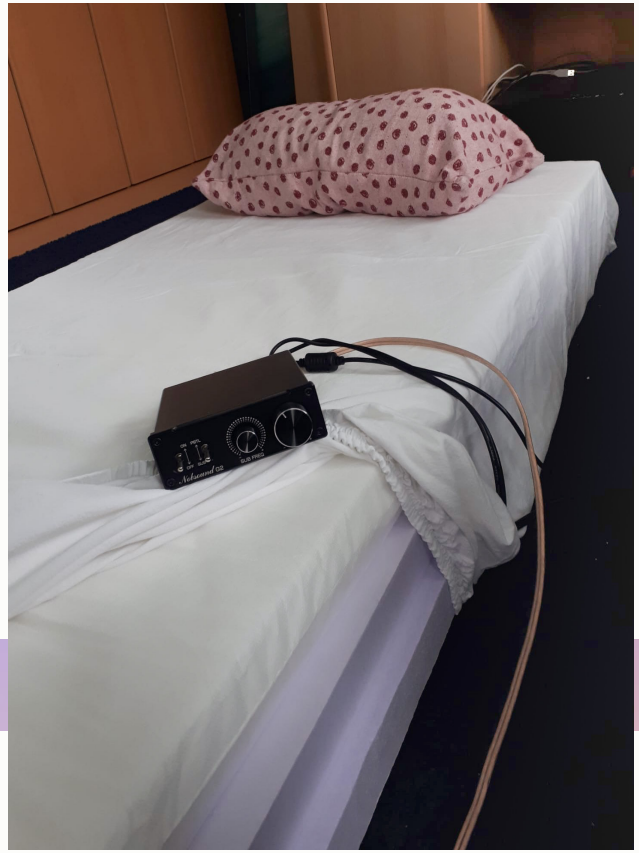


Figure 34: Prototype for testing

04 Design element 2: implementation design

4.1 Introduction

The second design element is the implementation design, which describes how users will use the Haptic Lullaby if it would be implemented in real life. This chapter consists of two parts: an online questionnaire for parents, to understand their view on the use of a vibrating sleep product for children, and a use scenario, in which the findings of the questionnaire have been taken to describe the intended use of the Haptic Lullaby.

4.2 Online parent questionnaire

Introduction

The main stakeholders of the Haptic Lullaby are the parents, who will not only buy it, but also make sure that the product is implemented in the bedtime rituals of the users, their children. Therefore it is important to take knowledge and opinions of these stakeholders into account when designing the Haptic Lullaby. During the interviews with parents themes were explored that provide general insights into the context around a sleep product for children. The implementation design requires more specific opinions from parents. What is their view on a vibrating sleep product? How would they like to control the vibrations? Which concept is most desirable? And which one are they willing to pay most for? An online questionnaire was set up to get answers.

Method

The questionnaire was an online Google form, divided into three sections: general questions, three sleep product concepts, and requirements & wishes. The general questions were meant to check if the children of the participants fall within the target group of 1 - 5 years old and to introduce them to the topic of sleep products. The questions were in Dutch, since Dutch parents were contacted. Sixteen replies were gathered through an open Facebook call and by contacting parents who participated in the interviews of chapter 2.4, or the prototype research described in chapter 5.4. All respondents have at least one child within the targeted age. Seven parents require much effort to get their child(ren) to sleep. On a scale from 1 - 7, three of them gave a six and four gave a five for how much effort getting their child to bed costs. In conclusion, 43,8% of the participants have children with sleep problems. All questions can be found in appendix 9.

4.2 Results

The questionnaire started with asking how many children the parents have and how old they are. The second question asked what kind of sleep products they use to help their child sleep. Only one parent has a child that does not use a plush toy, making a plush toy the most popular sleep product. Also popular are bedtime storybooks (used by twelve) and night lights (used by nine). One of the most important wishes parents have for a sleep product for their children is safety (mentioned by five parents), shortly followed by providing a feeling of trust (mentioned by three).

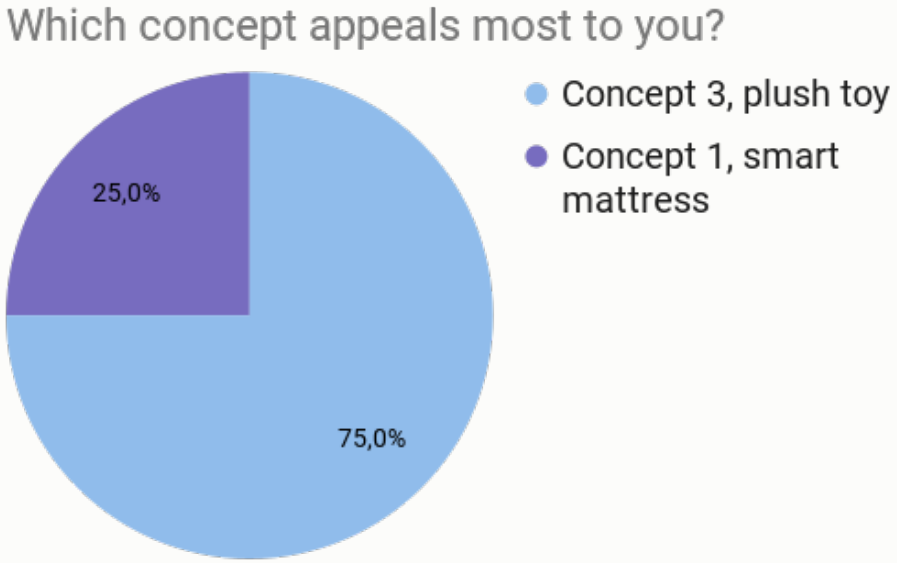


Diagram 1: Answers from parents, which concept appeals most?

The concept that appeals most to parents is concept 3, as can be seen in diagram 1. From the comments can be derived that the plush toy appeals most to them, because the form is familiar, meaning they understand how the product will work, and because it is transportable to other locations like grandparents or daycare. Concept 2 was not mentioned by anyone as the most appealing. When looking at the two proposed shape options for concept 3, the recognisable plush toy was preferred over the abstract blob/bean shape. Eleven parents liked the recognisable plush vs. five who liked the abstract form better.

Concept two gives the most diverse answers on how effective and calming parents expect it to be, and on how interesting parents find the concept. More diverse answers means that people are less in agreement with each other. People think that concept 3 is the most calming, effective and interesting, with eight respondents giving a six or seven for all three factors. Somewhere in between lies concept 1. It is scored lower than concept 3 and more diverse, but less diverse and higher than concept 2. The fact that children can lose concept 3 in bed was for parents the main reason to not choose that concept, but concept 1. What they liked about concept 1 is that the vibrations can be felt wherever the child lies or rolls around on the bed. Diagrams 2 till 10 show these results in more detail.

Diagram 2: How calming do you expect concept 1 to be for children?

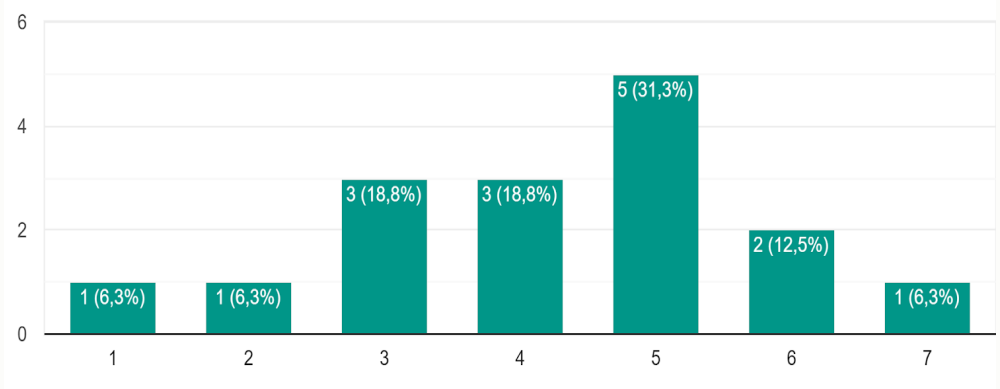


Diagram 5: How calming do you expect concept 2 to be for children?

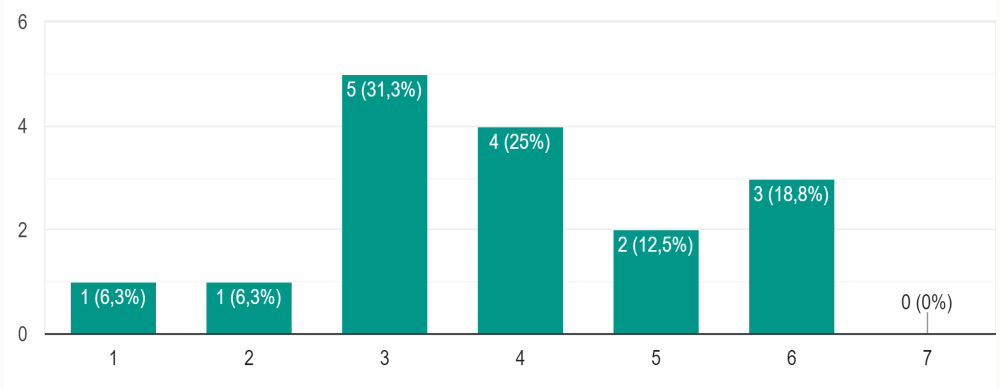


Diagram 3: How effective do you expect concept 1 to be for children?

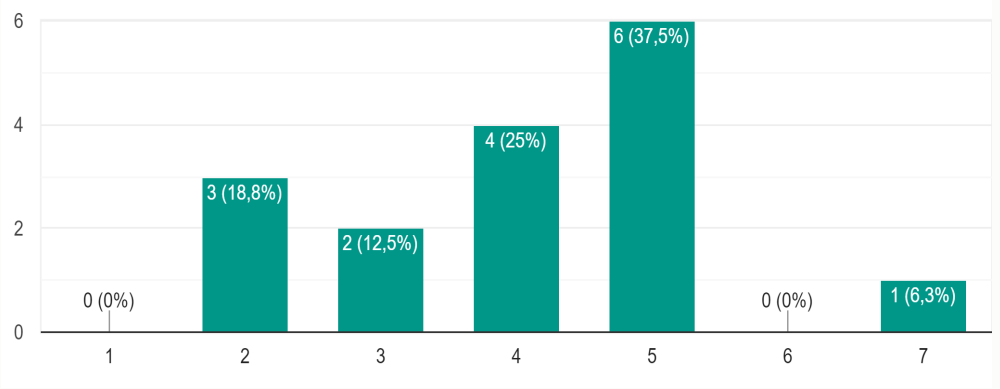


Diagram 6: How effective do you expect concept 2 to be for children?

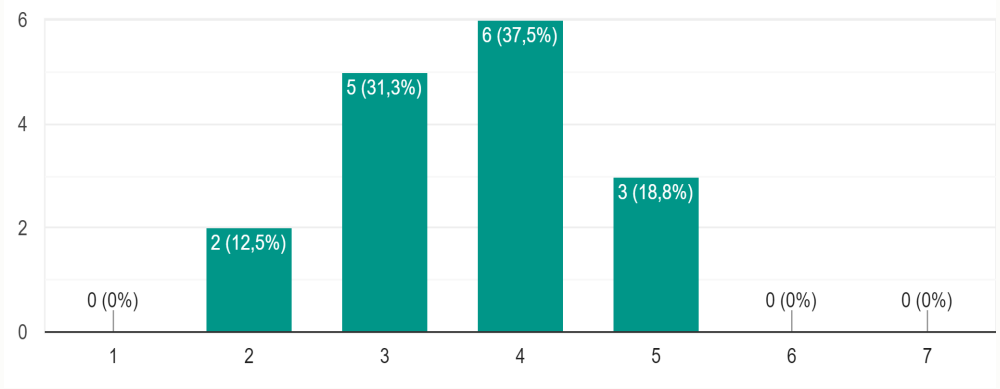


Diagram 4: How interesting is concept 1 for you?

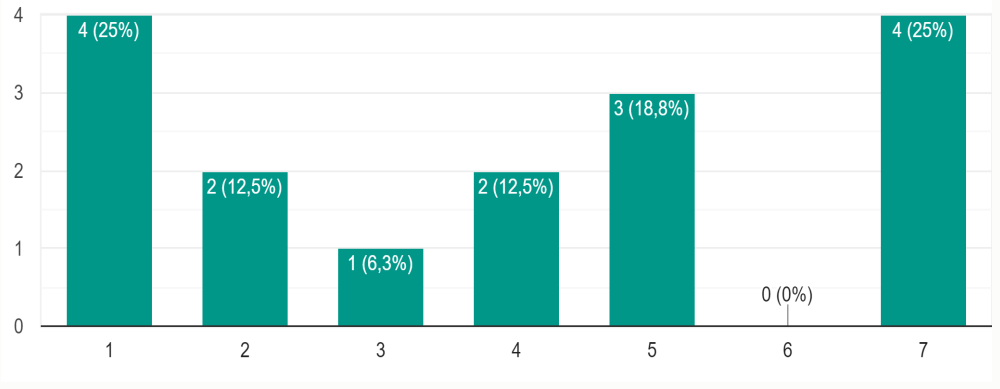
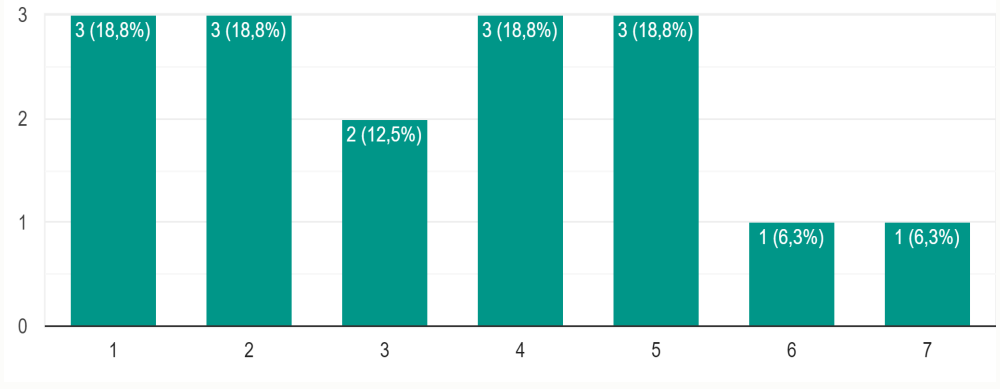


Diagram 7: How interesting is concept 2 for you?



4.2

Diagram 8: How calming do you expect concept 3 to be for children?

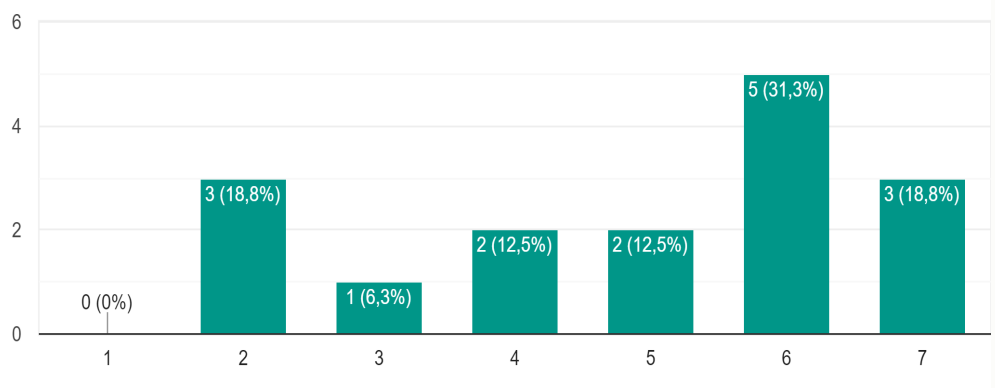


Diagram 9: How effective do you expect concept 3 to be for children?

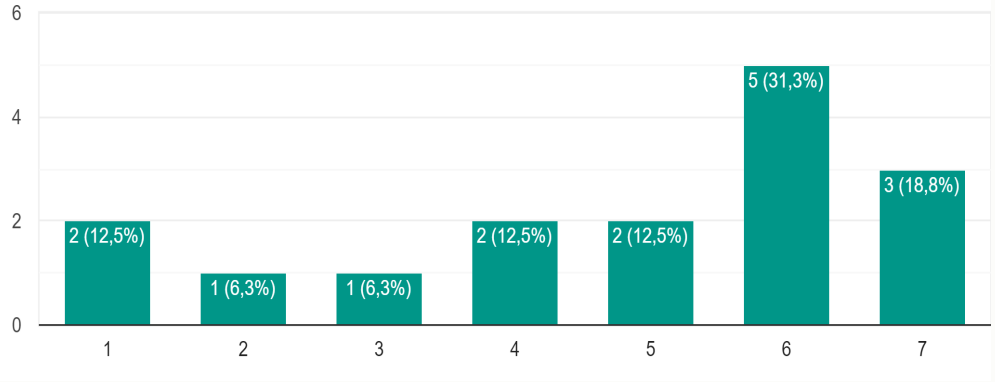
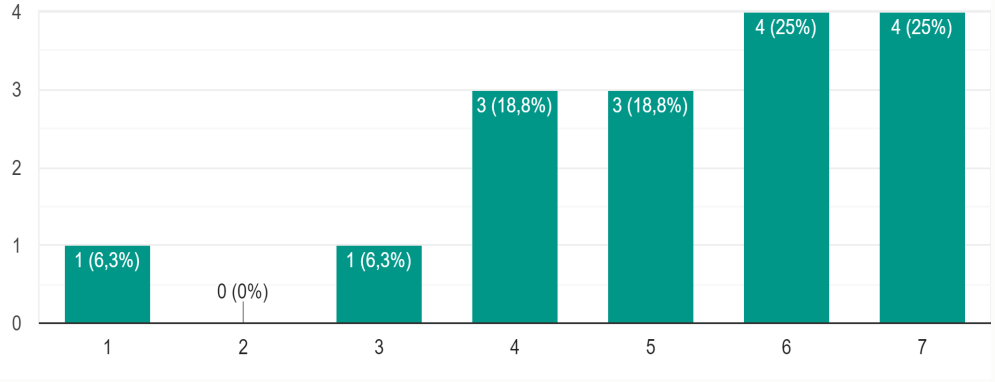


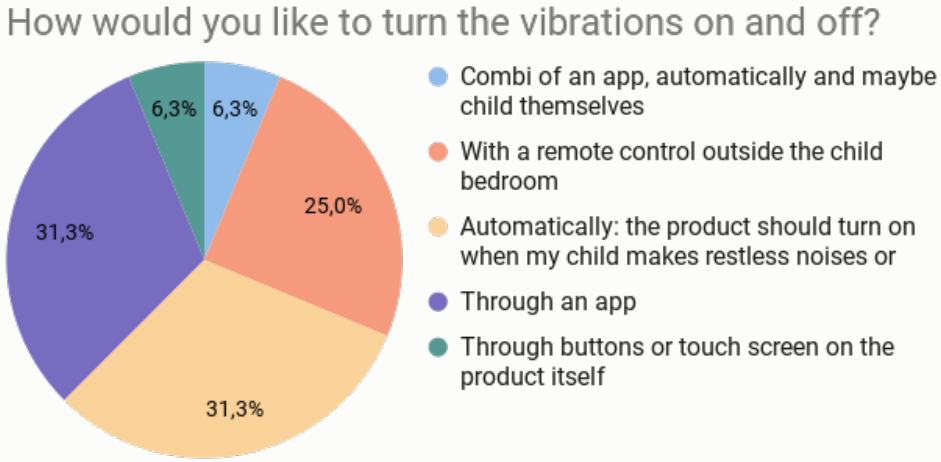
Diagram 10: How interesting is concept 3 for you?



The last section of the questionnaire explored how people envision the implementation of the three concepts. Diagram 11 gives an overview of how parents would like to turn the vibrations on and off. One parent wants a control option on the product itself, while all other parents prefer remote control (five preferred an app, four a remote control), automatic control (five answers) or both (one). Parents would spend the most money on concept 1, then concept 2 and lastly concept 3. Diagrams 12 till 14 show this result.

The functions that respondents would add to the sleep product are music or white noise. Eight parents mentioned some form of music, four would add white noise and two were interested in both. A heartbeat was suggested in the answers of two parents. The complete results of the questionnaire can be found in appendix 10.

Diagram 11: Controlling the vibrations, question answers.



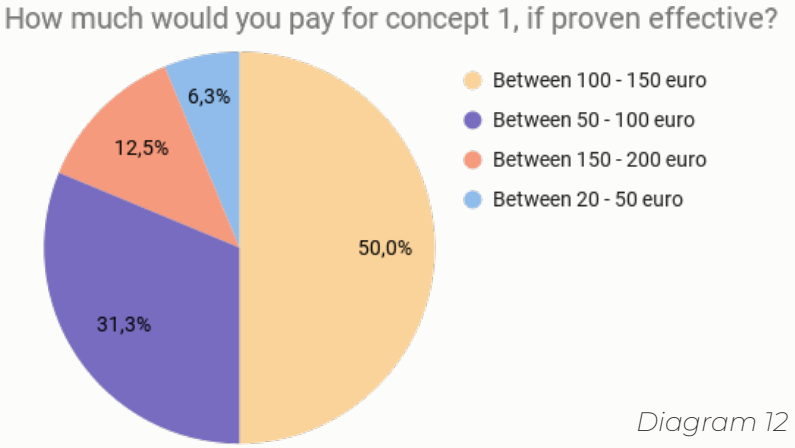


Diagram 12

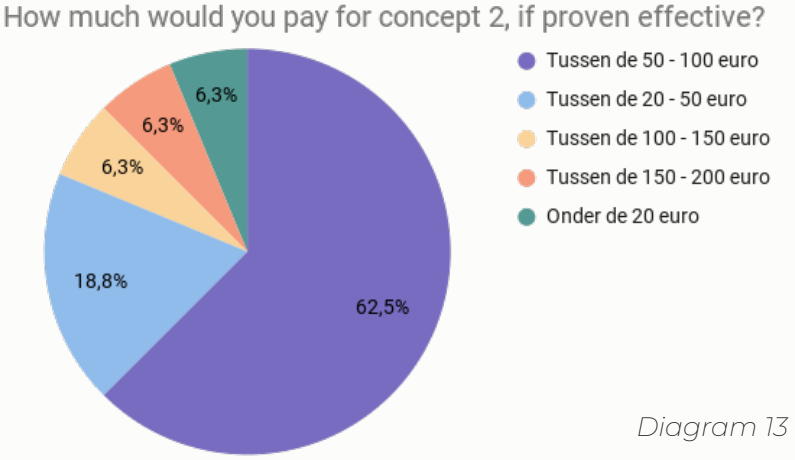


Diagram 13

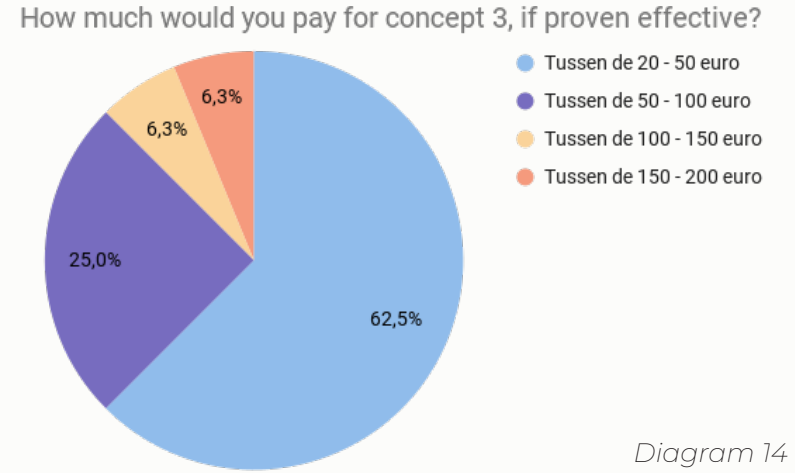


Diagram 14

Conclusions 4.2

Even though concept 1 is not liked the most, parents would pay the most money for it, indicating that the perceived value is high if research indicates that the vibrations work. They are just unsure if and how the smart mattress would work exactly. As almost all parents have children with plush toys, it is logical that they perceive that concept as more effective.
In conclusion, both concept 1 and 3 are good options from a parent perspective. Parents are willing to pay most for the smart mattress, indicating higher viability, and see a plush toy as the most feasible.

According to parents, the most desirable scenario is to include both the remote control through an app and an automatic smart function to the Haptic Lullaby design. This will allow parents to have control when they want, or let the product take care of a child's sleep for them.

What parents wanted to add to the product, music and white noise, are also vibration options for the Haptic Lullaby. These vibration modes could thus be vibrations that not only work for the children, which will be tested in the prototype tests in chapter 5.5, but that are also desirable for parents.

The conclusions from the online questionnaire inform design choices of the Haptic Lullaby. With the results of the questionnaire, it became clear that concept 2, the vibrating pad is least desirable. The complete decisions on product form can be read in chapter 3. The vibration design is developed in chapter 5. The scenario belongs to the implementation design and can be read in the rest of this chapter.

4.3 Use scenario

Scenario ideation

Apart from ideations on forms (chapter 3.3) and vibrations (chapter 5.2), an ideation was also done on possible use scenarios. For the use scenarios, the current scenario from the interviews was taken as a basis. Then new scenarios were made by thinking how a vibrating sleep product could change the current scenario. Different ideas were made for the way the vibrations could be turned on or off, for what kind of touch-point suits this control best, and for how the product could be charged and powered. All the ideas, parts of the total scenario, were written on post-its. Then the post-its were combined to easily and quickly create lots of scenario options. Appendix 11 shows all post-its and several scenario options.

Figure 35: Scenario ideation with post-its

Since the concept form has been chosen in chapter 3.3, a suitable scenario option could be selected. The following list of wishes was formed to methodologically find suitable scenario options:

The scenario should...
...allow the child to stay asleep, not waking them up
...be desirable for parents
...make the product ready for use at all times
...allow for easy transportation to other locations
...require as little effort as possible from parents
...give parents a high level of control over the vibration output
...have the most sustainable power option

In an excel sheet, all scenario options were given a ranking, showing to which degree they fulfil the wishes. This was done separately for the power methods and the vibration control options. The results are the following two tables 6 and 7.

The best way to charge the mattress was indeed, as initially designed in the concept, a power cable that can be plugged into a power socket. All battery options are less sustainable, because batteries include valuable chemical resources and with every energy transition some

Table 6: Scenario options for the power method

	Scenario \ Requirement	Desirability	Readiness for use	Mobility	Low parent effort	Sustainability	Total rating (1 = best)
	Power method						
1	Cable, power socket	+	++	--	++	+	1
2	battery chargable outside product	-	+/-	++	-	-	3
3	battery chargable inside product	+	+/-	+	+	-	2
4	battery, unchargable	--	--	+/-	--	--	4

Table 7: Scenario options for controlling the vibrations

	Scenario \ Requirement	No potential to wake up	Desirability	Readiness for use	Mobility	Low parent effort	Level of control	Total quality (1 - 5)
1	*Vibration control method*							
2	start & stop: phone message + voice control	+	++	+/-	+ (phone)	-	++	++
3	start & stop: baby monitor buttons/touchscreen	+		+/-		-	++	+
4	start & stop: voice control parents near product	--		-		-	+	-
5	start & stop with crying	+		++		++	--	+
6	start & stop: lots of/ no child movement	+		++		++	--	+
7	start: cry + press button by child	-		-		++	++ child -- parent	-
8	start: cry + press button by child and parent	-		--		-	++	--
9	stop: grip loosens on product by falling asleep	-	-- (not matching mattress)	-- (product falls, no vibe)		-	--	---
10	stop: X-time later than start, autoset	-		+/-		++	--	-
11	stop: X-time later than start, set by parents	+		+/-		+	++	++
12	stop: X-time after crying stopped, set by parents	++		+/-		+	+	++
13	start & stop: presence of crying + movement	++	++	++		++	--	+

energy is lost. The batteries also require more effort from parents and have the risk of running out of power during a night's sleep, reducing the "readiness" of the product. Therefore the power cable is the best option.

The most preferable option to control the vibrations is less clear than the choice of how to power the Haptic Lullaby. Multiple options score high, as can be seen in table 7. Therefore additional information was collected by parents in the online questionnaire. The questionnaire results mapped the desiredness for certain scenarios. Parents preferred an app to control the vibrations as well as a smart function that senses if the child is awake or not and adapts the vibrations accordingly. These were thus given ++ as a score for desirability.

For the final design these are also the two options that are included, because they scored high on the scenario wishes and are desired by parents. The chosen use scenario for the Haptic Lullaby can be seen in figure 36.

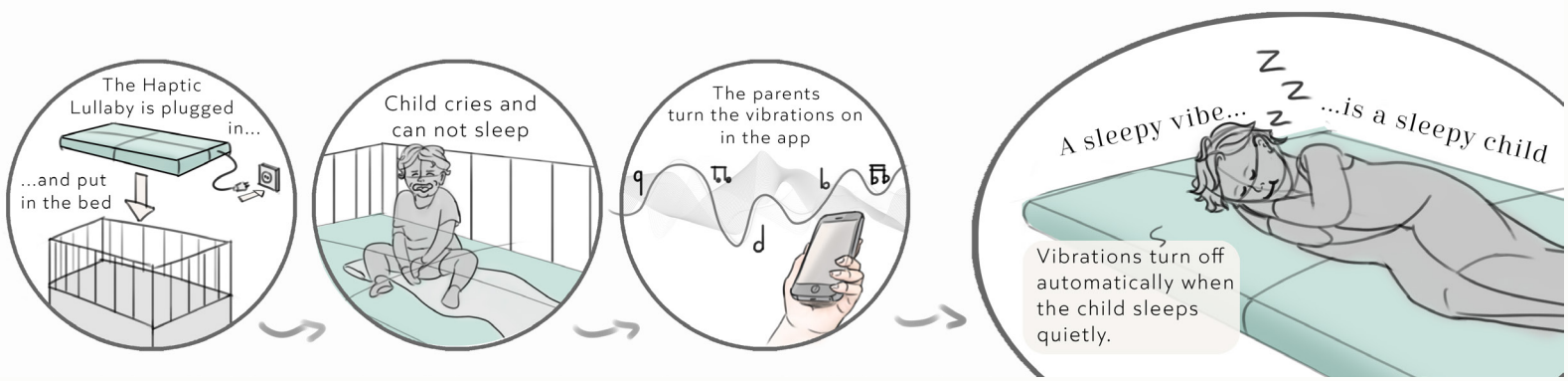


Figure 36: Use scenario of the Haptic Lullaby

05 Design Element 3: Vibration Design

5.1 Introduction

The core of the Haptic Lullaby product is its sleepy vibration. In the literature research no study was found that showed if or what kind of vibrations improve sleep. Therefore a foundational study on the sleepiness of different vibrations had to be conducted during this thesis.

The research questions that guide the vibration research are the following:

- Q1: Which vibration or vibration pattern is most sleep inducing or suitable for sleep to adults and to children?
- SubQ1: Which frequency is most sleepy?
- SubQ2: Which vibration pattern from a list of vibrations is most sleepy? ...from a list of thirteen vibrations for adults and a list of six for children
- SubQ3: Is the perception of the vibrations similar for adults and children?
- Q2: How is the sound of the vibration experienced?

The hypotheses for these research questions are:

- H1: Some vibration patterns will feel more sleepy than other vibrations.
- SubH1: Around 30 - 40 Hz will be found most relaxing or sleepy. Literature suggests that low frequency vibrations result in less arousal (Mazzoni, 2015) and 40 Hz seems to have beneficial effects (Olson, 2021) (Jirakittayakorn, 2017), so therefore this hypothesis is formed.
- SubH2: White noise and lullabies are most used in sleep products for children, so the hypothesis is that they will work best.
- SubH3: Adults and children have the same preferences for which vibrations feel sleepy.
- H2: Some vibrations will have more pleasant sounds for sleeping than others.

5.1

There were interesting and potentially sleepy factors and vibrations found in literature and in current products on the market. A list of eleven vibrations and vibration patterns was the result. With the list a research plan was made to test if it is possible to improve children falling asleep with vibrations and if yes, which vibration is most feasible. By using a prototype to research a phenomena, the experienced sleepiness of vibrations, the research can be categorised as design research. Prototypes not only help to understand product interactions and improve designs (Boess, 2010), but they can also serve as a kind of working hypothesis that dynamically generates knowledge (Boess, 2010; Stappers, 2007).

A pilot test was done with the prototype version described in chapter 3.4, after which the prototype was improved and two vibrations were added to the list. Subsequently, a test with adults was conducted to narrow down the list of thirteen vibrations to around six. These six vibrations could then be tested with the real target group, children between 1 -5 years old. More than six vibrations would make the test too long and complex for such a young age. An overview of the prototype research steps and outcomes can be seen in figure 37 below.

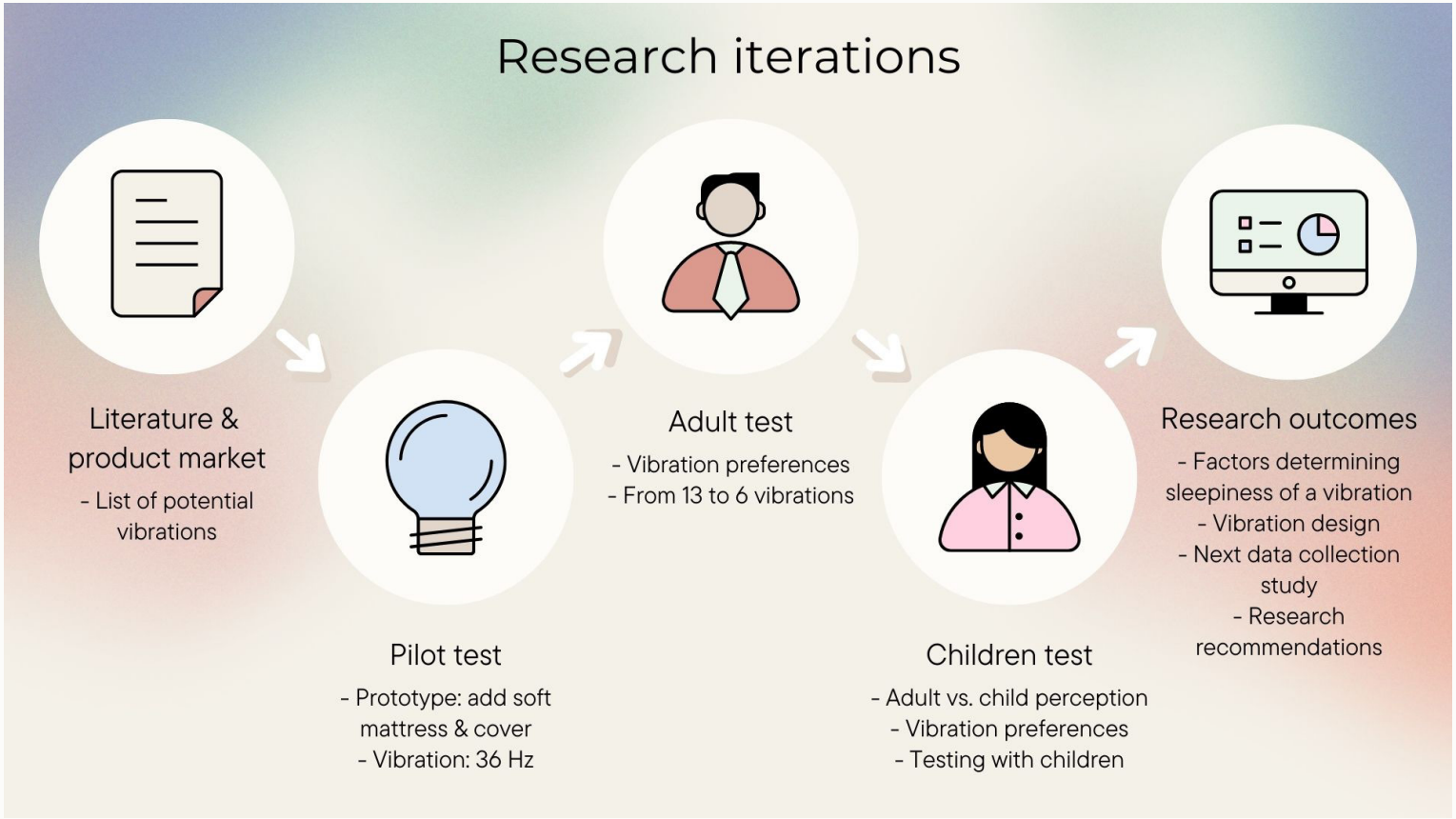


Figure 37: Research iterations described in chapter 5

5.2 Vibration ideation

Before all the research activities could be conducted, potential sleepy vibrations had to be selected and designed. The literature review was used to come up with vibration modes that seem feasible to enhance sleep or falling asleep, while the market analysis contributed with interesting options from existing products. Ideas from parents that came up during the interviews were also taken as inspiration.

From the gathered and brainstormed list of vibration options a selection was made. A criterion for vibrations to be included was that they should either have a scientific basis, be currently used as sleeping aid or in products on the market. The following list of vibrations and vibration patterns was formed:

- One frequency; the most sleepy vibe
- Heartbeat
- White noise
- Pink noise
- Brown noise
- Lullaby
- Parents voice
- Bedtime story
- Rain rhythm
- Binaural beats
- Breathing pattern; a changing volume/amplitude of one frequency
- Fade in and out

The heartbeat was chosen after a study that showed how a mother's heartbeat can calm infants after diaper change, also reducing the amount of crying (Chen, 2015). The heartbeat of a parent inspired the breathing pattern vibration. Some plush toys, for example an otter from Fisher Price, have bellies that expand and retract in a breathing manner, just as the Somnox.

White, pink and brown noise have been researched a lot, but without conclusive results. They are however very popular to put in sleep aiding products, especially white noise, so therefore they make the list. Lots of YouTube videos can also be found of white, pink or brown noise music. While looking for sound files of these noises, the concept of binaural beats came along. Literature indicates the potential of binaural beats for relaxation and sleep (Rishika, 2021).
The lullaby vibration came from the interviews. Several mothers sang lullabies themselves, or played a lullaby from a CD, phone or sleep product, although the products were not often used. Participant 4 said:

"The lullabies from those baby monitors sound super shrill. They don't sound beautiful, but like a computer."

Thus a lullaby was selected from an online source, not from a sleep product, that sounded like a typical lullaby, but was not super shrill. Interesting literature was found about lullabies as well. Studies show that lullabies promote sleep in newborns, are soothing, give a sense of social security and are an existing phenomenon across human cultures and time. For this effect, someone does not even have to understand the language of the lullaby (Unyk et al. , 1992; Trehub, Unyk & Trainor, 1993; Akkermann, 2021). Inspired by parents who sing lullabies themselves, the ideas of a parent voice and bedtime story vibrations took shape.

A single frequency sine wave is the most simple vibration and needs to be researched to form a foundational understanding if and how vibrations can help young children sleep. As a step between the single frequency and other vibration patterns, a vibration pattern was made that slowly fades in and out.

5.3 Pilot test

A pilot test was conducted with two children, who are three and nine years old. The goal of this test was to see if the prototype worked well and improve it for the tests with adults and other children. The pilot test would furthermore inform the method of the real tests with adults and children. During the pilot test, different vibrations were played and the oldest child was also allowed to adjust and play around with a single frequency vibration herself. The prototype consisted of a mattress sized piece of hard foam, in which the Dayton bass shaker was placed, see also chapter 3.4. The vibrations were based on Youtube videos or other internet searched sound files and adjusted in Audacity, where a low-pass filter of 40 Hz and 6 dB roll-off was put over the original sound files to make them better feelable. A list of links to the used videos or sound files can be found in appendix 12.

During the test, it was clear that a soft cover over the prototype was needed to make it more comfortable to lie on and to give the prototype a more finished, smart mattress-like look. Therefore a soft foam baby mattress from Ikea, the PLUTTIG, was bought after the pilot test and a mattress cover was put over the combination of the hard and soft foam. During the pilot test a thick, fluffy blanket was used as an alternative. The rug under the mattress helped to prevent vibrations being transported to the floor and thereby prevented noise production.

The oldest child indicated that a vibration of 36 Hz felt most sleepy, because it is not a really disturbing vibration, but “pretty low and not very loud”. 37 Hz already made a difference for her. She found that vibration also nice, but too loud.

The youngest child commented while the lullaby vibration was playing, that the vibrations felt ticklish on his cheek. “It tickles!” he said. After hearing and feeling the lullaby, the oldest child suggested playing some music she finds chill by an artist named Tycho. The vibrations of this music she liked also felt relaxed to her. To see if the 36 Hz was indeed the most sleepy single frequency vibration, this vibration was added to the list of possible sleepy vibrations that came out of the literature and product market reviews.

Figure 38: Pilot test

5.4 Testing with adults

Introduction

The goal of the prototype research with adults was to see how people experience the feeling and sound of vibrations in a mattress, and what preferences they have for a vibration to fall asleep with. Since the list of all vibrations was too long to test with children between 1 - 5 years old, this test also had the goal to narrow down that list. A few vibrations suitable and a few unsuitable for sleep would be selected, to understand if the preferences for and experience of the vibrations is similar to adults and children.

Testing with adults: method

Ten adults between 22 and 51 years old participated in the prototype research. After the research information (see appendix 13) was read to them, they were given a consent form to fill in. The consent form template can be found in appendix 14.

The test started by asking the participants to lie down on the mattress in whichever way was comfortable. To introduce the prototype to the participants, they were first allowed to adjust the frequency and amplitude of a single, sine wave vibration themselves. For this task, a phone with the Tone Generator app was provided to the participants. The experience of a whole body vibration was new for all participants. The free exploration therefore also gave them the opportunity to form a frame of reference of when a vibration feels suitable for sleep or not. The exploration ended with the task to indicate which frequency feels most sleepy or suitable for sleep and rate this frequency on a scale from 1 - 10, where 1 is not sleepy and 10 super sleepy. The test proceeded with the task to comment on and rate the sleepiness of a list of vibrations. The vibrations or vibration patterns were played after each other, proceeding when the participant had rated the current vibration. Participants were allowed to adjust the amplitude themselves, because not all sound files were of equal volume. The same order of vibrations /vibration patterns was kept for all participants and was as follows:

1. 36 Hz
2. 40 hz
3. Fade in-out
4. Heartbeat
5. White noise
6. Pink noise
7. Brown noise
8. Lullaby
9. Bedtime story
10. Rain sounds
11. Binaural beats
12. Breathing

The 36 Hz was included, because the oldest children of the pilot test found this the most relaxed and most suitable for sleep single frequency vibration. Literature indicates the potential for sleep of 40 Hz (Olson, 2021) (Jirakittayakorn, 2017), so therefore 40 Hz was added to the list. For the 35 Hz and 40 Hz vibrations, the participants were asked to compare them to the vibration they had just indicated as most suitable for sleep. In this way, the two vibrations were not only rated on sleepiness, but some validation was also done if the frequency participants selected in task 1 was indeed the most sleepy.

During the test, participants were asked to think out loud. Questions were asked to get more in-depth answers about why certain vibrations were sleepy or not; how the vibrations felt to the participants, and how the accompanying sound influenced the experience.
Apart from the ratings, typed notes were made during the test, in which participants' remarks and body language observations were documented.

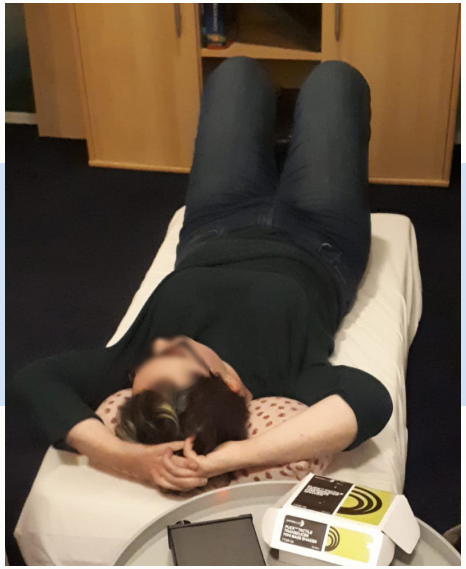
5.4 Testing with adults: results

There are several results coming forth from the test with adults. The complete notes and ratings can be found in appendix 15. The single frequency sine wave vibration participants perceived as most sleepy lies between 25 and 70 Hz, with most scores between 33 - 50 Hz. This is shown in table 8, where the most liked frequency per participant is noted down. Some participants could not choose one, but indicated two equally preferred single frequency vibrations.

Interesting to note is that frequencies around 80 Hz were often doubted if they were the most sleepy vibration, but most of the time a lower vibration was selected in the end. After their chosen sleepy vibration, the participants were exposed to the 36 Hz and 40 Hz vibrations. Two participants scored the 36 Hz vibration higher than their own chosen vibration, which was for those participants 40 Hz and 70 Hz. Nobody scored the 40 Hz vibration higher.

Table 8

	Best single freq (Hz)	
	1st choice	2nd choice
1	50	
2	33	
3	35	
4	47	80
5	57	
6	40	
7	25	35
8	33	
9	45	
10	70	



Participant 3 about the Lullaby: "I can completely imagine myself dreaming on this one."

Participant 7 about the Bedtime Story: "No I really don't like the talking. Distracts in the wrong way."

Diagram 15 shows the average score of each vibration mode with the Standard Error of the Mean (SEM). Looking only at the average, the single frequency selected by participants themselves scored highest, followed by the lullaby vibration and white noise. The bedtime story and heartbeat vibrations were perceived as the least sleepy. However, the SEM of almost all vibration modes is very large, meaning that there is uncertainty if the sample means represent the population means. If the SEM ranges do not overlap, there is a significant difference between vibrations.

Looking at which SEMs do or do not overlap, it can be seen that all vibrations except for the heartbeat, breathing, 40 Hz and fade-in-out vibrations were scored significantly higher than the bedtime story vibration. The single frequency, lullaby, white noise, binaural beats, 36 Hz, rain sounds and pink noise are also scored higher than the heartbeat. Higher than the breathing and 40 Hz are the single frequency, lullaby, white noise and binaural beats vibrations.

Diagram 15: Scores of each vibration, with standard deviation

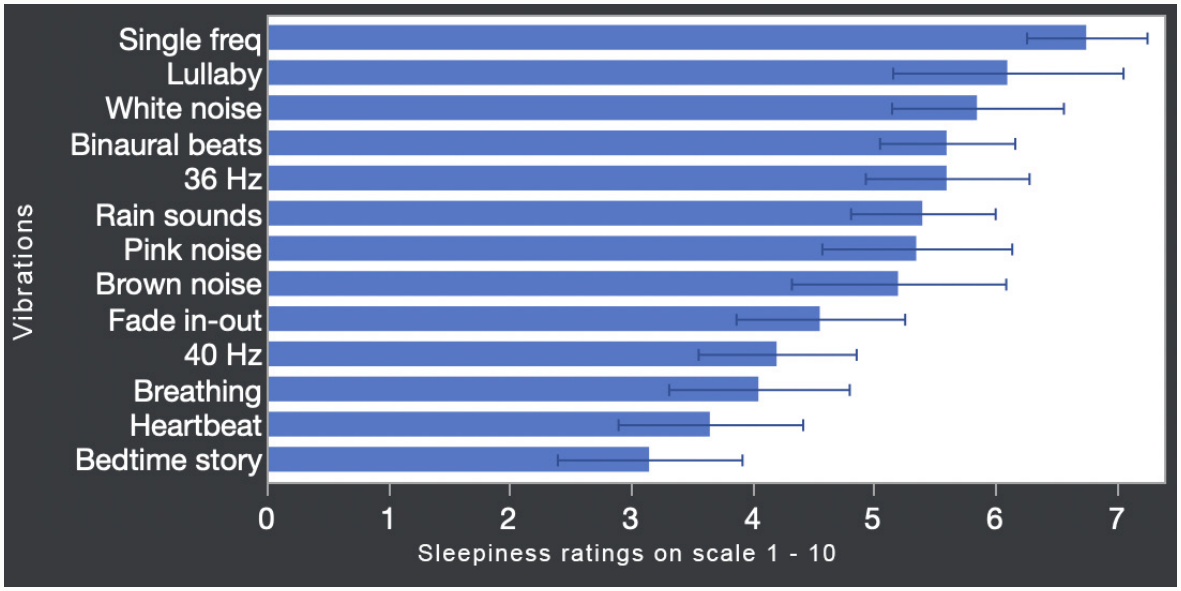
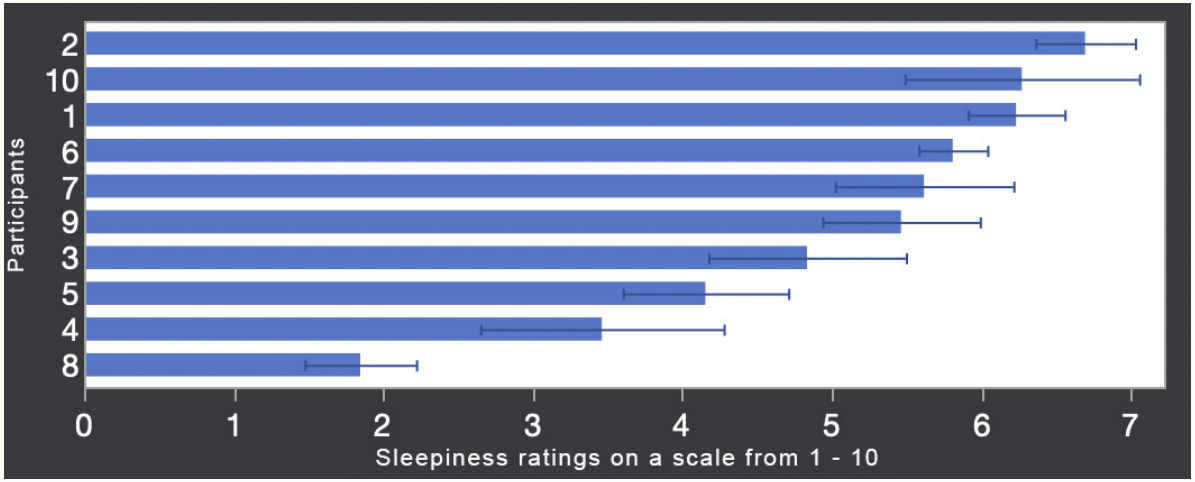


Diagram 16: Average score given per participant, with standard deviation



Diagrams 17 and 18 show a regression analysis of the gathered data. From them the significance of all vibrations and participants can be read. The RSquare under summary of fit of the participants is higher than that of the vibrations, indicating that who scores the vibrations is more predictive of how high or low a score is than the vibration itself. Some people just gave higher scores than others, which can also be seen in diagram 16. Participant eight clearly gave lower ratings than participant 2. What also differs between people is the size of the range of scores they give, so how diverse their scoring was. This can be seen when looking at diagram 16 or at the full results in appendix 15.

Diagram 17: Statistical analyses of the data 1

Summary of Fit

RSquare	0.360893
RSquare Adj	0.312557
Root Mean Square Error	1.980458
Mean of Response	5.03876
Observations (or Sum Wgts)	129

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	9	263.56261	29.2847	7.4664
Error	119	466.74359	3.9222	Prob > F
C. Total	128	730.30620		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	5.0371795	0.17442	28.88	<.0001*
participant[1]	1.1935897	0.521334	2.29	0.0238*
participant[2]	1.6551282	0.521334	3.17	0.0019*
participant[3]	-0.203846	0.540281	-0.38	0.7066
participant[4]	-1.575641	0.521334	-3.02	0.0031*
participant[5]	-0.883333	0.521334	-1.69	0.0928
participant[6]	0.7705128	0.521334	1.48	0.1421
participant[7]	0.5782051	0.521334	1.11	0.2696
participant[8]	-3.191026	0.521334	-6.12	<.0001*
participant[9]	0.424359	0.521334	0.81	0.4173

Diagram 18: Statistical analyses of the data 2

Summary of Fit

RSquare	0.17778
RSquare Adj	0.092723
Root Mean Square Error	2.275189
Mean of Response	5.03876
Observations (or Sum Wgts)	129

Analysis of Variance

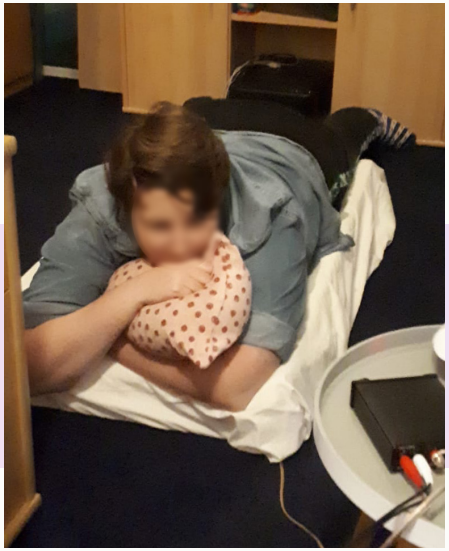
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	12	129.83398	10.8195	2.0901
Error	116	600.47222	5.1765	Prob > F
C. Total	128	730.30620		0.0226*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	5.0350427	0.200398	25.13	<.0001*
Label[36 Hz]	0.5649573	0.691498	0.82	0.4156
Label[40 Hz]	-0.835043	0.691498	-1.21	0.2297
Label[Bedtime story]	-1.885043	0.691498	-2.73	0.0074*
Label[Binaural beats]	0.5649573	0.691498	0.82	0.4156
Label[Breathing]	-0.985043	0.691498	-1.42	0.1570
Label[Brown noise]	0.1649573	0.691498	0.24	0.8119
Label[Fade in-out]	-0.479487	0.725836	-0.66	0.5102
Label[Heartbeat]	-1.385043	0.691498	-2.00	0.0475*
Label[Lullaby]	1.0649573	0.691498	1.54	0.1263
Label[Pink noise]	0.3149573	0.691498	0.46	0.6496
Label[Rain sounds]	0.3649573	0.691498	0.53	0.5987
Label[Single freq]	1.7149573	0.691498	2.48	0.0146*

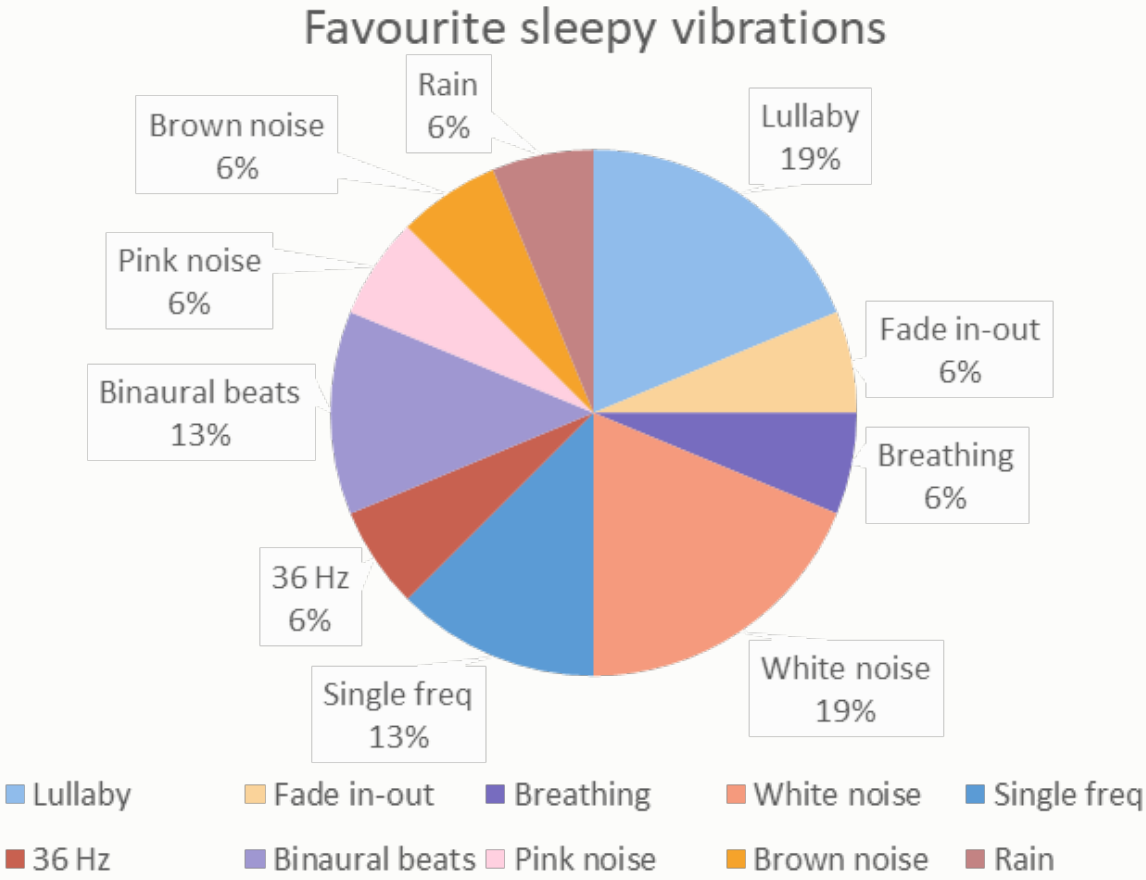
Because the SEM ranges are quite large, another analysis was done that looked at which vibration or vibrations were scored highest per participant. So for each participant their most sleepy vibration of the whole test was added to a list. From the list a circle diagram was made, see diagram 19. Only the heartbeat, bedtime story and 40 Hz vibrations were not the favourite sleepy vibration of anyone.

Now that the results have been presented, several conclusions can be drawn.



Participant 1 thinking out loud with the pink noise: "It feels like a big kitty is purring under me. I like it!"

Diagram 19: The highest ranked vibration per participant



5.4 Testing with adults: conclusions

From diagram 16 can be concluded that the opinion of people differs greatly, since the standard errors of the means are large. Looking at what the adults said during the test, this difference can also be seen. For example, about white noise participant 10 said "This one feels nice and not disrupting, like I am on the beach.", while participant 5 mentioned that he felt "like I am lying next to a railway while a freight train is thundering over it." The design of a vibrating product could therefore benefit from a personalisation option, or multiple vibrations to choose from. People's preferences differ too much to choose one. However, the most promising vibrations seem to be a single frequency vibration set by the user; a lullaby vibration; white noise or binaural beats. Circle diagram 19 supports this conclusion. Since ten out of thirteen vibrations are in the diagram, it also supports the conclusion that people's preferences are highly diverse.

From what people said during the tests can be concluded that people who are able or like to fall asleep with music give higher scores to the vibrations. They seem less busy with the sound accompanying the vibrations. This especially became clear with the lullaby vibration, where a lower rating was given by participant 6 who said: "I just don't sleep with music, but I can imagine that people who do will find this vibration chill." For others the idea of music was interesting, but the high tones and repetitiveness of the lullaby were disliked. They usually expressed this while feeling the binaural beats:
"This is better than the first melody, because the repetitive, high tones are gone." - participant 8.
The repetitiveness was also something people greatly disliked about the heartbeat, fade in-out and breathing vibrations.

From the regression analyses in diagrams 17 and 18, another explanation can be found for the large SEM ranges. These diagrams show that not only the vibration itself determines the score given, but that who gives the score is of more importance. Some people gave higher scores overall, liking vibrations for sleep in general more than others. Others gave consequently low scores. The range of the scores given also differs greatly per person, so some have stronger preferences than others.

The single frequency set by the participants themselves, the lullaby, white noise and binaural beats were experienced as the most suitable for sleep by adults. Even though the sample size was small, these are significantly scored highest. The least sleepy were the breathing, heartbeat and bedtime story. The vibrations that are chosen to be used in the consecutive test with children are thus the lullaby, binaural beats, white noise, bedtime story, breathing and heartbeat. The first three were chosen because they were rated most sleepy by the adults, and the last three because they were rated lowest. The single frequency was not chosen, because it had to be set by the users themselves. However, for children between one and five years old this is too difficult. By choosing these six vibrations, it could also be researched if adults and children experience vibrations in a similar manner or not.

The option of recording and playing back the parents' voices came up during ideation, but was not put in the research with children, because it would make the tests more complicated. Furthermore, the adults experienced the voices in the bedtime stories as very annoying. If the opinion of children on the bedtime stories turned out to be very positive, this can better be researched in a separate follow-up study.

5.5 Testing with children

Introduction

With the insights from the research with adults, a research with children could be started. What kind of vibrations do they like for sleeping? Is their perception similar to adults? The six vibrations that came forth from the adult tests, three potentially suitable vibrations for sleep and three unsuitable, would be used to research these questions.

Testing with children: method

In total three families were visited. The first two parents both have a child of just 1 year old. The third family that was visited has two children: one of 2 and one of 4 years old. The consent form template can be found in appendix 17, and the provided study information in appendix 16. To ensure participants stay anonymous, the filled in consent forms are not attached to this report.

The research method was adjusted from the test with the adults, as testing with this age comes with some differences and difficulties. Several of these are described in chapter 2.2, with considerations on research methods with children. First of all, complexity was reduced by shortening the list of vibrations to six instead of thirteen. Secondly, more time was reserved for the children to get acquainted with the prototype and the researcher, because trust improves willingness to participate and reduces anxiety (Punch, 2002) (Fargas-Malet, 2010). Because of the young age a caretaker, usually the mother, was present to help the child get on the mattress and make sure the child feels at ease. After reading the study information to the parents and filling in the consent form, the vibrations were turned on. The caretaker was asked to go with their child to the mattress and place them sitting next to it. The caretaker and researcher would then both hold out a hand, touching the mattress, so the child can see they don't have to be afraid. Usually this gesture sparked curiosity in the child, and they would reach for the mattress as well. Once the child touched the mattress, the caretaker would pick up the child and place them sitting or laying on it. Thereafter, the caretaker and researcher waited to see how the child reacted to the vibrations, verbal or in body language. To capture body language better, the tests were filmed with permission of the parents. Especially for the children of one and two years old, having their body language is important, since they cannot talk yet or only know a few words. So all information had to come from either the parent reading their child's body language and interpreting their sounds and few words, or from the body language captured in the video footage. From the child of four years old, an opinion could be asked. To make this as easy as possible, two vibrations were compared at a time. So first vibration 1 was compared to vibration 2, then 2 to 3, 3 to 4, etc. In this way, the child did not have to remember all the different vibrations. The way the comparison was brought to the child was as follows: "Is this vibration more or less nice to sleep with than the previous?" Or: "So is this vibration more sleepy? Or this?" The four year old was also asked how the vibrations feel to her. This seemed to increase her focus on the vibrations and let her feel them for a few seconds before comparing them to the other vibration.

During the tests, special attention was paid to the wellbeing of the very young children, and their willingness or "assent" to participate. If a child started crying and didn't stop, the vibrations were turned off and the test paused.

The timing of the experiment was made with consideration to the childrens' bedtime schedules. If possible for the parents, a time was selected just before one of the daytime sleeps, to increase the chance that the children were not full with energy, but ready to calmly participate. The timing was tweaked between tests. After test 1, it was discovered that too close to the bedtime can have a negative influence as well, namely that the child is too tired and not (emotionally) ready to meet someone new with some new product. It is better to not have to rush the test and take more time before naptime. A balance had to be found between wakefulness and tiredness of the child.
The research method was also discussed with assistant professor Mathieu Gielen, who teaches the IDE MSc elective courses Design for Children's play and Co-design and Research with children. He gave the tip to show the child with behaviour of the researcher and parent that the prototype is safe by for example touching it. He also suggested that instead of asking about the feelings that a child might have, a formulation could be used that focuses on the action or outcome. For example: "Is your doll going to sleep now?" instead of "Does this feel sleepy or relaxed?" Behavioural actions are something that children can relate to and describe more easily than feelings. Mathieu indicated the approach to let a child compare two vibrations at a time and not six at once is good, because it makes the method simpler.

Testing with children: results

The first child that was visited, had slept really badly that night and the test was very close to her bed time. Therefore she was in a crying mood and did not like to test a new product with a stranger next to her. Only with the sound of the lullaby vibration, she seemed to calm down a little. However, touching the mattress prototype was very scary. She seemed interested when her grandmother and the researcher both placed a hand on the mattress, but as soon as her grandmother brought her hand to the mattress, the child would start crying. The test was thus stopped to not distress the child more.

Figure 39: first child test

The second visit was planned with more time before the daytime sleep of the child. The girl was in a happy and curious mood. She crawled around the mattress, touched it when her mother and the researcher touched the mattress, and also tried to climb on the mattress herself. When her mother placed her on it, she sat there listening and giggling happily when feeling the vibrations. Her mother also lay the girl down on the mattress and said: *"I am surprised she is okay with lying down on it. That's really nice."* The girl reacted positively to all the vibrations, and it was very hard to notice any difference in her reaction between the vibrations. Even without the mother close to her, the little girl was interested in the mattress. When her mother was shortly in the kitchen, the child first crawled away from the mattress. Shortly after doing that, she crawled back and tried to get on. Figure 40 shows a few moments of the test.

Figure 40: multiple photos of test at second family: laying down & climbing on

The third family was visited twice. The first time, the oldest child had a friend playing over, so most of the test was planned to focus on her little sister. She however woke up really badly and cried a lot. So to test better with her, a second visit was planned. The older child and her friend disliked the heartbeat vibration most. The breathing was slightly better, but also not great. The lullaby was most suitable for sleep they said, followed by the white noise. They had neutral feelings with the binaural beats and did not know what to think of the bedtime story.

During the second visit, both the youngest and eldest child participated again. During this test, a table with expected behavioural responses, like laughing, frowning, crying or feeling, was brought along. The behaviour that occurred during the test could be quickly noted down. For the youngest child, little difference was observed between the vibrations. Only with the heartbeat vibration, she frowned more, indicating she does not really like it. The oldest child can speak full sentences, so she could provide more information. The white noise was nice she said, but she liked the binaural beats, breathing and lullaby better. Her mother noticed that with these vibrations, she was calmer too. The oldest liked the heartbeat vibration the least, just as the first time with her friend.

Figure 41: third family, visit 1: youngest child

Figure 42: third family, visit 2, oldest child

Testing with children: conclusions

From the tests with children it can be concluded that with children of one year old, it is not only very dependent on their mood how well tests can be performed, but because they can not talk, it is also difficult to know if there is any difference in their perception of the vibrations. It seems like the type of vibration does not really matter. Only the heartbeat vibration was clearly disliked most, just as with adults. The older children disliked the heartbeat and bedtime story most. Add the result that the lullaby, binaural beats and white noise were all received positively, and the conclusion can be made that it is highly likely that adults and children find the same vibrations sleepy, perceiving them in similar ways.

Additionally, the results show the potential to calm down children with a vibrating mattress. This first research shows that the method is feasible to study the sleepiness of different vibrations. With more of these tests, it is possible to gain more in depth insights into what the best vibration is for the sleep of children. Future tests should be conducted with the oldest children of the age group, so the four and five year olds, to get the best results.

5.6 Conclusions user tests

When both the adult and child tests were conducted, overall conclusions were drawn and decisions made for the vibration design of the Haptic Lullaby.

During the tests, several factors could be observed on which participants decided the sleepiness of a vibration. For example, when the amplitude of a vibration was too big, the vibration felt not suitable for sleep. The height of this maximum amplitude was dependent on the sensitivity of the person and the type of vibration, just as the minimum feelable amplitude. For all factors in the list, a similar difference between people exists. The border of what feels sleepy or not is somewhat personal. The factors determining sleepiness of a vibration are the following:

- Amplitude
- Frequency
- Structure of the vibration (pattern)
- Repetitiveness of the vibration (pattern)
- Speed of the (repeating) pattern
- (Volume of the) produced sound
- Associations with the produced sound
- Associations with the vibration feeling

As can be seen in the results in chapter 5.4, not all frequencies and vibration patterns were given equal scores. Even though not everyone liked the same vibrations, they all had their preferences. The influence of repetitiveness is also briefly mentioned before. A highly repetitive vibration is not experienced as sleepy, because it gets annoying and boring after a while. However, vibrations with a lot of variation are also not sleepy, because they distract too much. There is thus a balance between simplicity and diversity of a vibration, in a similar way that principle of MAYA, Most Advanced Yet Acceptable, indicates there is a desire for newness in a product consumer, but that newness should not make the product too hard to embrace (Dam, 2021a). The speed of a vibration influences how relaxed or energetic the vibration feels in a similar way that music with a high BPM sounds more energetic than low BPM music. Lastly there are the factors of associations with either the produced sound or feeling. If people have a negative association with one of these or even both, the overall experience is negative as well and not suitable for sleep. The following quotes showcase this well:

“It feels like a big kitty is purring under me. I like it, this vibration feels nice.” - participant 1 about the pink noise.

“This is kind of annoying. It sounds like the airco of the neighbours is on.” - participant 8 about the pink noise.

This list of factors are a new contribution to the field of haptics and are building a foundation for future product and technology design, as well as future research on the perception of vibrations. The factors can be used as a design tool for not only sleep products, but also other haptic experiences that include vibrations.

For the design of the Haptic Lullaby three vibration modes are selected that came best out of the research in terms of suitability of sleep and desirability from users. The three vibrations are: a single frequency adjustable between 30 and 50 Hz, a lullaby vibration and a combination of a lullaby with 39 Hz under it. The 39 Hz is an average from the vibration that adults set themselves as the most sleepy vibration and 30 to 50 Hz is a range that includes most of those vibrations. The lullaby scored the highest during the tests.

By including three vibration options in the Haptic Lullaby design, parents have the opportunity to choose from vibrations that came best out of the tests, one that feels most sleepy for their child. The slightly adjustable vibration provides parents with a feeling of control over the product and adds personalisation to the design. During the interviews it was concluded that when parents feel in control over a product, they perceive it as safer and they are more likely to want it. The vibration mode can be set in the app, where parents can also turn the vibrations on and off or activate the smart vibration mode to let the mattress sense if the child is awake and control the vibrations automatically.

Discussion & recommendations 06

6.1 Haptic research & children

6.2 Research method

6.3 Prototype

6.4 Ethics & social impact

6.1 Haptic research & children

When reflecting on the conducted research, several points of discussion come forth. First of all, multiple insights were gathered on doing research with children. The method used during this project was mainly observation by the researcher and (grand) parents. The information from the parents was especially insightful, because most of the participating children could not speak full sentences yet. The parents also know their child's behaviour patterns, for example what is common behaviour or not. However, this is a subjective observation method, in which personal opinions and judgement play a role. The research method could thus be improved by adding objective observations. A specialist on child behaviour, development and/or psychology could be added to the research team to achieve this. Possible professions are pedagogues, child physiotherapists and child psychologists. Pedagogues for example are educated to work with children and know what kind of child behaviour indicates certain motivations or emotions. These specialists can watch the video footage of tests back or be present during the tests alongside a main researcher. The first option has the advantage that the team who visits the parents and children stays small, which is less intimidating for children.

Another insight from doing design research with such young children, is that you have to be flexible and open to changes in your planning. Sometimes these children just wake up badly and are incapable of participating in a test with some new prototype offered by some new face. This highlights the importance of the Haptic Lullaby as a product, but for the tests themselves it means you have to be flexible and have patience. As a designer or researcher you can try to push on, but better is to make a new appointment with the parents and come back later, because a too tired child or a moody child will not give valuable information about a prototype. Rescheduling was also the solution used during this project and it worked well. In conclusion, any research that tests prototypes with children will have to reserve time into their planning for second attempt tests. Especially during COVID-times, because on top of the mood swings from bad sleeping children, families in quarantine can also force appointments to be rescheduled.

Looking at haptic research specifically, it could be seen that some children are more hesitant to try something new than others. To give the shy children a feeling of safety around the prototype, and spark their curiosity, it often helped when a parent, the researcher or both were touching the mattress. Examples can be seen in figures 43 and figure 44.

Figure 43: child feeling vibrations with her mom

Figure 44: child touching the mattress when the researcher did

During one test, a doll was also used by the mother, who laid the doll down on the mattress and acted like it was going to sleep. The child then walked away to get a blanket and all other doll stuff, and eventually got onto the mattress herself as well, see figure 45. It is hard for very young children to understand why they should test something or why right at this moment. This example shows that acting out and roleplay can make young children more involved in haptic research and more willing to participate.

Figure 45: third family, visit 2: parents enacting with the child's doll

These discussions lead to a recommendation on how the product could best be brought to users to be successful. A first-time user should not be an exhausted child, as the tests showed that the new experience of the vibrations can be scary for them. The advice to first let a child get used to the vibrations during an energised moment during the day should be put in use instructions or in an introduction tutorial in the app for parents. A positive first use experience can increase the chance of success.

6.2 Research method

The validity of the conclusions drawn from the research can be doubted, because the sample sizes were quite small. Just 10 adults participated, and 4 children. Furthermore the environmental setting was mostly similar for the adult participants, as the same room was used for all tests and most were conducted in the beginning of the evening, but the setting was not completely controlled. Consistent factors are important, because a lot of factors play a role when doing research on sleep. Not only time of day, location, oxygen level, light intensity or temperature of the room, but also tiredness, comfort and stress levels of participants can influence results. Regardless of the validity of the results, there is value in the conducted research. What has been shown is that it is feasible to research which vibrations are more sleep inducing than others with the used method, and that a mattress shaped prototype is a suitable product form for these kinds of tests. Furthermore, the conclusions about the sleepiness of different vibrations lays a foundation for future research. The list of factors that influence the sleepiness of a vibration is new to the fields of haptics and sleep product design.

6.3 Prototype

Something that worked well during the design research was the chosen concept to test with. The advantage of a mattress shaped prototype is that the focus of participants lies on the vibration experience and not on the product form. It thus reduces complexity of the product and narrows the amount of factors that are researched. If too many factors are researched at once, it is unclear which variable influences which outcome. For example, a test with a plush toy would inevitably include interaction qualities of the product, instead of only testing the vibration experience.

Something that can be improved about the prototype for adults was the size of the mattress, as most of them had to pull up their legs to fit on it. For tests with children the prototype can be improved by reducing the amount of (visible) wires and removing the laptop out of their view, because these two things attract their attention a lot. A waterproof mattress would also be an improvement and is essential for future research during sleep.

6.4 Ethics & social impact

Looking at the Haptic Lullaby product, some possible risks have to be addressed. Future research has to be aware that the physical impact of these vibrations on young children is unknown. Especially vibrations on the head could have a negative impact (Caryn, 2019). However, other vibrations, like binaural beats, have the ability to enhance deep sleep and have a positive impact (Rishika, 2021). The question arises if what feels unsuitable for sleep is also unhealthy. Is playing the “wrong” vibrations harmful? Therefore a thorough study should be conducted on possible physical effects before the Haptic Lullaby is released on the market.

A social problem all sleep products have is that over time they make their user dependent on the product. After a period of use, people can not fall asleep without it. For users of the Haptic Lullaby this could be a problem, because they only have one at home and not on vacation, or when they stay with friends or family. This is a design challenge future iterations of the Haptic Lullaby could tackle.

Sleep problems are an increasing problem of modern society. One in four people is not content with their sleep, of which six till ten percent are diagnosed with insomnia (Neuendorf, 2015). The effects of this are huge for society, as bad sleep not only affects daytime functioning, but also mental health (Neuendorf, 2015). The Haptic Lullaby can thus contribute to society by decreasing sleep problems. If the product works for children, it could also be a solution for adults. Furthermore, removing bad sleep habits at a young age is beneficial as it prevents behavioural and mental problems later in life (Neuendorf, 2015). Lastly, if a child sleeps well, the parents do not have to be awoken during the night. The impact of better sleep is thus relevant on a small family scale and big societal scale.

07 Final Design: The Haptic Lullaby

Introduction

Several elements of the Haptic Lullaby have been discussed through this report. Here they will be summarised, and information will be added about the place of the Haptic Lullaby in the smart mattress market; about product materialisation, aesthetics and branding, about the intended user experience and the value for users. The branding is formed by analysing websites and logos of related (smart) products and combining these insights with the moodboad on materialisation and aesthetics.

The final design

The Haptic Lullaby is a smart mattress that uses vibrations to help young children fall asleep. The mattress has three vibration options: a lullaby, a single frequency sine wave vibration and a combination of a lullaby with 39 Hz vibration. The sine wave vibration can be slightly adjusted by parents. Based on the preferences during the user research, this range is set between 30 and 50 Hz. Parents can control the Haptic Lullaby through an app, where they choose the vibration and can turn the vibrations on and off remotely. No need to walk into the child's bedroom anymore, you can stay in bed when the child cries at night. The remote control aims to prevent the iterative cycle of a parent walking in the bedroom, soothing their child, walking out of the bedroom and having to return because the child gets afraid to be abandoned and starts crying again. As the vibrations soothe the child, the parents don't have to get into the bedroom, removing the moment where fear of abandonment kicks in.

User value & experience

Haptic Lullaby provides a soothing experience for its users, children between 1 -5 years old. The name refers to how the experience should be: a lullaby that you feel. And by feeling this tactile lullaby you feel sleepy, just as a sung lullaby makes you sleepy. Parents do not experience the vibrations, but they could hear the sound accompanying the vibrations. Their product experience is mostly with the app. The app layout should be simple, clean and with large user interface (UI) elements, because parents have to be able to operate the app at night in their bed. The app should be made in dark mode, reducing the risk to wake up a parent more when controlling the app during the night.

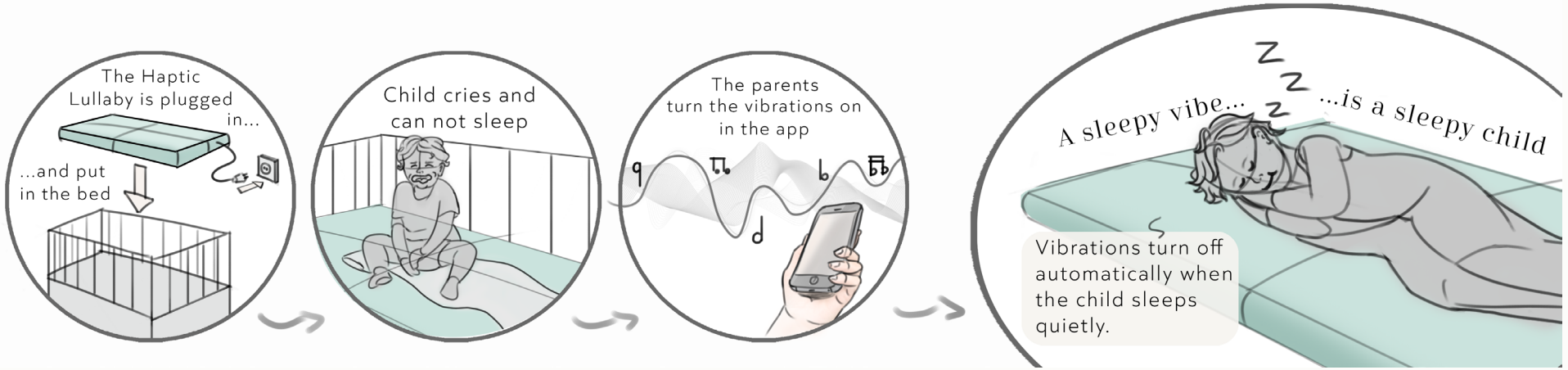


Figure 46: User experience shown in a scenario

The key value that the Haptic Lullaby provides not only to the child using it, but also to the parents is better sleep. When the child sleeps better, parents will be less or not woken up during the night. The smart vibration function unburdens the parents completely, while the app gives them remote control. No need to get out of bed. With the Haptic Lullaby, parents also get their evenings back. Getting rid of spending hours trying to get their child to bed, but having time for themselves is of great value. Lastly, the adjustable frequency of one of the vibration options allows for personalisation. It gives a personal touch to the product experience. These user values are shown in figure 47.

Better sleep for parents and child

Get undisturbed nights back by improving your child's sleep. Or have a relaxing evening for yourself without spending hours putting your child to bed.

Personalisable

Turn on the vibration with variable frequency, to adjust the Haptic Lullaby to the wishes of your child

Figure 47: User values of the Haptic Lullaby

07

Aesthetics & materialisation

A moodboard inspired the final aesthetics and materialisation of the Haptic Lullaby. The moodboard, seen in figure 48, is made from images related to child sleep products, night, bedrooms, sleeping, smart mattresses, other sleep or relaxation products or materials that feel relaxing and soft.

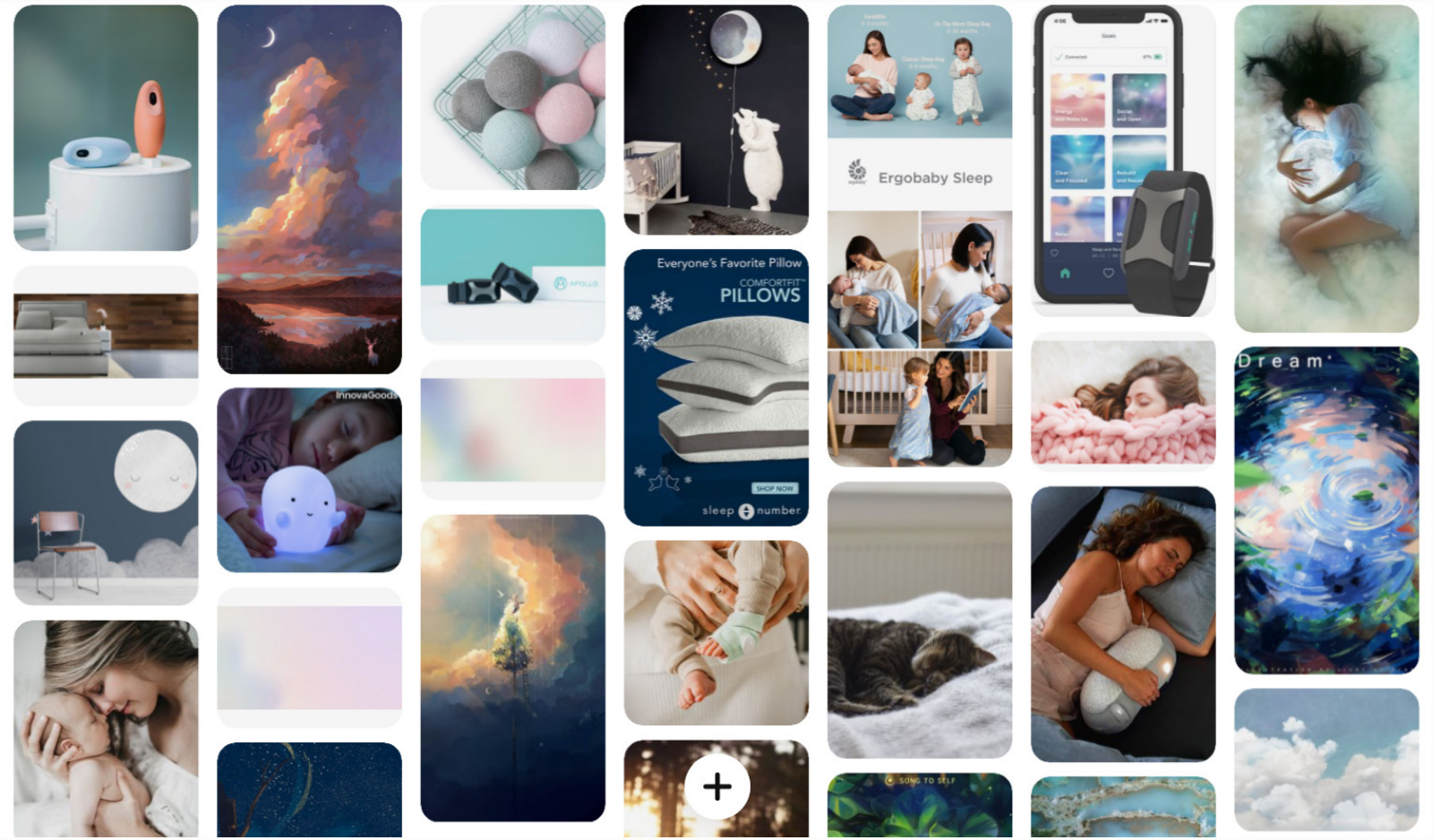


Figure 48: Moodboard on aesthetics & materialisation

The colours are mostly pastels, with dark blue for contrast that also refers to the night sky. Whites and slightly off-whites are used together with the pastels to give a calm, relaxed feeling. The softness of clouds and the colours of the sky during sundown are also an inspiration for colours and aesthetics. Often used materials are soft finished silicone, wool, memory foam and cotton.

Inspired by this moodboard, the Haptic Lullaby has a soft cotton mattress cover around the mattress. The colour options are pastels, for example pastel greenish-blue or light pink, see figure 49. A waterproof cover sould be under this layer, to protect the smart mattress below it against leaking accidents from children during the night.

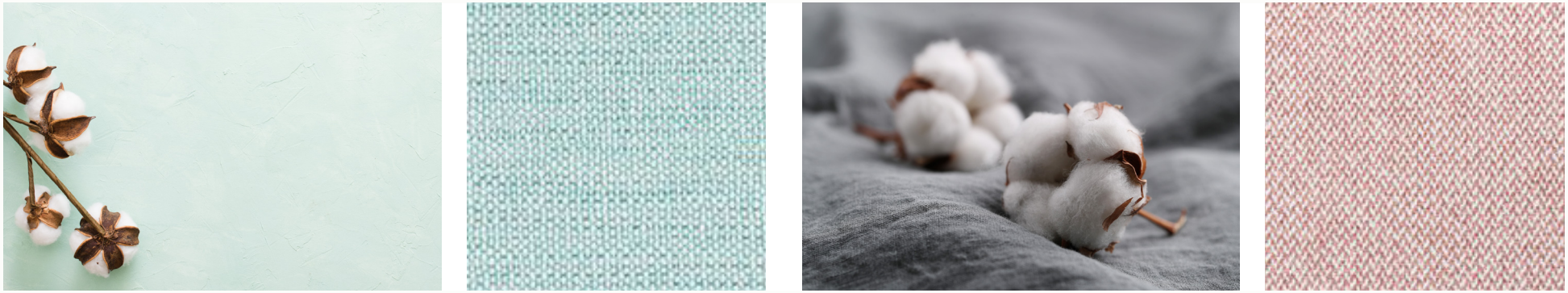


Figure 49: Soft cotton with colour options of the Haptic Lullaby

07

Smart mattress market

To understand the potential of the Haptic Lullaby as a product, we can look into the product market that it is part of. The Haptic Lullaby measures specific input from the user, the amount of movement and sound, and adapts its function accordingly, namely turning the vibration on or off. Its design is digital, connected, responsive and intelligent. Therefore it is a smart product (Raff, 2020) and belongs to the smart mattress product market. The smart mattresses researched during the current product market analysis in chapter 2.3 give an overview of the market. The mattress with a special foam structure from Purple is the least expensive and costs around $1400 dollars, converted to €1590 euro. The other real smart mattresses cost between $2600 and $6400 dollars, which is around €2950 till €7260 euro. Smart mattresses are thus luxury products on which customers spend a lot of money. These prices are for queen size beds, the standard for adult mattresses, so a kids mattress would cost a bit less. The high prices show how valuable a good night's sleep is for people and that they desire solutions for bad sleep. Solutions like the Haptic Lullaby. Parents who have a smart mattress themselves will not reap the benefits of it if their child keeps waking them up during the night. With the Haptic Lullaby, parents can finally enjoy their own perfect mattress, undisturbed.

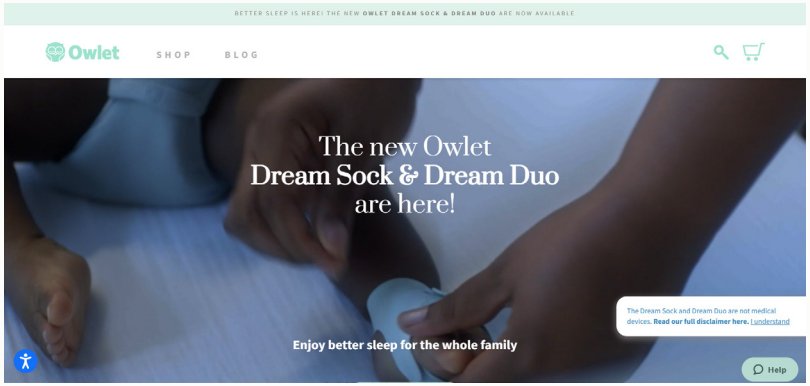
What contributes to the feasibility of the Haptic Lullaby is the fact that the smart mattress market is quite young and growing. Purple for example started in 2015 and SleepNumber in 2017. The Haptic Lullaby taps into the new opportunity of this growing market.

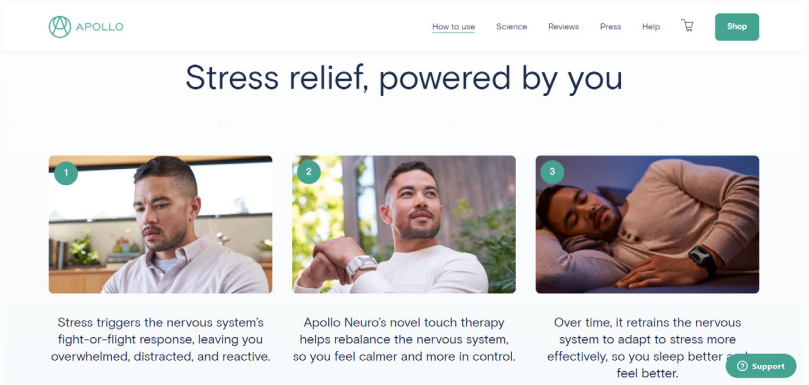
Figure 50: Smart mattresses. (Eightsleep, 2022; Purple Innovation, 2022; ReST, 2021; SleepNumber, 2022)

Marketing of the Haptic Lullaby

The Haptic Lullaby is a product not only belonging to the smart mattress market, but it is also related to products like the Somnox, Moonbird and Apollo Neuro. These are all smart products that use a certain output (breathing or vibrations) to help people relax, meditate or sleep. Looking at their websites, the main page consists of similar elements. At the top an experience image is placed with a key sentence to show in one view the use or purpose of the product. In other words: why you should have it. Then, not specifically in this order, several elements follow: a few key advantages or main achievements of the product; a visual, often a GIF, that shows how the vibrations or breathing work; the (scientific) basis of the product, why does it work?; and a few positive experiences from users. The websites are all very clean. The way the elements are ordered seems in line with the golden circle branding strategy, in which a company first states why they sell product/service X, before telling you how they get there and with what product or service. The reason for this is that people buy the why, not the what (Gardner, 2017).

Adobe Fonts was used to analyse the fonts on the websites of these smart products. The font on the Somnox website looks like Proxima Soft; the one on Moonbird like Quiet Sans; and on Apollo Neuro like Neue Haas Grotesque or Neue Haas Unica. These are all friendly and clean looking sans serif fonts, just as the fonts in the moodboard shown earlier in this chapter. The combination of clean





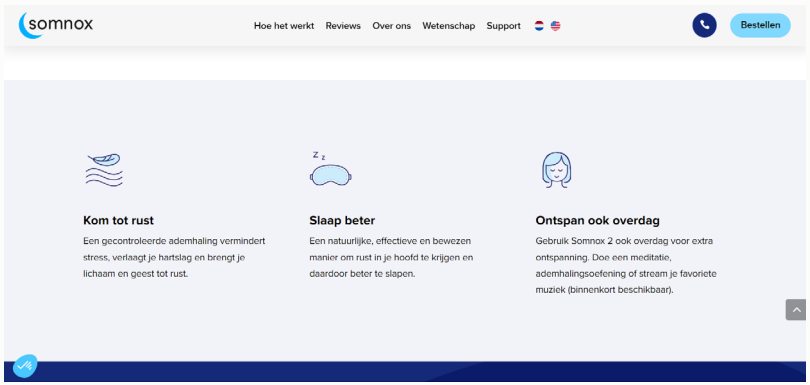


Figure 51: websites of related products

and friendly makes the product advertisement look trustworthy but approachable. Images on the websites show a caring parent, often the mother, with a child, adding a feeling of relatedness.

Related smart sleep products for children are the sleep monitor products from Owlet. Their website is similar to the Somnox, Moonbird and Apollo Neuro in that it starts with an experience video and some user reviews are also on their front page. Owlet however uses a serif font next to a sans serif font, to make it look more established and to add a bit of elegant dreaminess. All four products or brands have simple logos with lots of rounded shapes.

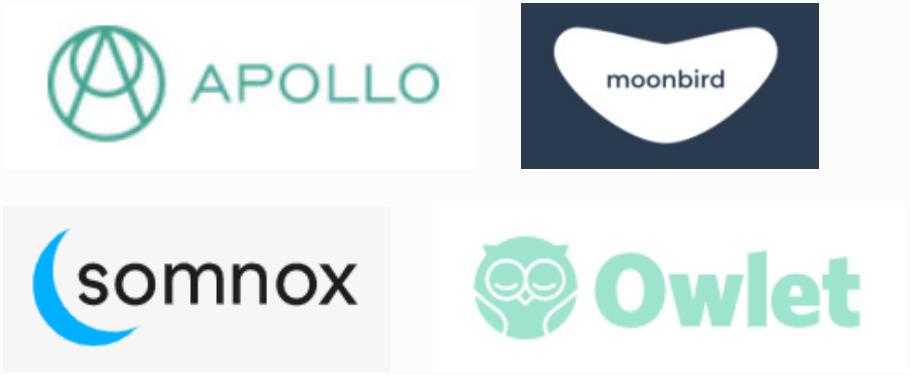


Figure 52: logos of related products

A visual communication style of the Haptic Lullaby is designed based on the moodboard and the style analysis of the four related product websites and their logos. The visual communication style is expressed through a web page visualisation, see figure 53.

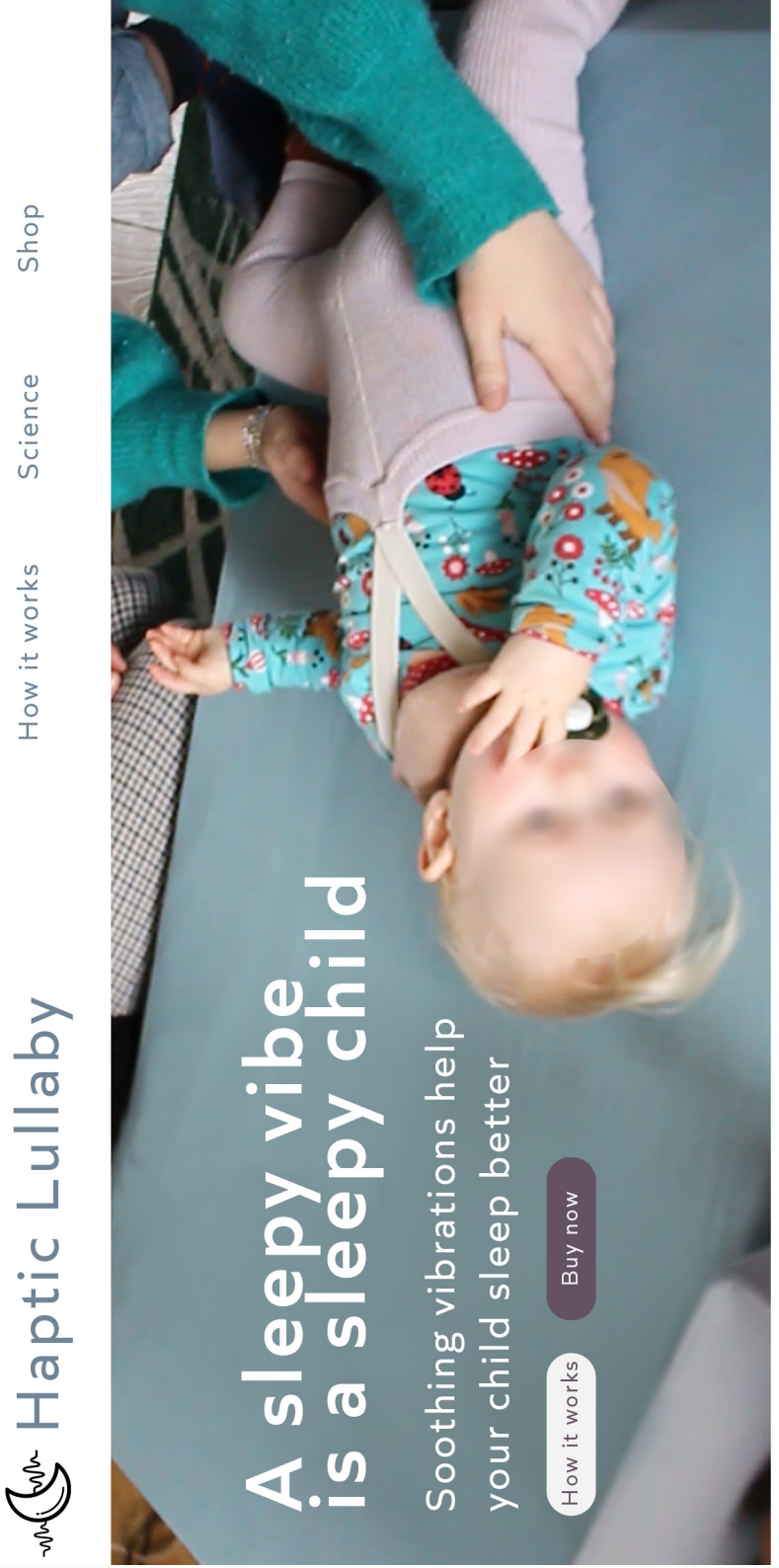
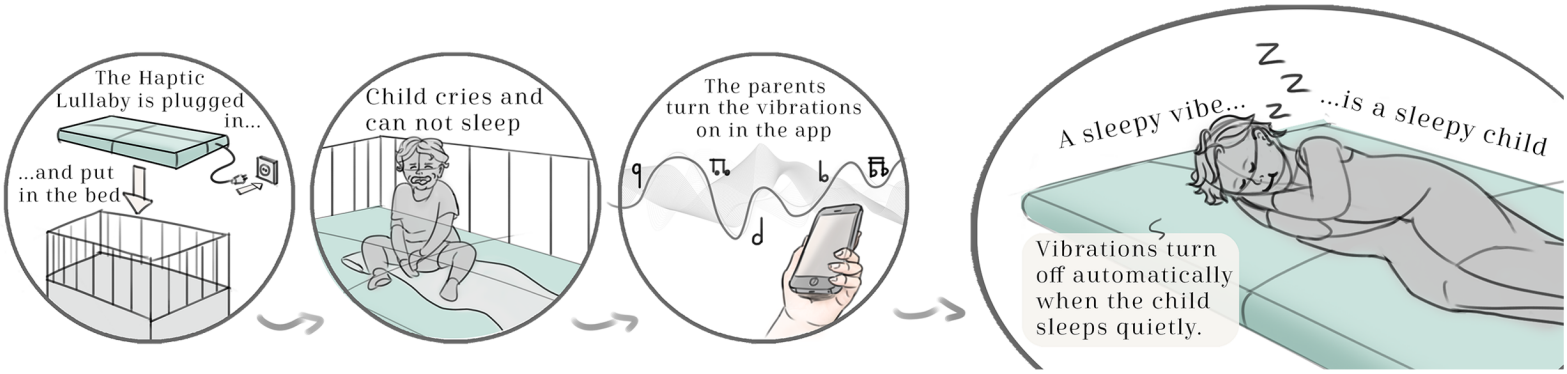


Figure 53: Visual communication style of the Haptic Lullaby

How Haptic Lullaby works



Better sleep for parents and child

Get undisturbed nights back by improving your child's sleep. Or have a relaxing evening for yourself without spending hours putting your child to bed.

The power of vibrations

Based on research

Designed with parents and children in mind through scientific research

Soothing vibe

The soft tones and soothing feeling of the lullaby-based vibration calms down children

Personalisable

Turn on the vibration with variable frequency, to adjust the Haptic Lullaby to the wishes of your child

08 Future research

Introduction

There are a few aspects of the final Haptic Lullaby design that lay a foundation for future research. These will be discussed in this chapter, while chapter 9 discusses next steps for the product development of the Haptic Lullaby.

First of all, the research on sleepy vibrations can be elaborated on. This graduation project gives a list of factors that influence if a vibration (pattern) feels sleepy to people. However the research done was with a small sample size and limited age range. Future research can follow a similar approach with a bigger, more comprehensive group of participants. Also not all participants had sleep problems. Future research could test if there is a difference in preferences between bad and good sleeping people.

A bigger sample size is also needed to better validate the ranking of the different vibrations. Additionally, research could be done on the effect of order on the perceived sleepiness of the vibrations. This research could be executed by making several test groups between which the order of the vibrations differs. Another factor that can be studied is the moment of the day on which the test is done. Nine out of the ten adult tests were done around dinnertime or at the beginning of the evening, somewhere between 17.00 and 21.00. So no tests were done shortly before bedtime or during sleep.

This brings up a next big step to take in sleepy vibration research: testing the vibration options during sleep over a longer time period. A longitudinal study could provide in depth insights in the effects of a vibrating smart mattress and validate if the lullaby, white noise, binaural beats and single frequency vibrations are indeed the most sleep enhancing. Before the smart mattress can safely be tested during a night sleep with children between 1 and 5, it should be made waterproof and wires have to be worked away inside the product or behind a bed. The youngest of these children use diapers and even the oldest can have a little accident at night, so therefore waterproof is important. To prevent dangerous play with electrical wires and components, these should be safely out of reach.

The youngest children seemed to have little preference for a certain vibration. Nonetheless, the heartbeat vibration was perceived least pleasant, seen by their frowning faces or restless movements. Adults also indicated this as one of the least pleasant vibrations. Future research could dive deeper into the preliminary conclusion that the preferences of adults and children do not differ. If this is true, initial research on the effect of vibrating mattresses can be done with adults, instead of children. For product developers, this would be valuable, because it saves a lot of time, is easier to conduct and easier to get ethically approved. Only final validation steps during sleep should still be done with the real target group, young children, because their sleep cycles differentiate from adults. If adults turn out to have different preferences, it would already be helpful for product developers if the effect on 1 - 5 year olds is similar to 5 - 10 year olds, because these children can talk well and express their experiences better.

While doing haptic research with the very young children, most insights were gained by reading body language or listening to the parents who read their child's body language. However these are both subjective ways of observation. As described in chapter 6, future research can improve the method by doing objective observations with a pedagogue, child physiotherapist or psychologist. It will be interesting to see if they observe more differences in the reactions of children on the vibrations.

09 Future product development

Introduction

Some of the just described future research is also what needs to be done to develop the Haptic Lullaby into a real marketable product. A main aspect that needs to be researched and designed further is the vibration itself. The conducted research lies a foundation to be built on, showing it is feasible to develop a vibrating sleep product, but more testing with bigger sample sizes is needed to iteratively design the Haptic Lullaby vibration. Therefore a plan for the next round of data collection is written out here.

Next round of data collection

In the next research, a bigger mattress should be used on which adult participants can fully lie down without pulling up their legs. The setting of the test can be more clean, with less distracting elements in the room, making sure the environment is consistent between tests as well. With a short questionnaire beforehand participants can be excluded who feel very tired or who are highly stressed, because these moods greatly influence the rating people give. The rest of the method can be similar to the previous research with adults: a list of vibrations is played to the participants who will give comments on how they experience the vibrations and score each vibration on a scale from 1 to 10, with 1 being not suitable for sleep at all and 10 being perfect for sleep.

The vibration options that should be tested during a followup research are based on the results of this graduation project. Taking the lullaby vibration and single frequency vibration as a basis, combinations and variations can be made. For example, a 39 Hz vibration (the average of the most prefered frequencies) can be put under the lullaby vibration. Other lullabies can be included to the list and a variation of the current lullaby in which the high notes are removed as well. People who disliked the current lullaby were mostly annoyed by the high tones. With the results of such a test, the vibration design can be improved. The more iterative tests

like this, the more sleepy the vibration will become. In this graduation project the assumption has been formulated that the perceived sleepiness of a vibration is similar for adults and children. The next round of data collection can thus be done with adults, who are capable of giving more in depth feedback than children.

Continuation

After a few rounds of data collection, in which the vibration design is iteratively improved, the vibration should be tested during a night's sleep with children. As indicated before, the prototype has to be waterproof and no wires should be reachable at this stage. This test should be done with children, because their sleep cycles differ from that of adults. The best is to test with the oldest children of the target group, so from age 4 or 5, because they can speak whole sentences and thus explain their opinions and experiences better. They would have to describe how well they slept during nights with and without the Haptic Lullaby. The observations of their parents can be added to the childrens' experiences. For example, did they have to get less out of bed during the night? Did they spend less time putting their child to bed? Parents could also be included in the study to test out the app that goes with the smart mattress. Video footage of the test nights is needed to enrich the subjective data of children and parents with objective observations.

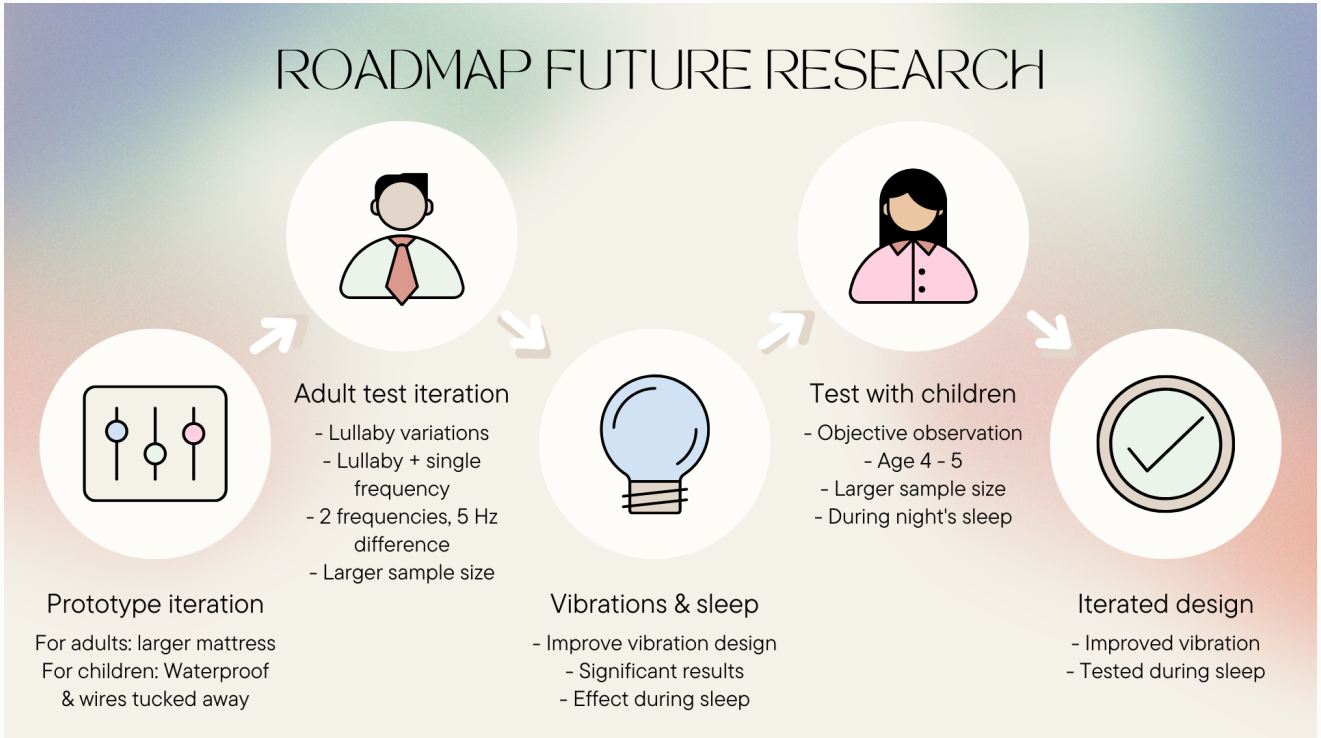


Figure 54: Roadmap for future research

A collaboration with neuroscientists could improve such a study during the night, because then the physical effects of vibrations during sleep can be analysed as well. Neurological insights can show if the product is safe to use during sleep, a criteria for the Haptic Lullaby to become a viable product. With the findings of a test during sleep, final adjustments can be made to the (vibration) design of the Haptic Lullaby. Figure 54 shows these steps in a roadmap overview.

10 References

1. Akkermann, M., et al. (September 30, 2021). Sound sleep: Lullabies as a test case for the neurobiological effects of music. *Cambridge University*. Retrieved on 19-12-2021 from: https://www-cambridge-org.tudelft.idm.oclc.org/core/journals/behavioral-and-brain-sciences/article/sound-sleep-lullabies-as-a-test-case-for-the-neurobiological-effects-of-music/3C301CFA1A2B6D5AE9C1BB3E0EF0C19E
2. Apollo Neuroscience Inc. (2022). *We're bringing the best of neuroscience to improve your health and wellbeing.* Retrieved on 24-01-2022 from https://apolloneuro.com/pages/science
3. Bayer, L., Constantinescu, I., Perrig, S., Vienne, J., Vidal, P.P., Muhlethaler, M. et al. (2011). Rocking synchronizes brain waves during a short nap. *Current Biology, vol. 21, no. 12*, pp. R461–R462. doi: 10.1016/j.cub.2011.05.012. http://www.cell.com/current-biology/pdf/S0960-9822(11)00539-2.pdf
4. Bee, H., Boyd, D. (2004). Putting it all together: the developing child., from *The developing child,* 10th edition, Pearson Education.
5. Björ, B. et al. (June 1, 2007). *Acute effects on heart rate variability when exposed to hand transmitted vibration and noise.* Retrieved on 7-9-2021 from https://link.springer.com/article/10.1007%2Fs00420-007-0205-0
6. Boess, S., Pasman, G., & Mulder, I. (2010). Seeing things differently: Prototyping for interaction and participation. In *Proceedings of the 6th International Workshop on DeSForM 2010: Design and Semantics of Form and Movement* (pp. 85-97).
7. Carden, L. (April 2018). Habit formation and change. *Current Opinion in Behavioral Sciences, 20:117*, Elsevier. DOI: 10.1016/j.cobeha.2017.12.009
8. Caryn, R. C., & Dickey, J. P. (2019). Transmission of Acceleration From a Synchronous Vibration Exercise Platform to the Head During Dynamic Squats. *Dose-Response*. https://doi.org/10.1177/1559325819827467
9. Castro, J. (2013a, July 30). *What is Pink Noise?* Retrieved on 7-9-2021 from LiveScience: https://www.livescience.com/38464-what-is-pink-noise.html
10. Castro, J. (2013b, July 30). *What is White Noise?* Retrieved on 7-9-2021 from LiveScience: https://www.livescience.com/38387-what-is-white-noise.html
11. Chen, W., Bambang Oetomo, S., Tetteroo, D., Versteegh, F., Mamagkaki, T., Serras Pereira, M., Janssen, L., & Meurs, van, A. (2015). Mimo pillow : an intelligent cushion designed with maternal heart beat vibrations for comforting newborn infants. *IEEE Journal of Biomedical and Health Informatics, 19*(3), 979-985. https://doi.org/10.1109/JBHI.2014.2349153
12. Dam, R., F. (2021a). *The MAYA Principle: Design for the Future, but Balance it with Your Users' Present*. Retrieved on 13-1-2022 from Interaction Design Foundation: https://www.interaction-design.org/literature/article/design-for-the-future-but-balance-it-with-your-users-present
13. Dam, R., F., Siang, T., Y. (2021b). *Personas – A Simple Introduction*. Retrieved on 26-01-2022 from https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them#:~:text=Personas%20are%20fictional%20characters.,user%20you're%20designing%20for.
14. Dickson, G. T., Schubert, E. (1 November 2019). How does music aid sleep? Literature review. *Sleep Medicine, Volume:63*, Page(s):142. Elsevier.

15. Dunn, S., C. (September 23, 2021). *How Much Does a Baby Shower Cost*. Retrieved on 24-01-2022 from https://babykidcare.com/how-much-does-a-baby-shower-cost/
16. Eightsleep. (2022). *Pod Pro Mattress*. Retrieved on 24-01-2022 from: https://www.eightsleep.com/eight-pod-sleep-cool/?irclickid=tcr2lb1vjxyitptuqswjdsanukgzou1dmwluyy0&utm_source=impact&utm_campaign=ideaing.com&irgwc=1
17. Fargas-Malet, M., McSherry, D., Larkin, E., & Robinson, C. (2010). research with children: methodological issues and innovative techniques. *Journal of Early Childhood Research, 8*(2), 175–192. https://doi.org/10.1177/1476718X09345412
18. Feldman, R. S. (2016). Ontwikkelingspsychologie [Child development] (7e editie; A. Moons, Eindred.; E. Lahlah, L. Voets, & G. van der Wielen, Nederlandstalige bew.; V. Walsmit, G. Bouman, T. Zuiderbaan, & M. Kerkhof, Vert.). Amsterdam: Pearson.
19. Galland, Barbara C., & Mitchel, Edwin A. (April 19, 2010). Helping children fall asleep. Published by group.bmj.com
20. Garcia-Molina, G., Mahadevan, A. (2017). Slow waves in the sleeping brain. *Koninklijke Philips N.V.* Retrieved on 21-9-2021 from https://images.philips.com/is/content/PhilipsConsumer/Campaigns/HC20140401_DG/Documents/smartsleep-whitepaper.pdf
21. Gardner, K. (January 17, 2017). *How to Use the Golden Circle in Content Marketing*. Retrieved from Business2Community.com on 24-01-2022 from https://www.business2community.com/content-marketing/use-golden-circle-content-marketing-01752202#:~:text=The%20Golden%20Circle%20is%20a,they%20do%20what%20they%20do.
22. Geddes, L. (18 October, 2020). *White noise as sleep aid may do more harm than good, say scientists*. Retrieved on 7-9-2021 from the Guardian: https://www.theguardian.com/lifeandstyle/2020/oct/18/white-noise-as-sleep-aid-may-do-more-harm-than-good-say-scientists
23. Gielen, M. (January 2015). Co Design and Research with Children & Design for Children's Play. Reader ID5184 & ID5185, TU Delft Faculty of Industrial Design Engineering.
24. Grandin, T. (1992). Calming effects of deep touch pressure in patients with autistic disorder, college students, and animals. *Journal of child and adolescent psychopharmacology, 2*(1), 63-72.
25. Halo. (2022). *BassiNest® Premiere Series Vibrating Bassinet*. Retrieved on 24-01-2022 from https://www.halosleep.com/new-halo-bassinest-swivel-sleeper-premiere-series-herringbone-4419
26. Himes, B. J. et al. (5 May, 2021). The Effect of Beat Frequency Vibration on Sleep Latency and Neural Complexity: A Pilot Study. *IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 29*, pp. 872-883, 2021, doi: 10.1109/TNSRE.2021.3076983.
27. Jirakittayakorn, N., & Wongsawat, Y. (2017). Brain responses to 40-Hz binaural beat and effects on emotion and memory. *International Journal of Psychophysiology, 120*, 96-107.
28. Kavurmaci, M., Dayapoğlu, N., & Tan, M. (2019). Effect of music therapy on sleep quality. *Alternative Therapies Health Med, 1*.
29. Kerr, S. and Jowett, S. (May 17, 1994). Sleep problems in pre-school children: a review of the literature. Child: Care, Health and Development.
30. Kimura, Hitoshi., Kuramoto, Akisue., Inui, Yuma., and Inou, Norio (June 1, 2017). Mechanical Bed for Investigating Sleep-Inducing Vibration. *Journal of Healthcare Engineering Volume 2017*, Article ID 2364659, 9 pages.
31. Korres, G., et al. (2018). A Vibrotactile Alarm System for Pleasant Awakening. *IEEE TRANSACTIONS ON HAPTICS, VOL. 11, NO. 3*
32. Kumar, R. (2014). *Research methodology, a step-by-step guide for beginners* (4th edition). Los Angelos: SAGE

10

33. Lai, H. L., & Good, M. (2006). Music improves sleep quality in older adults. *Journal of advanced nursing, 53*(1), 134-144.
34. LaMotte, S. (3 May, 2021) *White noise (and pink and brown): The science behind the sounds.* Retrieved on 6-9-2021 from CNN: https://edition.cnn.com/2021/03/18/health/white-pink-brown-noise-sleep-wellness/index.html
35. Laura A Dima (2022). *The Finger Rug Rug*. Retrieved on 20-01-2022 from https://lauraadima.com/projects/the-finger-rub-rug/
36. Litsenburg, R. R. L., Waumans, R. C., Van den Berg, G., Gemke, R. J. B. J. (2010). Sleep habits and sleep disturbances in Dutch children: a population-based study. *European Journal of Pediatrics 169(8):1009. Springer Berlin Heidelberg*. 0340-6199. DOI: 10.1007/s00431-010-1169-8
37. Liu, Y. (September 2020). Doplor Sleep, friendly feedback towards a better hospital soundscape for sleep. [IPD Master Thesis, Delft University of Technology, Delft, The Netherlands] Retrieved from repository.tudelft.nl http://resolver.tudelft.nl/uuid:aee9664f-7c86-44a7-8b5e-9c606531e51d
38. Loewy, J. et al (2013). "The Effects of Music Therapy on Vital Signs, Feeding, and Sleep in Premature Infants." *Pediatrics* 131.5: 902-918.
39. Loveday, A. (September 20, 2019). *UK Study Reveals How Much First-Time Parents are Spending on Baby Gear*. Retrieved on 24-01-2022 from https://ergobaby.co.uk/blog/uk-study-reveals-how-much-first-time-parents-are-spending-on-baby-gear/
40. Mahadevan, A., Garcia-Molina, G. (2017). SmartSleep: quantifying slow wave activity enhancement. *Koninklijke Philips N.V.* Retrieved on 21-9-2021 from https://images.philips.com/is/content/PhilipsConsumer/Campaigns/HC20140401_DG/Documents/smartsleep-whitepaper.pdf?_gl=1*tfw8rd*_ga*OTEwNDY5OTQxLjE2MzE2MDgxMDY.*_ga_2NMXNNS6LE*MTYzMjIwNjY2OC42LjEuMTYzMjIwNjk5OC42MA.._ga_7HJGB4S2PKMTYzMjIwNjY2OS4xLjEuMTYzMjIwNjk5OC42MA..&_ga=2.251113987.421276062.1632206669-910469941.1631608106
41. Mazzoni, A., Bryan-Kinns, N. (2015) How Does It Feel Like? An Exploratory Study of a Prototype System to Convey Emotion through Haptic Wearable Devices. 2015 7th International Conference on Intelligent Technologies for Interactive Entertainment.
42. Means, M. K., Lichstein, K. L., Epperson, M. T., Johnson, C. T. (22 March 1999). Relaxation therapy for insomnia: nighttime and day time effects. *Behaviour Research and Therapy 38, Issue 7 (2000).* Pages 665-678.
43. Nandhini, P., Janney, J. B., Divakaran, S. (September 2016). Design of an Intelligent Pillow with Maternal Temperature and Heartbeat Vibrations for Comforting NICU Infants. *Indian Journal of Science and Technology, Vol 9 (33).* DOI: 10.17485/ijst/2016/v9i33/99606
44. NCCIH. (June 2021). *Relaxation techniques: What you need to know about them*. Retrieved on 8-9-2021 from NCCIH: https://www.nccih.nih.gov/health/relaxation-techniques-what-you-need-to-know
45. Neuendorf, R., Wahbeh, H., Chamine, I., Yu, J., Hutchison, K., & Oken, B. S. (2015). The Effects of Mind-Body Interventions on Sleep Quality: A Systematic Review. Evidence-based complementary and alternative medicine : eCAM, 2015, 902708. https://doi.org/10.1155/2015/902708
46. Newsom, R. (December 18, 2020). *Relaxation exercises to help fall asleep.* Retrieved on 8-9-2021 from Sleep Foundation: https://www.sleepfoundation.org/sleep-hygiene/relaxation-exercises-to-help-fall-asleep
47. Nixon, G M., et al. (September 18, 2016). Falling asleep: the determinants of sleep latency. Published by group.bmj.com
48. Oers van, M., Stoevelaar, J. (December 2019). Whitepaper: The Somnox Sleep Robot, scientific background.
49. Olson, L. (2021). The magics of 40 hertz. *Journal of Internal Medicine*, *290*(5), 944-946.

50. Ouellet, M. (18 Augustus 2017). *Gorilla University: How do Vibration Speakers Work?*Retrieved on 20-01-2022 from https://gorillagadgets.com/blogs/gorilla-gadgets-blog/gorilla-university-how-do-vibration-speakers-work
51. Owlet. (2022). *Owlet Dream Sock. Smart baby monitor that tracks sleep quality.* Retrieved on 24-01-2022 from https://owletcare.com/products/owlet-dream-sock
52. Perrault, Aurore A., et al. (February 4, 2019). Whole-Night Continuous Rocking Entrains Spontaneous Neural Oscillations with Benefits for Sleep and Memory. *Current Biology 29*, 402–411, Elsevier Ltd.
53. Piaget, J. (1954). *The construction of reality in the child*. Routledge.
54. PrecisionMicrodrives. (2021). *Vibration motors. Eccentric rotating mass (ERM), LRA, and solenoid.* Retrieved on 20-01-2022 from https://www.precisionmicrodrives.com/motors/vibration-motors
55. Punch, S. (2002). Research with Children: The Same or Different from Research with Adults? *Childhood*, 9(3), 321–341. https://doi.org/10.1177/0907568202009003005
56. Purple Innovation. (2022). *The Purple grid.* Retrieved on 24-01-2022 from https://purple.com/purple-grid
57. Raff, S., Wentzel, D., & Obwegeser, N. (2020). Smart products: conceptual review, synthesis, and research directions. *Journal of Product Innovation Management, 37(5)*, 379-404.
58. ReST. (2021). *ReST Original Smart Bed with GelGrid.* Retrieved on 24-01-2022 from https://restperformance.com/product/rest-bed-with-gel-grid/
59. Rishika, R., Gupta, A., Sinha, S., & Reka, S. S. (2021). Sleep Pattern Study with Respect to Binaural Beats Using Sensors and Mobile Application. *Wireless Personal Communications*, 1-17.
60. Sanders, E. B. N., & Stappers, P. J. (2012). *Convivial toolbox: Generative research for the front end of design*. Bis.
61. Schott, G. D. (1993). Penfield's homunculus: a note on cerebral cartography. *Journal of neurology, neurosurgery, and psychiatry, 56*(4), 329.
62. Seydel, R. (18 July 2017). *How Do Speakers Work: Understanding Audio Reproduction [Infographic].* Retrieved on 20-01-2022 from https://blog.landr.com/how-do-speakers-work/
63. SleepNumber. (2022). *Categories / Mattresses.* Retrieved on 24-01-2022 from https://www.sleepnumber.com/categories/mattresses
64. Stappers, P. J. (2012). Doing design as a part of doing research. In *Design research now* (pp. 81-91). Birkhäuser.
65. Suni, E. (August 14, 2020). *Stages of Sleep.* Retrieved on 8-9-2021 from Sleep foundation: https://www.sleepfoundation.org/how-sleep-works/stages-of-sleep
66. Thorpe, K. J., Staton, S. Sawyer, E., Pattinson, C., Haden, C., & Smith, S. (2015) Napping, development and health from 0 to 5 years : a systematic review. *Archives of Disease in Childhood, 100,* pp. 615-622. http://doi.org/10.1136/archdischild-2014-307241
67. Tononi, G., Riedner, B.A., Hulse, B.K., Ferrarelli, F., Sarasso, S. (January, 2010). Enhancing sleep slow waves with natural stimuli. *Medicamundi 54*(2):82-88.
68. Toompas, S.(Mat 12, 2020). *16 High-Tech Baby Monitors*. Retrieved on 24-01-2022 from https://www.parents.com/baby/gear/monitor/5-high-tech-baby-monitors/

69. Trehub, S. E., Unyk, A. M., & Trainor, L. J. (1993). Adults identify infant-directed music across cultures. Infant Behavior and Development, 16(2), 193–211. https://doi.org/10.1016/0163-6383(93)80017-3.CrossRefGoogle Scholar
70. Tsai, H. J., et al. (2015). Efficacy of paced breathing for insomnia: enhances vagal activity and improves sleep quality. Retrieved on 7-9-2021 from https://onlinelibrary.wiley.com/doi/10.1111/psyp.12333
71. Unyk, A. M., Trehub, S. E., Trainor, L. J., & Schellenberg, E. G. (1992). Lullabies and simplicity: a cross-cultural perspective. Psychology of Music, 20, 15–28.
72. Utami, Desak Ketut Indrasari., et al. (May 2018). Building design and performance test of vibration beds with Whole Body Vibration. *Journal of Global Pharma Technology*
73. Wahbeh, H., Calabrese, C., Zwickey, H., & Zajdel, D. (2007). Binaural beat technology in humans: a pilot study to assess neuropsychologic, physiologic, and electroencephalographic effects. *The Journal of Alternative and Complementary Medicine, 13*(2), 199-206.
74. Waterhouse, J. et al. (2012). Daily rhythms of the sleep-wake cycle. *Journal of Physiological Anthropology*. Retrieved on 7-9-2021 from https://jphysiolanthropol.biomedcentral.com/track/pdf/10.1186/1880-6805-31-5.pdf
75. Yui, L. (September, 2020). Doplor Sleep, Friendly feedback towards a better hospital soundscape for sleep. IPD Master Thesis TU Delft.

Appendices 11

1. Interview questions
2. Research information interviews
3. Consent form interviews
4. Notes interviews
5. Timeline exercises of interviews
6. Statement cards
7. Excel sheet prototype self test
8. Brainstorm sketches
9. Online questionnaire, questions
10. Online questionnaire, results
11. Scenario post-its
12. List with links sound files
13. Research information test adults
14. Consent forms test adults
15. Results test adults
16. Research information test children
17. Consent forms test children
18. Revised planning
19. Project brief

11 Appendix 1: interview questions

Thema's: kinderen + slaaprituelen, slaapproblemen, slaap producten, slaappatroon, leeftijd & slapen.

Vragen voor ouders:

- Hoeveel kinderen hebben jullie en hoe oud zijn ze?
- Wat is het slaappatroon van jullie kinderen? Zijn jullie tevreden hiermee? (Of hebben ze slaapproblemen?)
- Wat is/was de moeilijkste leeftijd om kinderen in slaap te krijgen? Welke leeftijd slapen ze het slechtste?
- Wat zijn problemen/moeilijkheden bij het laten slapen van kinderen?
- Wat wisten jullie niet over slaap & kinderen voordat jullie kinderen kregen, en nu wel? Oftewel: wat weet ik als niet-ouder volgens jullie niet over slapen & kinderen?
- Hebben jullie informatie opgezocht over kinderen & slapen voor jullie ouders werden? Zo ja, waar en welke info?
- Hoe beïnvloedt het slaapritme van uw kind jou/uzelf? (slaap, emoties, gedrag, functioneren, etc.)
- Kunnen jullie stap-voor-stap op deze tijdlijn zetten & beschrijven hoe het kind(eren) naar bed brengen verloopt? (vanaf het moment dat het kind/de kinderen naar bed moeten tot ze slapen)
- Hebben jullie dingen die je altijd doet voor het naar bed gaan? Of bij het gaan slapen? (Hebben jullie speciale slaaprituelen?) Zo ja, welke?
- Welke van deze dingen/rituelen is het meest en welke het minst belangrijk? Hoe komt dat?
- Kunnen jullie merken of het kind wel of niet goed slaapt? Zo ja, hoe?
- Welke dingen hebben merkbaar invloed op hoe goed of slecht jullie kind slaapt?
- Bij slechte slapers: Welke dingen hebben jullie geprobeerd (acties, producten, etc.) om het in slaap vallen te verbeteren? Kunnen jullie die rangschikken op effectiviteit?
- Bij goede slapers: Stel jullie kind zou slecht in slaap vallen of 's nachts veel wakker worden, wat zou het eerste zijn dat je probeert om dit te veranderen?

- Waar zou een slaap product voor uw kind aan moeten voldoen?
- Zou ik jullie voor een vervolgonderzoek mogen benaderen?

Appendix 2: Research information interviews

Informatieformulier Interview over slaap van jonge kinderen

De interviews zullen gaan over alles wat komt kijken bij de slaap van jonge kinderen. Het doel van het onderzoek is om een begrip te krijgen van de context, zodat een goed passend product kan worden ontworpen. Wat komt er allemaal spelen bij het naar bed brengen van kinderen? Welke slaapproblemen hebben ze? Zijn er producten die het in slaap vallen of blijven slapen helpen? Etc, etc.

Tijdens het interview zullen geschreven notities gemaakt worden door de onderzoeker. Hierbij worden geen namen genoteerd, zodat de data anoniem blijft. Persoonlijke gegevens als naam, woonplaats of email adres worden dan ook apart bewaard van de interview data. Deze persoonlijke gegevens worden niet gedeeld buiten de onderzoeker (Marjolein Schoorl). De geschreven notities zullen worden vernietigd zodra het afstudeer project beëindigd is. Alleen geanonimiseerde data blijft bewaard in het afstudeer rapport. Er is geen risico verbonden aan deelname aan de studie.

De Technische Universiteit Delft heeft als onderzoeksbeleid dat wetenschappelijke studies reproduceerbaar en controleerbaar moeten zijn. Om hieraan te voldoen moet de data vindbaar, toegankelijk, interoperabel (dat je er zonder beperking mee kan samenwerken), en herbruikbaar zijn. Aan het einde van het afstudeerproject wordt de geanonimiseerde data dan ook verwerkt in het Graduation Report, dat op repository.tudelft.nl komt te staan.

Appendix 3: Consent form interviews

The filled in consent forms are not included in this report to ensure participants stay anonymous.

Toestemmingsformulier onderzoek naar slaap van kinderen

Selecteer alstublieft de gepaste circles	**Ja**	**Nee**
Deelname aan de studie		
Ik heb de informatie over de studie gelezen op [/ /], of het is aan mij voorgelezen. Ik heb de kans gehad vragen te stellen over de studie en mijn vragen zijn naar tevredenheid beantwoord.	○	○
Ik geef vrijwillig toestemming om deel te nemen in deze studie en begrijp dat ik mag weigeren om vragen te beantwoorden en ik op elk moment me kan terugtrekken van deelname, zonder opgaaf van reden.	○	○
Ik begrijp dat deelname aan deze studie een interview betreft, waarvan geschreven notities worden gemaakt door de interviewer. Persoonlijke informatie wordt anoniem gemaakt voordat data wordt geanalyseerd.	○	○
Gebruik van informatie in de studie		
Ik begrijp dat informatie die ik geef gebruikt gaat worden in het afstudeer project van Marjolein Schoorl, en dat resultaten van het onderzoek gepubliceerd worden in het afstudeer rapport (Graduation Thesis) voor de TU Delft. De resultaten van de interviews zijn input voor het ontwerp van een slaapproduct voor jonge kinderen. Data wordt tijdens het project beveiligd bewaard in de OneDrive van de TU Delft.	○	○
Ik begrijp dat persoonlijke informatie die mij kan identificeren [zoals naam of woonplaats], niet gedeeld wordt buiten de onderzoeker.	○	○
Ik geef toestemming voor het gebruik van geanonimiseerde quotes in onderzoeksuitkomsten.	○	○
Ik stem in voor het overdragen van de gedeelde copyright over de tijdlijn opdracht naar Marjolein Schoorl.	○	○
Toekomstig gebruik en hergebruik van de informatie door anderen		
Ik geeft toestemming voor het opslaan van geanonimiseerde data, namelijk de interview notities en tijdlijn opdracht, in database 4TU.ResearchData, zodat het gebruikt kan worden voor toekomstig onderzoek en leren door de TU Delft.	○	○

Handtekeningen

_____	_____	_____
Naam deelnemer	Handtekening	Datum

Ik heb accuraat het informatieformulier voorgelezen aan de deelnemer en, tot het beste van mijn kunnen, verzekerd dat de deelnemer begrijpt dat ze vrijwillig deelnemen en toestemmen.

_____	_____	_____
Naam onderzoeker	Handtekening	Datum

Contact onderzoeker voor verdere informatie: Marjolein Schoorl,

[email]

Appendix 4: Notes interviews

Interview 1

1) 1, 17 maanden
Slaapkop, tenzij tandjes, dan eigenlijk nog goed.
↳ blijven janken, gaat ze dan slapen? 1 of 2 nachtjes

2) 1 slaapje sommige, zij 2.
11.00 - 12/13 15 - 16/16.30
19u - 6/7
Ook wel 8.30 gehad,
soms 5.15 dan weer naar bed
Gewoon niet accepteren als te vroeg
dan eruit. Wakker als naar werk

3) vermoeden, dat zometeen moeilijkste wordt 2-3 jaar
Altijd na voeding lekker slapen
Begin 7 8 voedingen per dag
melk blijven geven
In slaap ritueel? Stel tussen 5 & 7 wakker? → even aan borst en weer slapen.

4) Boekjes met rijmes. Moeite op tijd naar bed te krijgen. voor zomer. kennis bood hulp. Overdag goed ritme. Baby op gevoel
Nu echt ritme.
7 uur naar bed. Huilen oke, echt janken niet. Was moeilijk om te leren dat 't oke is.
Ritme is super belangrijk

Interview 2

1) 1,5 & 4
2) Wisselend per fase.
1,5 nu; eerste 7 maanden sliep ze in dezelfde ruimte als hun.
Nu eigen bed. Ging eerst goed, later herkende ze dat je weg ging. Toen iets langer bij blijven dan steeds verder weg zitten.
Tent: alles anders. Eigen cabine.
Kinderwagen in slaap. Daarna thuis weer terug bij af. Opnieuw bij blijven tot sliep. Nu neerleggen en lange doei. Even nog mama roepen als oudste op bed gaat. Snel kus en slapen.
Nog niet in slaap gevallen maar wel lekker liggen. laatste 2 weken weer.

3) Verlatingsangst. → tussen 1 & 1,5 ongeveer ↳ /1 & 2
4) Rond 1,5 jaar
Ook bij oudste gehad.

Babyfoon waarbij je heen en weer kan praten. Alleen bij oudste.
Verhaaltje kwijt. Kleurenlamp, kleurt kleur, niet als ouders slapen
6 - 6:45 rood, overdag maar nog niet eruit
groen → mag hij eruit,
Philips Hue lamp → met app
als zij eruit zijn dan verder groen.
Voordeel van lamp of afstand

Rustig wakker worden. Nog geen prikklok
Alleen rode lamp. Knuffels stelen.

lampjes & wekkers die met tijd iets doen. Schaapjes etc. Nieuw huis met deze lampen overal.
fase dat ze geen klok kunnen kijken maar wel besef van dat het vroeg kan zijn. nadeel losse wekkers is niet op afstand.
Nijntje oogjes: klik! → meteen wakker
Lamp maakt hem niet wakker.

10. Leren voor slapen = belangrijk
Massage tijdelijk. Liedje doet zij wel en papa niet. Mama weet wel.
Speen & knuffels belangrijk voor jongste.
↳ veiligheid.
Starten met bedritueel moet duidelijk zijn. 5 min wijzer boven aan en dan gaan we slapen (oudste). Kookwekker zetten voordat ze klok ging leren.

12. Nabijheid bieden, meer knuffels

8) 18.30 → vanaf dat zo moe is
Beetje zeurderig
als douchen dan ervoor 18u
Bed leeg als ze gaat slapen
's ochtends: ergens tussen 5 & 6, nog even borst, weer in bed, lekker slapen, dan wel knuffeltjes soms daarmee even spelen

trappelzak, winter met mouwtjes

10) Luier moet echt, meest belangrijk dan borstvoeding, contactmomentje

Borstvoeding goede uitwisseling vol goede stoffen. nooit ziek

11) Ervaringen vragen.

Verkouden: tip navragen en hulp

Facebook groepen met ouders

Osteopaat → kijkt naar samenhang hele lichaam. Soort manueel therapeut, maar zonder forceren.

Huilbaby & Osteopaat helpt
Eten, slapen, aandacht, luier
↳ begin engel
heel intensief
nu meer interactie

Wakker, 11 min janken, uiteindelijk over

Muziekje → hoe moe ze is, alleen als ze nog heel wakker is. Soort afleiding.

Producten: fever niet iets bs of dan, want daar kan ze zich mee verstikken, of bloedsomloop afknellen, o.i.d. Iets vast aan/onder/op bed zou het fijnste zijn.

10) Verhaaltje - jip & janneke

13) - 's middags te kort slapen, 's avonds ook moeilijk → te moe
- In auto in slaap na eten, dan weer wakker, is moeilijk
Garantie voor slecht in slaap komen
(eigen kamer)

12) Ligt aan oorzaak
papa missen, verhaaltje maken met happy end
Oorzaak niet weten, langer bij zitten
slaapliedje zingen. Ze kan het nu wel goed vertellen, is fijn.
Jongste: ronddragen; wiegen
↳ deed ze vroeger

11) Stevig zijn, lief & knuffelig eruit zien
Bij ene is het dan altijd goed
Geen harde geluiden.

Minder donker = niet alleen.
Vooral overdag verlatingsangst
→ nachtlampje

Pinguin muziekje met hartslag → saai
↳ schel

Slaaprituelen zijn belangrijk → zelfde volgorde aanhouden.

Mag later benaderen

Babyfoon → optie bedje.
↳ vanaf beneden kan je dat aanzetten

Baby: elke 3 uur wakker. Oudste gelukkig niet veel wakker.

3

1) 3j & 10 maanden
2) ja & nee,
Oudste: 's middags goed, laatste paar weken 2-6 keer 's nachts uit bed, snel weer slapen. 's middags bijslapen
19.30 naar bed
Nu geen heksen meer. Wil zindelijk zijn, maar 's nachts af nog niet
Jongste: slaapt hele nacht door
3) Oudste nu het lastigste. In slaap komen
Smoesjes om niet te hoeven slapen.
Wat snapt ze wel of niet van mijn uitleg?
We Smoesje, ~~kussentje~~, lampje → wandlampje, of zelf naar wc,
licht, donker, eng gelaat, fantasie
Vaak naar boven.
6) Ieder kind is anders. Ene snapt wel door, ander niet. Geen goed of fout.
• Oei, ik groei → boek met ontwikkelingen
•
8) Verhaal belangrijkste voor oudste
Smoesjes: mama beneden, kind zij boven, roepen
- knuffeltje (→ belangrijk), & speen; nachtlampje
iets minder donker
foto van papa & zusje ~~[illegible]~~
- oppas mag wel boekje mee, mama niet
- haast bed potje, langzaam aan zelf

---

1) bijna 2 & bijna 5
2) Super goede slapers. Allebei eigen kamer
Uitprobeer periode: Oudste ingetrapt: op de grond naast liggen & langzaam weg, maar dat escaleert
toen via boekje: huilen, 5 min aanh; terug leggen, 1 dag 2 uur volhouden
1e: rond 4½ jaar ↳ daarna goed
2e: rond 1 jaar
→ Standaard internet tip
Deel verlatingsangst,

↳ wel terugkomen, maar geen oogcontact of het doen

7) Eerste echt alles googlen. Ze denkt je & dit overleeft ze wel.
6) Slaap: niet van tevoren verdiept.
Voorkeurshouding, voorkomen. → zwak hoofdje

8) meestal dezelfde knuffels
→ controle
deur open: uitzicht op trap, anders zien.
! bedje: al in de buik gezongen, nu wordt ze er kalm van. Dus altijd mama op bed leggen

geen knuffel is probleem.

Verhaaltje: moet echt, ook als ze bijv. in de auto al heeft geslapen.

12) Jongste: opnieuw wat je eerder deed. kan niet praten. Verlatingsangst

Oudste: achterhalen wat er is, altijd een reden. Of angst of spanning of aandacht
Niet in op dingen verzinnen.

13) Mug in kamer. Verder eigenlijk goede slapers. Spannende dingen → opeens weer bed slapen.

11) - Verkouden: bedje schuin
- Matrasje kun je ook schuin zetten bijv.
- Warm of koud hebben in bed is moeilijk te herkennen. → zij gebruiken klassieke neurotische mobiel
- Muziekjes die nu uit babyfoons komen: nooit gebruikt want klinkt super schel
Iets mooi's, niet computer
- hand

• Jonge ouders: zomer & wintertijd is lastig, want nooit schema om.

5

1) 5 jaar (& 2 broers onder dan zij)

2) Ja goede slaper. Altijd? Begin jaren lastiger. Veel, lang tussen de middag geslapen, tot 3 jaar.
Verschilt per kind, 2 jaar ongeveer niet meer.
↳ a 3.
Baby ritme, duurt even, is ingewikkeld met voeding, ingewikkelder. Slapen veel maar niet wanneer je wil.
Zij nu, tussen 19 - 19.30 naar bed
7 uur ~~de~~ wakker maken.
anders tot 8 uur. Soms bij haar liggen
Broers wakker & eruit, dan zij ook eruit.
Anders blijft ze liggen.
Neefjes/ ~~te~~ nichtje ~~vroeg~~ vroeg wakker, te weinig nachtrust.

5 8) Als moeders: ~~hier~~ adviezen wel aanhoren, maar eigen plan trekken. Bijv. adviezen over hoe te liggen verandert elke 10 jaar.
Luister naar jezelf, onbewust.
Weet zelf vanuit opleiding wel veel over ontwikkeling kind.
- Tip: slaapritme krijgen: plan echt volhouden voordat het is ingesleten. Niet maar 2 dagen.
Vast ritme, voor slapen, helpt.
- Als ze afwijkt van het schema, dat krijg ik het altijd terug. Niet doen ben je uiteindelijk langer bezig. Dan komt ze er opeens 3 keer uit.

3e kind: verhaaltje kan ook CD zijn, CD kan ook bedje zijn,
↳ liggend in bed, pyjama aan
↳ bedje duurt langer dan verhaal
~~maar~~ ↳ tijdwinst mama maar later slapen want CD af
pyjama

8) plassen, tanden p., verhaaltje
Begin tijd maakt niet veel uit voor haar

• Beetje afhankelijk ook van de week
• Drukke week kan ook eerder naar bed.
• Ritueel 20 min.
↳ kan sneller
3e kind, wil zelfstandig, moet zelfstandig
Spelletje van maken,
Ritueel: Hetzelfde bij alle kinderen?
Groeit, als moeder & geeft.
~~[illegible]~~ M. slechte slaper. Deel oorzaak autisme. Als hij slaapt, slaapt hij goed.
↳ hele gezin meer ritme, werkt erg goed.
Vakantie: alles anders, maar volgorde aanhouden werkt,

---

12) Meer met haar ritme oppakken, nu doet ze veel zelf. Echt naast gaan staan.
In haar bed laten slapen als het echt slecht gaat. Samen leidt teveel af.
↳ uiteindelijk oppak & over leg
↳ met knuffels

5 bedden in huis, waar ga je logeren.
geheimpje. anders broers niet blij.

14) Werkt omdat het anders, speciaal, anders bijzonder is. Feestje.
Dus ook niet te vaak doen.

11) Had altijd een nachtlampje. Ander ~~bed~~ bed, hoog. En toen paste lampje niet meer. Nu schemerlampje.
Mama niet zo blij, teveel licht denkt ze.
In slaap doet ze het weer aan als mama uit doet.
Pratende leeftijd: serieus nemen
Deur op kier: want zij wilde deur open. Gevoel van veiligheid. Contact rest van het huis
Lastig: ene kind wel licht & gehuid, ander niet.
Trial & error → grote gemene deler

Uitstapje ander kind: hoes om matras, lig je in. → druk.
Als baby lag hij altijd te spartelen, dus ze legde hem altijd strak in.
doeken, → help toen goed.
Eigenlijk andere 2 ook. Goed stevig vasthouden → rustiger.
Rustiger in hoofd = beter slapen

Kinderen met spenen & duimen:
Zuigbehoefte maakt in deze leeftijd dat ze beter slapen
Glow in the dark speen → zelf terugvinden
→ > 1 j.

Duimen afleren moeilijk, helpt toch bij ~~stress~~ in slaap komen.

Tussen wenkbrauwen wrijven → slaap hormoon vrij. Boven naar beneden

Geur moeder: M. in wieg een shirt van haar → geur bij jonkvrouwes zeker.
tip van kraamhulp
→ voor baby
verloskundige → voor mama

6 Babyfoon camera

1) 2 jaar
2) was goed, laatste tijd niet echt.
(4) Normaal ritueeltje, snel slapen
nu snel schreeuwen, niet willen
~~sta~~ liggen. Ligt niet aan licht
Verlatingsangst?
Voedt 's avonds

8) Badkamer potje tanden, luier,
pyjama, slaapzakje, boekje
↳ ook al onrustiger, wil niet naar
boven. Eerst stond hij zelf al aan de trap.
Verschilt per keer. Nu niet meer naar
bed willen. Voorheen: wil je naar bed? Ja,
nu niet.

(8) Nu dingen opgezocht. Monsters enz,
maar nog niet gelaten, dus kan niet.
Is een beetje gissen. Verlatingsangst?
Lampje geprobeerd.
Wijzen naar deur, wil slaapkamer
uit. Maar is niks op de gang.
Dingen:
→ Slaapzakje, apen knuffels, speen.

8) Hoe langer het duurt, hoe moeilijker
het wordt. Meer aandacht helpt niet.
Nog steeds overstuur.

Slaapt ietsje korter overdag, eerst 13-15.30,
nu 1,5 u. Kinderdagverblijf soms langer
dan moe. Wel echt slaap nodig overdag.

8) Alles even belangrijk. Boekje zeker
niet ook. Korter boekje. Zo'n vast iets.
Altijd vooral mama, dus hij wil liefste
mama. Papa toch anders.

13) Drukke dag zonder slaapje, juist
onrustig 's nachts. Geen goed aan
overslaan als je iets hebt.
Kan wel bij anderen, oma bijv.,
slapen. Vertellen wat hij wil.
En daar moet ook echt oma hem naar
bed brengen. Echt van de vaste structuur.

Slaapzakje: geborgen, liggen niet onder
dekentje. Niet met benen tussen spijlen
Ideaal eigenlijk.

11) Veiligheid. Alles wat anders is trekt
aandacht, willen er meteen iets mee.
daarzitten enz.

12) Bij haar genomen, maar dat gaat ze niet
vast doen. Beetje zakkende. Even wel
laten huilen. Wil dat hij zelf gaat slapen.

11) Leuk uitzien: aanspreekt, dier, niet eng.
Niet te fel licht.
Dat het een vriendje wordt.
↳ Jullie gaan samen slapen → tegen kind zeggen

Zij nog geen lampje met wakker tijd

Leuke kleuren, gezellig & vertrouwd
voor kind.

Vakantie zelfde tentje
- ritme & regelmaat heel fijn

Hadden muziekje: altijd is kortstondige
zeker. Liedje uit + zelf zingen en dan
in slaap. 2 maanden terug nog heel
belangrijk, nu niet.

Ja later

8
1) 3 kids, jongste net 6
2) goede slapers
3) 8 maanden, moeilijkste leeftijd
↳ altijd heel consequent geweest:
tijden en waar slapen
Min mogelijk eruit halen.
Borstvoeding: elk prepje eruit.
Met fles duidelijk, ↳ je zelf niet
geen honger. hoeveel ze drinken

Nachtmerries ooit, 1 a 1,5, verder
goed slapen
Nu smoesjes → buiten doelgroep

8) Vaste tijd. Douchen, pyjama,
tandenpoetsen, even lezen 5 à 10 min,
kusje, aai over bol, licht uit & slapen
↗ kwijt of vies
1 fave knuffel → reserve knuffel
↳ geur mama eraan

Iets korter boekje → stiekem bladzijde
overslaan.
13) Rond 3: 10 min in auto slapen,
bijna thuis. Daarna niet meer thuis slapen.
Pasgeboren: feestje of drukke dag,
prikkels overloaded, ander ritme

1e keer uur, nu korter. 15 min.
Beetje zeuren. Mama is er nog steeds
zeggen helpt niet tegen huilen.

Ja later benaderen

7
1) 2 j 9 m(m) & 9 maanden (j)
2) M nu wel. Half jaar terug in slaap
vallen moeilijk. Zichzelf wakker houden
Roepen. Nu goed. Soms wakker 's nachts
wakker, speen terug. → heel belangrijk
& knuffel ook.
Hoe beter? Elke 10 min naar haar
toe. Zo kort mogelijk. In bed houden,
tenzij echt over toeren.) Nooit in eigen
bed. ↳ Bij zitten, max 15 min.
's nachts ook. Soms ~~[illegible]~~ 1,5 u, dan
's ochtends uitslapen.
Dat was moeilijkste leeftijd.
Baby speen eruit was huilen.
6) Boeken, ouders tip, ouder van nu →
tijdschrift, consultatiebureau → om lo min tip
↳ "Buskruit met muisjes" ↳ groeigids
Boek met sprongen baby & kinderen
5(6)) Dat ze uiteindelijk echt wel in slaap
vallen. Er is veel info, maar als je
eigen gevoel niet klopt, dan werkt het niet.

Zelf beslissen wat je doet
Kind serieus nemen dat er iets is.
Nu vertellen. Vanaf 2j+3 maanden kon
dat een beetje.

8) Knuffel heeft naam. 2 boekjes: kind & bijbel
tot voorkort sterretjes babyfoon, nu
ze die niet meer. Philips Avent.
Praten kort houden
Einde 19.20 - 19.30
Papa & Mama beide af en toe kids naar
bed. Mama vaak jongste, borstvoeding

Speen & knuffel noodzakelijk
Tandenpoetsen ook, aan herinnert
Liedjes zingen ook belangrijk
Boekje wil ze soms niet

13) Vlak voor slapen visite, drukte.
Half uur voor het ritueel al rustige
dingen doen.

12) Is er overdag iets niet meer prikkels?
Opvang? eten of drinken?
Naar haar toe & vragen. Duidelijk zijn
in wat wel en niet kan. Consultatiebur.
daarna. Tips vragen vrienden.

↗ rond 1,5
12) Ooit even gedaan; erbij zitten
maar wel negeren. Ze was er,
stukje verder steeds. ↳ geen reactie

Muziekbeestje: 30 sec → onderdeel ritueel

5) ~~Eigen~~ Voor kinderen fijn: eigen bedje
en niet teveel eruit. Aandacht
kan, maar niet eruit. Huilen is niet
erg. Moeilijk voor ouders.

~~[illegible]~~ Fopspeentjes → m half jaar afgepakt
want dan gewoonte. ↳ even ~~[illegible]~~
paar weken lastig, daarna over
→ echt alleen slapen

11) Zachte geluiden. Bij mn tante
harde hartslag op opvang, vond
zij eng.
ouder → Knuffel, donker, vaste tijden
↳ maar niet overdag
In slaap huilen mag er zijn.
Gehoord voelen.
Herkenning dat het tijd is te gaan slapen.

Mag nog berichten

Slapen bij elkaar, hielp bij hun wel
↳ Er is iemand.

9
1) 3j, 14, 17
2) ze slaapt goed, altijd al. flessen helpt,
borstvoeding kinderen meer wakker.
Vaste tijden
Meer bijhouden met fles.
3) oudste weer altijd slecht tot 6j.
4) niet opgezocht, wel kraamhulp.
Consultatiebureau. Bij mensen.
5) Vooral zelf heel rustig bij blijven.
Vast iets voor slaap belangrijk.
Zorg ook dat ze niet oververmoeid
raken, dan ook slechter slapen.
Vast ritueel niet te spastisch.
↳ duidelijk is dat we gaan slapen.
's nachts wakker: mama beetje
onderhandel ruimte, papa echt niet,
is consequent. Niet erg als je andere
rollen daar in hebt.
Rond 19.30 → wel kijken of ze moe is
8) fles, iPad rustig filmpje,
's middags slapen als het later wordt samen
omkleden, tanden, verhaaltje, zingen
zelfde liedje → echt alleen slapen,
15 min +-

9. Bedje echt belangrijk voor haar
Tanden poetsen → wil geen gaatjes
Vaste knuffel

13. Verkenden slechter slapen
Iets heftigers gebeurd → voor haar
+ Speen kwijt, combi is moeilijk

12. 's nachts wakker: papa terug speen
Echt slecht: mama bedje opnieuw
of fles met beetje melk als echt erg
In bed houden, warmte
↳ slaap ritueel opnieuw

11. Rustig. Keuze of geluid of licht of combi:
Want Elk kind anders.
Zacht licht. Mensen zelf maken.
Soms eigen bedje ↳ interactief op eigen manier
foto's eigen, digitaal → nieuwe ond.
↳ persoonlijk, met onderzoek info erbij
Kinderen alleen voelen. Wat kind nodig; stem? gezicht? geur? foto?
Ontwerp geen sterretjes projectie o.i.d, is er al.

Laat maar weten als ik nog kan helpen

10. M A
1) 2,5 & 6,5 ;
2) geen goede slapers, nooit geweest.
Oudst. Inslapen moeilijk: vanaf 3 ietsje beter
doorslapen tot 6 eindelijk.
Onrustig slapen. Vroeg wakker
Alles geprobeerd. nu melatonine kids
Regenboog trap: gevoeligkind.nl
↳ slaapmeditatie 30 min
kleurtjes af, ademhalingsoefeningen.
↳ therapie, laten huilen, etc.
Hoe vermoeider maakt niets uit.
Oudste hoog gevoelig.
Op school gebeurd, 's nachts verwerken
Nacht angsten. Specifiek ritme.
Altijd bij blijven tot slapen. Bed in kamer.
Ander kind slaap cyclus veranderen.
Badje met lavendel.
Na drukke dag echt bijkomen volgende dag.
3) Ritme: echt heel belangrijk. Geeft een kind vastheid.
Naar kind en ouder zelf luisteren. Iedereen geeft tips, vrije opvoeding. Belangrijk.
Frictie met mensen die anders denken.
Bij jezelf blijven.
8) Samen op kamer. Oudste halverwege nacht bij ouders in bed.

11
1) 2 kinderen, [illegible] 5 j en 11 maanden
2) Zoon heel goede slaper. Altijd wel.
Vanaf 0 maanden doorslapen, prima.
Slaap & structuur heel hard nodig
Tot bijna basisschool middagslaap.
Eigen bed wel echt nodig.
Allemaal veilig en hetzelfde.
Dochter: de eerste paar dagen goed, maar toen echt slecht. Vanaf 6 m. eindelijk overdag ook slapen. 2 slaapjes.
Avonden en nachten nog steeds
Elk uur huilend wakker voor paar weken. Deze week nog maar 2 keer wakker 23u & 3u.
Tegelijk naar bed. Hij prima, zij hysterisch.
Bang voor weggaan.
↳ Dan kun je zelf 's avonds ook niks.
Ineens kan ze opeens dingen die ze voorheen niet kon.
Andere slaapzak → warm, mouwen.
Nog nooit nacht doorgeslapen.
Tandje doorgekomen. Er is eigenlijk altijd weer iets. Ongemakken altijd.
Voeding last.
12) Altijd mama. Borstvoeding nog.
Leek vaak enige manier om rustig te maken. Geprobeerd van niet, maar dat werkte niet. Knuffel whitenoise.*

Eerst ingebakerd. Op schoot, wiegen.
* verschillende geluiden, schaap.
Waterval; stofzuiger; geluiden die ze herkennen van baarmoeder. + hartslag.
Ook rood lichtje. Kindje heeft het idee dat moeder nabij is. Help eerst een beetje, daarna niet meer.
Slaaptraining geprobeerd. 3 uur lang moet volhouden met ander kind naar bed
kind alleen naar gestresst, gaat ze niet van slapen. En eerder stoppen met huilen omdat het teveel wordt, niet omdat het probleem opgelost is. } in hersenen
↳ Ik ben een beetje anti.
8) Als ze weg loopt gaat ze huilen.
0.45 ligt ze echt in bed, slaapt nog niet. T op bed. Heen en weer van haar naar T.
Echt hysterisch; kokhalzen, zweten.
Als oudste ligt even nog bij zitten.
Nieuw: steeds meer naar de gang.
Beetje verlatingsangst wat speelt.
Ook bij hun in bed onrustig.
Het ritueel is zeker consequent.
Geen peil op te trekken overdag wel of niet goed slapen.

Geprobeerd: verzwaringsdeken, tunneldeken, → elastieken deken om matras,
↳ voelde ze zich vervelend door.
Nu zuiver wollen deken → iets zwaarder en rustgevende stof.
Maar afschoppen.
Nieuwe slaapzak, komt bijna binnen ↳ met mouwen. Niet uittrappen.
Slaaptrainers: dag/nacht leren. Leren klokkijken.

9. Het is het ritme & de stabiliteit. Niet om volgorde, maar om dat alles gedaan is.

13. Spanning. Bijv. zenuwachtig zijn ergens voor. Liggen woelen. Standaard dingen. Merk je aan haar dat ze heel erg prekelt.

11. Materiaal belangrijk: bijv. wol heeft geruststellende werking op je huid.
Zachte matrassen.
Veilig zijn. Synthetisch → statisch
Soort wol maakt uit.
Dilling → website met wollen kleding
↳ ronde hoeken bijv.

Vorm: veilig. Dat het kind er niks uit kan halen, batterijen bijv.

• Kijken waar kind en ouder zich fijn bij voelen is echt belangrijk.

ja weer benaderen.

↳ M: valt in slaap met fles op schoot.
23u wakker.. Gerust stellen met dai over bol.
Slaapt beter in, maar 's nachts onrustiger, langer uitslapen
Dromen, praten in slaap.

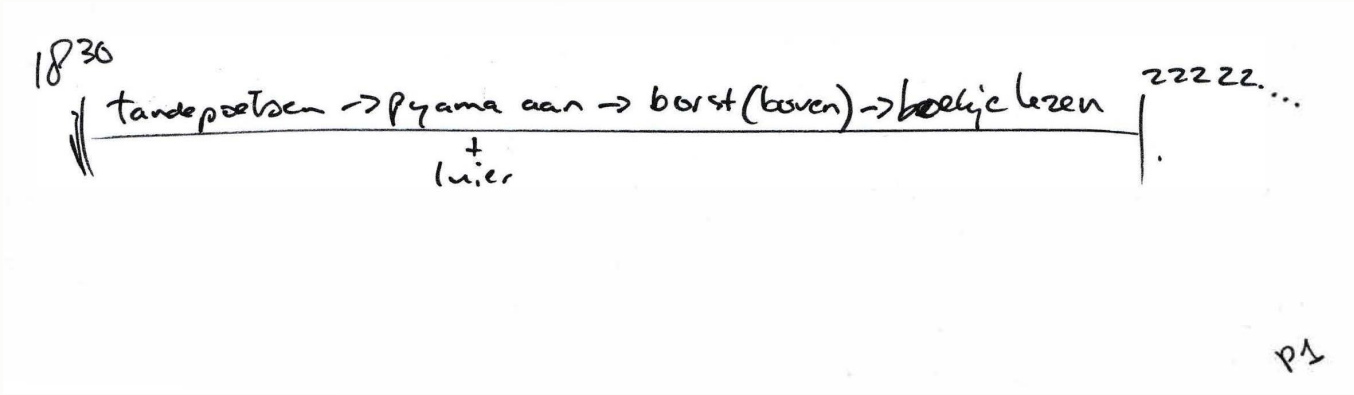
Drukke middag sliep ze toch 's avonds goed.
Zal heus wel een keer veranderen.

11) Knuffel kun je met klittebandje aan het bed maken.
Moet niet een enorm ding zijn.
Dat is eng. Niet adem kan benemen. Geen eng touwtje.
Neus en mond niet kunnen bedekken als ze om rollen.
Ze hadden eerst geen spijlen.
Knuffels vanaf half jaar, maar hangt af van je kindje. Gevoel van ouders zelf ook.
In kraamperiode: mocht geen plastic zeiltje onder matras, moet ademend zijn & ventilerend.
Soms hebben kinderen een kruik ↳ pasgeboren babytjes.
Express niet aangeschaft: sensor die aangaat als het kind geluid maakt.
Dan gaat elke keer dat ding aan.
Hoor je ook via babyfoon. Keuzes, zal niet iedereen vinden.
Liever zelf inbed.

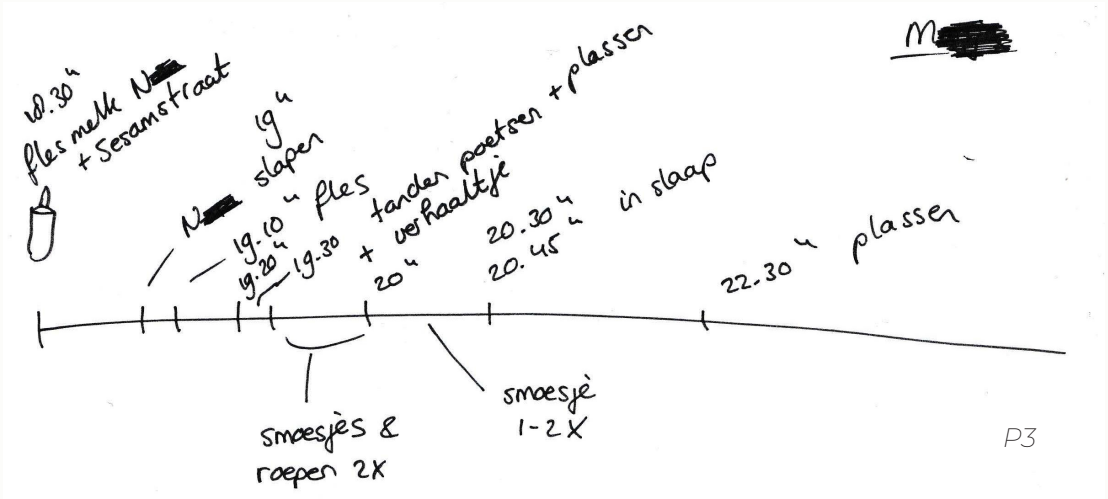
13) Bij haar niet echt. T wel.
Hele drukke dag, dan kan hij 's nachts dromen.

Ja later nog benaderen.

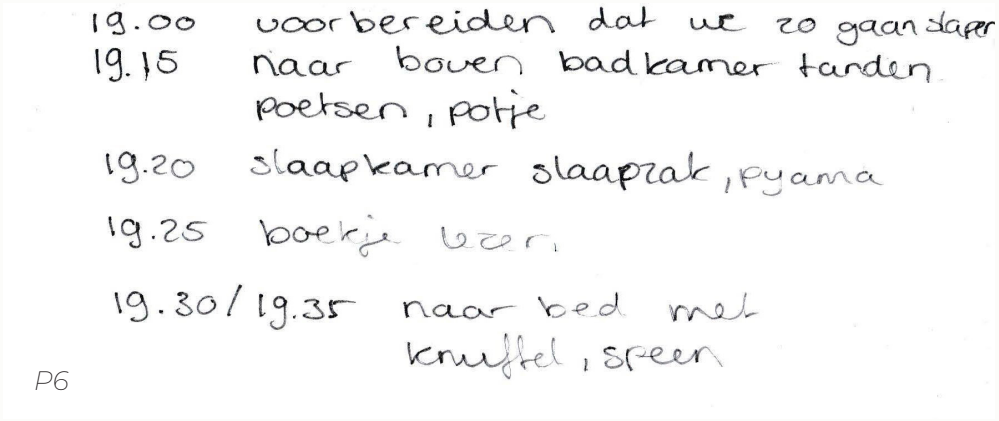
Appendix 5: Timeline exercise



P2)
19.00 uur kinderen naar boven 1 ouder mee
Oudste kleed zichzelf uit. Jongste wordt uitgekleed.
Oudste gaat zelf naar de wc en doet zijn luier aan
Jongste gaat even mee naar de wc en krijgt daarna luier en pyjama aan
Oudste pakt in de badkamer de tandenborstels en doet er tandpasta op. Jongste gaat in de stoel in de badkamer zitten en haar tanden worden gepoetst. Oudste poetst eerst zelf en ouder poetst na.
Met een washandje maken we gezichten en handen schoon .
Samen naar kamer van jongste. Kort boekje voorlezen in de stoel met oudste en jongste. Vaak wil de oudste voorlezen
Oudste gaat naar eigen kamer. Jongste krijgt een kus en knuffel van oudste. Daarna slaapzak aan, slaapliedje zingen en in bed liggen.
Naar de kamer van de oudste, langer verhaal voorlezen op bed. Massage (huiswerk van logopedist om te ontprikkelen na een lange dag), Liedje en even knuffelen. Kleurtje als nachtlampje uitzoeken. Kus en knuffel
Jongste heeft speen en 2 knuffels in bed. Oudste 2 knuffels, oudste wisselt met knuffels. Hij mag er 2 van ons.



P3



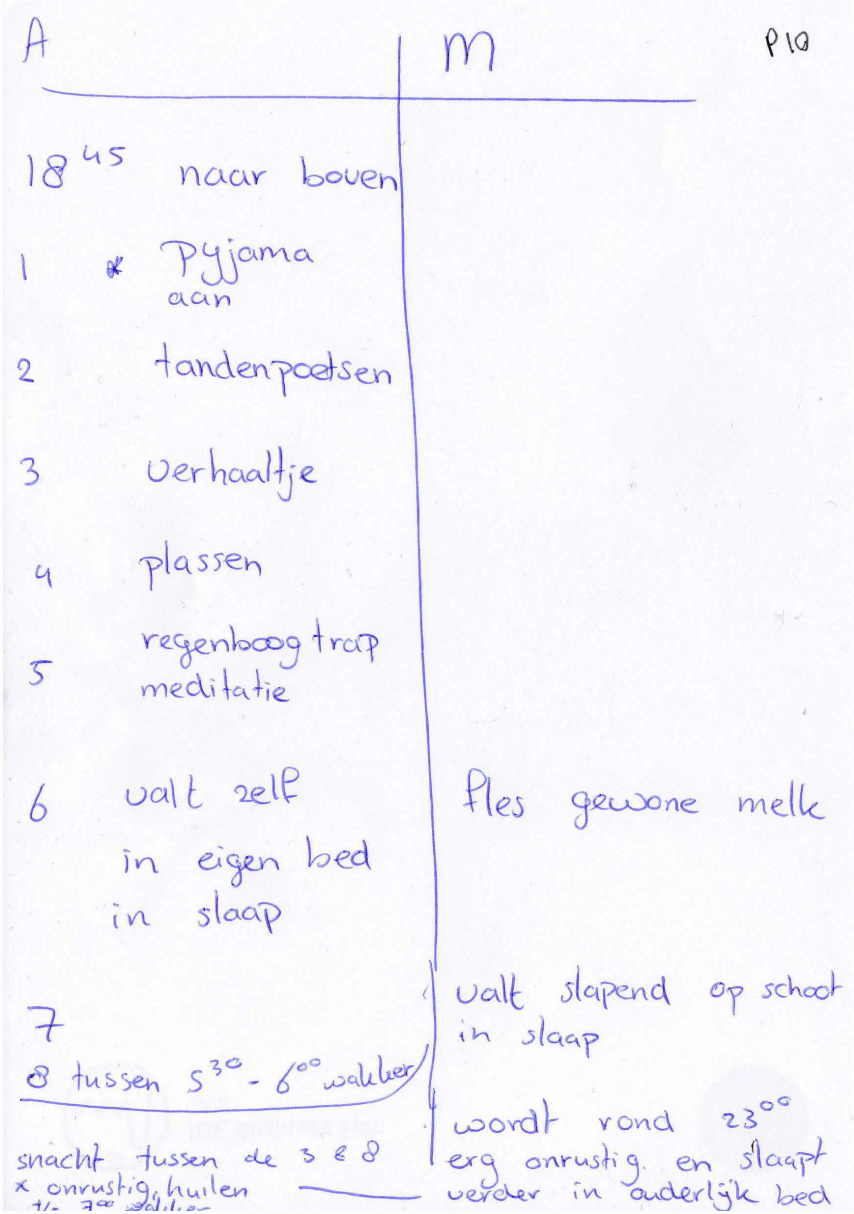
P6

P4)

1. Na het eten (ca. 7 uur) geven we aan dat we naar boven gaan om te slapen
2. We vragen de kinderen om hun knuffels waarmee ze slapen te gaan pakken (indien die beneden liggen)
3. Ze gaan naar boven
4. De jongste krijgt een schone luier, de oudste gaat naar het toilet
5. Pyjama aan
6. Tandenpoetsen
7. De zusjes geven elkaar een knuffel en kus en ook aan de ouder die hen niet op bed legt
8. De jongste krijg haar slaapzak aan
9. Verhaaltje van Dikkie Dik voorlezen (allebei apart in hun eigen slaapkamer)
10. Jongste wordt op bed gelegd
11. Oudste doet de deur van haar slaapkamer op de juiste stand (zodat ze zicht heeft op de trap), doet het licht uit en gaat in bed liggen
12. Ik zing nog een liedje voor de oudste (iedere avond hetzelfde, fragment uit een klassiek muziekstuk) en geef haar een knuffel en kus. En met een 'weltruste lief meisje, tot morgen' loop ik haar kamer uit.

P5)

20 min ritueel. Plassen, tanden poetsen, pyjama, verhaaltje. Begin tijd maakt niet veel uit.



P7)
19:00 naar boven, speen en krijn pakken (knuffel). Naar de badkamer om tanden te poetsen. Papa of mama poetst eerst en daarna A. Dan gaan we naar de zolder, verwisselen we de luier en doen we pyjama aan. En daarna lezen we twee boekjes. Een kinderboekje en een boekje van een Bijbelverhaal. En dan zingen we nog een liedje. En dan mag je zelf in bed klimmen. Dan kletsen we nog even hoe de dag is gegaan. Wat waren fijne dingen. Kusje en dan gaan we naar beneden.
Klaar om 19.20/19.30. Half uur voor ritueel al rustige activiteiten. Niet meer rondrennen bijv.

P8)
Douchen, pyjama, tandenpoetsen, even lezen 5 à 10 min, kusje, aai over de bol, licht uit en slapen.

P9)
Start rond 19.30, wel kijken of ze moe is. Fles. IPad met rustig filmpje. ‘S middags nog slapen als het ‘s avonds laat wordt. Omkleden, tanden poetsen, verhaaltje, zingen. Altijd hetzelfde liedje. Totaal +- 15 min.

P11)
Om 18.15 naar boven, dan uitkleden, schone luier en romper aan. Druppeltjes vitamine d. Dan T roepen die samen een boekje komt lezen. T gaat dan naar zijn eigen kamer pyjama aan doen en ik geef haar nog een borstvoeding op haar kamertje in het donker. Dan leg ik haar met slaapzak speentje en knuffel in het ledikant en ga weg om T naar bed te brengen.
Soms daarvoor nog even in bad beide.
Vaak is het als ik weg loop huilen. Ik ga dan niet gelijk heen want T heeft ook zijn eigen bed tijd ritueel.

Appendix 6: Statement cards

Hij wordt zo [met Hue lamp] rustig wakker. Nog geen sterke prikkel, alleen rode lamp.

He wakes up calmly like this [with Hue lamp]. No strong stimulation yet, only red light.

P2

Time indication should be of low intensity, no sound.

Muziekjes die nu uit babyfoons komen klinken super schel, niet mooi.

P4

Music that comes out of current baby monitors sound super sharp, doesn't sound beautiful

If you use music, make it sound beautiful

Bij de oudste gebruiken we een babyfoon waarbij je heen en weer kan praten.

With the oldest we use a baby monitor through which you can talk back

P2

Don't need to get out of bed or parent upstairs for every small thing that really has to be told before sleeping

---

De oudste bedenkt momenteel veel smoesjes om niet te hoeven slapen

The oldest comes up with many excuses to not go to sleep

3y old, P3

Moeten zachte geluiden zijn. Op opvang waren er harde hartslag geluiden tijdens middagslaapje, vond ik gewoon eng klinken

P8

Too loud sounds are not good, sound should also sound non threatening.

Als ik iets van het schema niet doe, krijg ik het altijd terug. Niet doen ben je uiteindelijk langer bezig.

P5

Skipping something from the schedule results in a longer time till sleep, not shorter.

Overgang tussen zomer- en wintertijd is lastig, want dan moet het schema ineens om.

Transition to or from daylight saving time is difficult, cause the schedule has to change suddenly

P4

Tussen 6 & 6:45 is de lamp rood. Dan is het ochtend, maar mag hij er nog niet uit. Groen? Dan mag hij eruit.

Between 6 & 6:45 is the lamp red. It is morning at that time, but too early to get out. Green? Then he can get out of bed.

P2

Ze werd echt elk uur huilend wakker de afgelopen weken.

She really woke up crying ~~every~~ every night the last few weeks
11 months; P11

Problem: wake up crying

Vast ritueel is belangrijk, maar hoeft niet te spastisch. Wel goed duidelijk dat we gaan slapen. P9

Ritual is important, but don't get too stessed out ~~the~~ to follow it per minute ~~or~~ precisely.
↳ Start of the ritual should be clear

Niet al het huilen is slecht, alleen moeilijk voor ouders te accepteren

Huilen is oke, echt janken niet. Het was moeilijk om te leren dat dat oke is. P1

Crying is okay, ~~really whining not~~ hard yelping/whining/howling not. It was hard to learn that that's okay.

Not all crying is bad, but hard for parents to accept

/advies

Kennis bood hulp [bij slechter slapend kind]. Strak dagritme.

Acquaintance offered help/advice [when child slept worse]. fixed dayRhythm
P.1, child 17 months

Flesvoeding scheelde heel erg, niet met elk piepje ernst om te voeden.

Bottle feeding helped a lot, you don't have to go out with every little squeak to feed. P8 & P9

- Geen honger 's nachts helpt slapen
- not being hungry at night improves sleep

Op een gevulde maag slaapt ze lekker

Na (borst) voeding slaapt ze altijd lekker.

After (Breast) feeding, ze will always sleep nicely. P1

Helps: not being hungry

Er is eigenlijk altijd weer iets. Ongemakken altijd.

~~There~~ Every time there is something wrong again. Some discomfort, always. P11

Problem: discomfort

~~Knuffel~~ Knuffel met whitenoise, hartslag en rood lichtje helpt eerst een beetje, maar daarna niet meer. P11

Plush toy with whitenoise, heartbeat and red light helped a little at first, but not anymore/not long

"Muziekje?" Ligt eraan hoe moe ze is. Alleen als ze zoals nu nog heel wakker is. Is een soort afleiding."

"Music?" "Depends on how tired she is. Only when she's really awake, like now. It is some kind of distraction."
P1.

Music toy can be a distraction for when she is super awake, to focus on sleep/relaxing.

Het [in bed van broers logeren] werkt omdat het anders, speciaal is. Dus ook niet te vaak doen.
P5

It [laying in bed of brothers] works because it is different, special. So I should n't allow it too often

Special events can improve the will to go to bed & fall asleep

Half uur voor het slaap ritueel gaan we al rustige dingen doen.

Half hour before the sleep ritual, we already only do calm activities.
P7

As a baby he always lay writhing, so I put him in tight cloths, to give pressure.
P5

for some children pressure works calming

Toen [=bij verlatingsangst] iets langer bij blijven zitten en dan steeds verder weg zitten.
P2

Then [=with fear of abandonment] I stayed longer en slowly sat further away.

Elke 10 min [moest] ging ik naar haar toe, zo kort mogelijk. In bed houden hielp.

Every 10 min I had to go to her, as shortly as possible. Keep her in bed, that helpt.

Quote about 1.5 y old, child now 2, P7

We zijn altijd heel consequent geweest in tijden en waar slapen

We have always been super consequent with bedtimes and location.
P8

Consequentie is important.

Starten met het bedritueel moet duidelijk zijn.

The start of the bed ritual should be clear.
P2

P1

Liever niet iets los of aan, want daar kan ze zich mee verstikken, of bloedsomloop afknellen.

Preferably not something loose or on her, because she could strangle herself or squeeze her circulatory system.

Speen en knuffel erg belangrijk voor jongste, gevoel van veiligheid.

Pacifier and plush toy very important for youngest, feeling of safety.

P2

Deur moet open, soort [gevoel van] controle.

Door has to stay open, kind of control [/feeling of control]

P4

Feeling of control over environment can ~~help~~ improve will to sleep.

Eerste [om weer beter te laten slapen] zou nabijheid bieden zijn. ~~Veel~~ meer knuffels voor het slapen.

First thing [to improve the sleeping] to do would be offering security, cuddle more before sleeping

P2

Slaap overdag even belangrijk als nacht.

Als ze 's middags te kort slaapt, gaat het 's avonds ook moeilijk. Dan is ze te moe.

~~In auto na het eten in slaap vallen is garantie voor slecht in slaap komen~~

P3

If she sleeps too little during the day, it will be difficult in the evening too. She will be too tired.

Sleep during day just as important as during the night

Controle over licht & omgeving

De oudste heeft een kleurenlamp waar van hij kleur mag kiezen om mee in slaap te vallen.

The oldest has a color lamp of which he can choose the color to fall asleep with. (Philips Hue)

P2

Controle over light & environment

Pas de dag starten als het ochtend is. → ritme sterk aanhouden

"Gewoon niet accepteren als ze te vroeg wakker wordt"

Persoon 1 - 17 maanden kind

Just don't accept it if she wakes up too early."

Only start the day if it's morning

→ keep strongly a rhythm

Om een slaapritme te krijgen moet je je plan echt volhouden, niet maar 2 dagen.

P5

To get a sleep rhythm, you have to stick to your plan. Not just 2 days.

Iets interactiefs op je eigen manier kan interessant zijn, dat mensen zelf iets maken

An interactive product that you can make your own would be interesting. That people can make ~~some~~ / build something themselves! P9

Ik heb express ~~geen~~ geen product gekocht met sensor die aangaat als het kind geluid maakt. P11

Parents want to have control and influence over what the product does and when.

Er is veel info, maar als je eigen gevoel niet klopt, dan werkt het niet.

There is a lot of information, but when your feelings ~~don't~~ don't match, it will not work P7

Als wij er uit zijn dan doen we de lamp eerder op groen. Voordeel van lamp op afstand.

If we are out [of bed] earlier than the lamp is green, we turn it ~~green~~ green. Advantage of lamp with remote control. P2

Remote control allows for personalisation and flexibility

Het moet niet een enorm ding zijn. Dat is eng. P11

It shouldn't be able to cover mouth & nose and take their breath. → The product

Het materiaal is belangrijk. Ene materiaal is geruststellend, andere, vaak synthetische, niet. P10

material should be soft and calming, not static.

Geur ~~van~~ moeder helpt zeker bij jonkvies bij slapen

Smell of mother helps, especially with young ones, to sleep P5

Het moet er leuk uitzien, kinderen aanspreken. Dat het een soort vriendje wordt

It should look fun, appeal to children. ~~So~~ so it becomes a kind of friend. P7

Fun + little friend = good

Belangrijk om kind serieus te nemen in dat er iets is.

Important to take the child serious that there is some problem

P7

from little more than 2 y.old, the kids can explain problems better, take them seriously

Bij de oudste zal ik proberen te achterhalen wat er is, altijd een reden. Angst of spanning of aandacht.

With the oldest I would try to discover what's behind it, there's always a reason. Fear or tension or attention.

almost 5 y. P4

Blijf naar kind en als ouder zelf luisteren. Iedereen geeft tips en zegt het beter te weten, maar je moet bij jezelf blijven.

P10

Parents of bad sleeping children can get a lot of negative "tips". Stay with your own feelings & believe

↳ So product should be adjustable to household

Eerst naar haar toe en vragen of er iets is. Daarna tips vragen aan vrienden of consultatiebureau

First I would go to her to ask if somethings wrong. Then I'd ask tips from friends or consultation bureau

P7

People would first think of asking around for (behavioural) tips, and don't immediately think of a product.

Ernst is echt als ze in de auto slapen voor 10 minuutjes

Disastrous is when they sleep in the car for 10 minutes

P8

short sleep decreases drive to fall a sleep, which is unhandy.

In auto in slaap vallen na het eten is garantie voor slecht in slaap komen daarna (thuis)

P3

Falling asleep in the car after diner is a guarantee for falling a sleep with much difficulty (at home)

Normaal sliep hij snel na het ritueeltje, nu gaat hij snel schreeuwen en wil hij niet liggen.

P.6 → 2y old

Normally she slept quickly after the ritual, now he screams quickly and doesn't wanna lay down

Verlatingsangst rond 1,5 j.

Later herkende ze dat je weg ging.

P2 (Tussen 1 & 1.5 à 2)

Later on, she recognized you leaving.

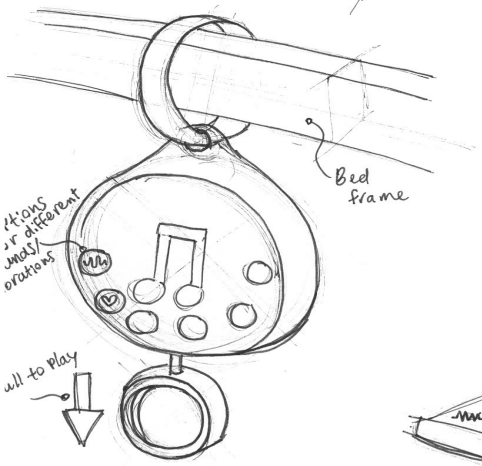
(Between 1 & 1.5 à 2)

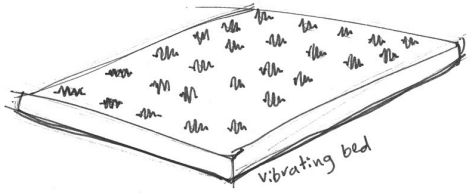
Fear of Abandonment around 1,5 y.

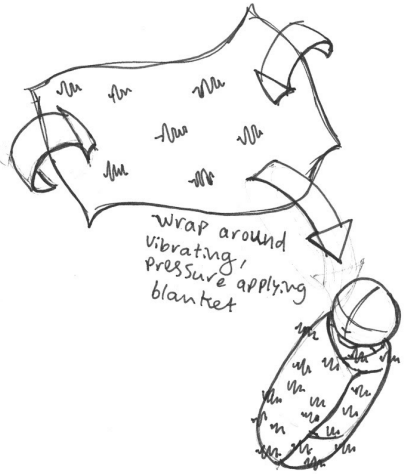
11 Appendix 7: Excel sheet prototype self test

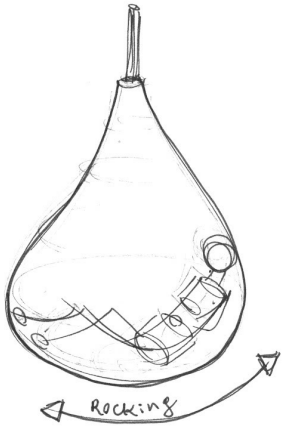
26-10-'21	bass shaker	soft foam	4	40 Hz	1/3 of dial	belly	busy, medium energy	3	2,5	a fan	2	much less audible than the white noise
26-10-'21	bass shaker	soft foam	4	heartbeat	1/3 of dial	belly	a constant, slightly quick heartbeat	3,5	3	heartbeat	3	rhythm strongly catches attention
26-10-'21	bass shaker	hard foam	6	40 Hz	less than 1/3 of dial	belly	high energy	2,5	2	electric component? Fan?	2	hard block is not so nice to hold. Also possible to rattle against the desk, because of the hardness of the material.
26-10-'21	bass shaker	hard foam	6	40 Hz	less than 1/3 of dial	high back	massage	3	4	refrigerator in the back	2	feels less intense on the back, more relaxed. But also sound of vibrations through my chair
26-10-'21	bass shaker	hard foam	6	white noise from youtube: https://www.youtube.com/watch?v=nMfPqeZjc2c&t=20588s	2/3 of dial	belly	something that moves/crawls, or a rumbling tummy	4	5	tuned to an unused frequency; calm	4	sound much louder than feeling
26-10-'21	bass shaker	hard foam	6	white noise + womb https://www.youtube.com/watch?v=HnbnGSH9mqY&t=6204s	2/3 of dial	belly	stronger rumbling.	3	4	Darker rumbling, less calm, more ominous	3	sound is so loud compared to the feeling of the vibrations
29-10-'21	bass shaker	hard + thin soft	6	40 Hz	1/3 of dial	belly	a rumbling tummy	3	3	a fan	3	still quite hard, maybe more soft foam
	lofelt	none		40 Hz	over 50% phone	hold between finger tips				no sound!	7	super silent! However how do I put it in a product? As the sides need space to vibrate
	lofelt	none		general music, pop	over 50% phone	hold between finger tips				the song, nice quality	6	very softly you can hear the music if you hold the L5 next to your ear, but even then softly

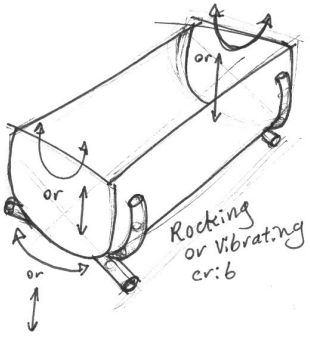
Appendix 8: Brainstorm sketches

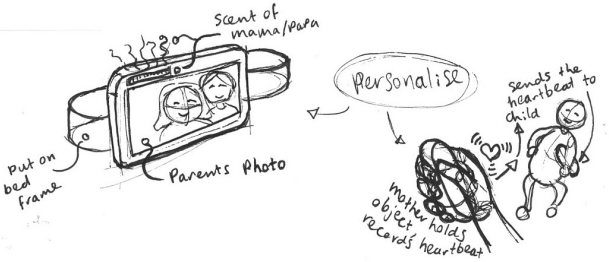


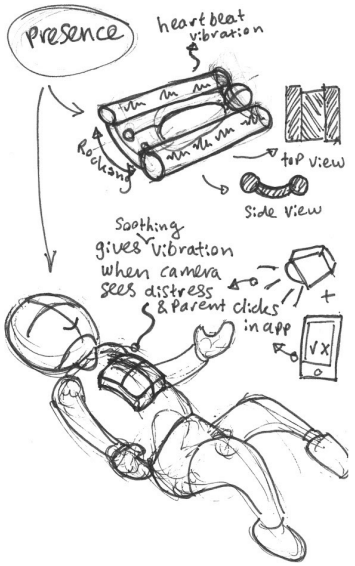












Appendix 9: Online questionnaire, questions

Onderzoek naar slaap product voor jonge kinderen

Hallo! Mijn naam is Marjolein Schoorl en ik ben momenteel aan het afstuderen voor de Master Design for Interaction aan de TU Delft, faculteit Industrieel Ontwerpen. Mijn afstudeer opdracht is het onderzoeken & ontwerpen van een product dat met behulp van trillingen jonge kinderen (1 - 5 jaar) helpt in slaap te vallen.

Met deze vragenlijst wil ik van ouders de visie op en wensen voor een dergelijk product in kaart brengen. Hiervoor zal ik uw mening vragen over een aantal concepten (product ideeën). Het invullen duurt ongeveer 10 minuten.

Door deze vragenlijst in te vullen geeft u toestemming voor het gebruik van de door u ingevulde antwoorden. Alle antwoorden zullen anoniem opgeslagen en verwerkt worden. De verzamelde data zal alleen worden gebruikt in het afstudeer project. Uitkomsten van deze survey kunnen worden gedeeld in afstudeer publicaties, zoals de afstudeer presentatie en scriptie. Voor vragen, mail naar: [redacted]

Alvast bedankt voor uw deelname!

Log in bij Google om je voortgang op te slaan. Meer informatie

*Vereist

Algemene vragen

Hoeveel kinderen heeft u? *

Hoe oud zijn uw kinderen? *

Welke van de volgende slaap producten gebruikt u om uw kind(eren) te helpen in slaap te vallen? *

Bewerkingsrechten vragen

- [ ] Knuffel(s)
- [ ] Nachtlampje
- [ ] Product met (slaap)muziekje
- [ ] White noise product of knuffel
- [ ] Speciale knuffel (vink graag "anders" aan en licht toe wat voor knuffel)
- [ ] Speen
- [ ] Voorlees boekje
- [ ] Ik heb geen specifieke slaap producten voor mijn kind
- [ ] Anders:

Wat is er voor u belangrijk in een slaap product voor jonge kinderen? *

Op een schaal van 1 - 7, hoeveel moeite kost het gemiddeld om uw kind(eren) naar bed te krijgen en te helpen in slaap te vallen?

	1	2	3	4	5	6	7	
Geen moeite	○	○	○	○	○	○	○	Veel moeite

Volgende

Formulier wissen

Concept 1: speciaal matras

Dit concept bestaat uit een speciaal matras, dat zo is ontworpen dat de trillingen optimaal gevoeld worden als uw kind in bed ligt. De trillingen zijn voelbaar door het hele matras, dus over het hele lichaam. Dit concept vervangt het huidige matras van het kind. De trillingen kunnen aan en uit gezet worden op afstand. Hierdoor hoeven de ouders niet de slaapkamer in om het matras te bedienen.

Op een schaal van 1 - 7, hoe rustgevend verwacht u dat concept 1 is voor kinderen? *

	1	2	3	4	5	6	7	
Niet rustgevend	○	○	○	○	○	○	○	Zeer rustgevend

Op een schaal van 1 - 7, hoe effectief verwacht u dat concept 1 is om kinderen te helpen slapen? *

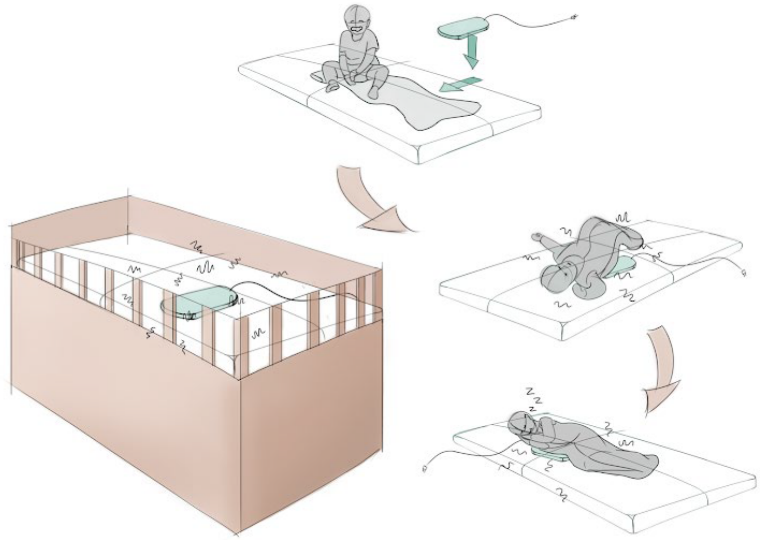
	1	2	3	4	5	6	7	
Niet effectief	○	○	○	○	○	○	○	Zeer effectief

Op een schaal van 1 - 7, hoe interessant vind u concept 1? *

	1	2	3	4	5	6	7	
Niet interessant	○	○	○	○	○	○	○	Zeer interessant

Licht alstublieft uw antwoord op de vorige vraag kort toe. Waarom vindt u het concept wel/niet interessant? *

Concept 2: product onder eigen matras



Concept 2: product te plaatsen onder matras

Bij dit concept kan het eigen matras gebruikt worden. Het platte, schijfvormige product kan onder een matrasje gelegd worden. Hierdoor hoeft er geen nieuw matras aangeschaft te worden. De voelbaarheid en het gevoel van de trillingen kan wel per soort matras verschillen. Bij dit concept zullen de trillingen meer voelbaar zijn op 1 stuk van het matras in plaats van door het hele matras heen, namelijk daar waar het product onder ligt. De bediening is hetzelfde als vorig concept.

Op een schaal van 1 - 7, hoe rustgevend verwacht u dat concept 2 is voor kinderen? *

	1	2	3	4	5	6	7	
Niet rustgevend	○	○	○	○	○	○	○	Zeer rustgevend

Op een schaal van 1 - 7, hoe effectief verwacht u dat concept 2 is om kinderen te helpen slapen? *

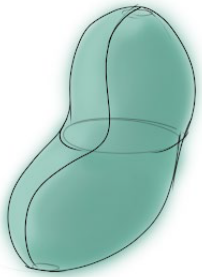
	1	2	3	4	5	6	7	
Niet effectief	○	○	○	○	○	○	○	Zeer effectief

Op een schaal van 1 - 7, hoe interessant vind u concept 2? *

	1	2	3	4	5	6	7	
Niet interessant	○	○	○	○	○	○	○	Zeer interessant

Licht alstublieft uw antwoord op de vorige vraag kort toe. Waarom vindt u het concept wel/niet interessant? *

Concept 3: knuffelbare vorm



Concept 3: knuffel / blob

Dit concept kan mee in bed worden genomen om uw kind te helpen in slaap te vallen. Het heeft twee mogelijke product vormen: een knuffel of een abstracte zachte blob vorm. De trilling zal op 1 plek, daar waar het kind het product vast houdt, worden gevoeld, in plaats van over het hele lichaam zoals bij de andere twee concepten. Bediening is hetzelfde als de vorige concepten.

Op een schaal van 1 - 7, hoe rustgevend verwacht u dat concept 3 is voor kinderen? *

Niet rustgevend	○	○	○	○	○	○	○	Zeer rustgevend

Op een schaal van 1 - 7, hoe effectief verwacht u dat concept 3 is om kinderen te helpen slapen? *

	1	2	3	4	5	6	7	
Niet effectief	○	○	○	○	○	○	○	Zeer effectief

Op een schaal van 1 - 7, hoe interessant vind u concept 3? *

	1	2	3	4	5	6	7	
Niet interessant	○	○	○	○	○	○	○	Zeer interessant

Licht alstublieft uw antwoord op de vorige vraag kort toe. Waarom vindt u het concept wel/niet interessant? *

Welke van de twee vormen van concept 3 heeft uw voorkeur? *

- ○ Vorm 1, de knuffel
- ○ Vorm 2, een abstracte blob/boon vorm

Waarom verkiest u de hierboven gekozen vorm boven de andere vorm? *

Vragen over de 3 concepten

Welk concept lijkt u het meest effectief om jonge kinderen te helpen slapen? *

- Concept 1
- Concept 2
- Concept 3

Waarom lijkt u dit concept het meest effectief? *

Welk concept lijkt u het minst effectief om jonge kinderen te helpen slapen? *

- Concept 1
- Concept 2
- Concept 3

Waarom lijkt u dit concept het minst effectief? *

Welk concept trekt u het meeste aan; zou u het liefst willen hebben? *

- Concept 1
- Concept 2
- Concept 3

Waarom zou u deze het liefste willen hebben van de drie concepten? *

Welk(e) element(en) van het ontwerp zou u anders willen zien? En waarom? *

Welk(e) element(en) van het ontwerp vind u het meest waardevol? En waarom? *

Onderzoek naar slaap product voor jonge kinderen

Log in bij Google om je voortgang op te slaan. Meer informatie

*Vereist

Eisen en wensen

Hoe zou u het liefste de trilling van het product aan- en uitzetten? *

- ◯ Via een afstandsbediening buiten de kamer van het kind
- ◯ Via een app
- ◯ Via knoppen of touch screen op het product zelf
- ◯ Via een babyfoon
- ◯ Via een control paneel in de kinderkamer
- ◯ Via een control paneel buiten de kinderkamer
- ◯ Automatisch: het product moet aan gaan zodra mijn kind onrustige geluiden begint te maken of te huilen, en dan uitgaan zodra hij/zij weer stil is.
- ◯ Anders:

Hoe lang zou u willen dat de trilling aan blijft? *

- ◯ Hele nacht
- ◯ Minder dan 30 min
- ◯ 30 min - 1 uur
- ◯ Meer dan 1 uur
- ◯ Voor een tijdsduur die zelf in te stellen is
- ◯ Totdat mijn kind niet meer huilt/praat/actieve geluiden maakt

Zou het product nog andere functies, naast een slaap trilling, moeten bevatten? En zo ja, welke functie(s)? *

Hoeveel zou u betalen voor concept 1, als bewezen is dat het kinderen helpt in slaap te vallen? *

- ◯ Onder de 20 euro
- ◯ Tussen de 20 - 50 euro
- ◯ Tussen de 50 - 100 euro
- ◯ Tussen de 100 - 150 euro
- ◯ Tussen de 150 - 200 euro
- ◯ Meer dan 200 euro

Hoeveel zou u betalen voor concept 2, als bewezen is dat het kinderen helpt in slaap te vallen? *

- ◯ Onder de 20 euro
- ◯ Tussen de 20 - 50 euro
- ◯ Tussen de 50 - 100 euro
- ◯ Tussen de 100 - 150 euro
- ◯ Tussen de 150 - 200 euro
- ◯ Meer dan 200 euro

Hoeveel zou u betalen voor concept 3, als bewezen is dat het kinderen helpt in slaap te vallen? *

- ◯ Onder de 20 euro

- Tussen de 50 - 100 euro
- Tussen de 100 - 150 euro
- Tussen de 150 - 200 euro
- Meer dan 200 euro

Heel erg bedankt voor uw deelname!

Oproep: Ik ben nog op zoek naar ouders van een slecht slapend kind (1 - 5 jaar) die mijn product prototype (test versie van een product) willen testen. Wilt u meedoen of kent u iemand die mee wil doen? Mail mij!
[redacted](ook voor vragen en meer info)

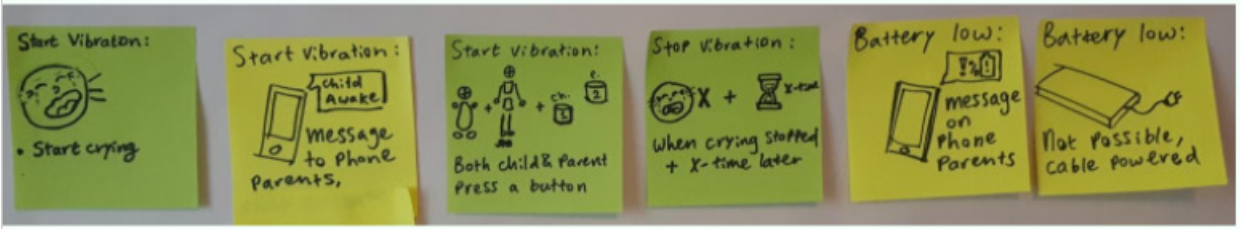
Vorige Verzenden Formulier wissen

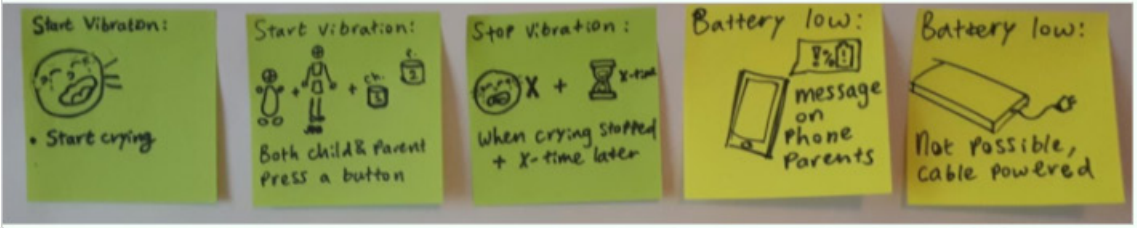
11 Appendix 10: Online questionnaire, results

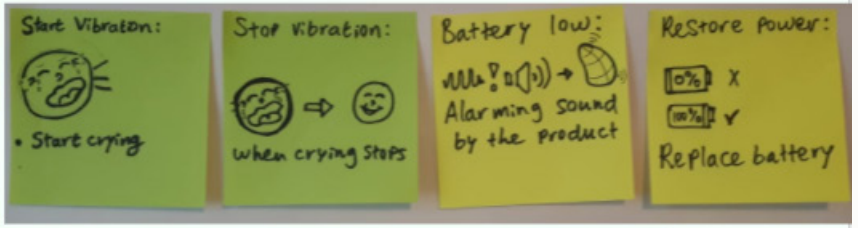
Tijdstempel	Hoeveel kinderen heeft u?	Hoe oud zijn uw kinderen?	Welke van de volgende slaap producten gebruikt u om uw kind(eren) te helpen in slaap te vallen?	Wat is er voor u belangrijk in een slaap product voor jonge kinderen?	Op een schaal van 1 - 7, hoeveel moelte kost het gemiddeld om uw kind(eren) naar bed te krijgen en te helpen in slaap te vallen?	Op een schaal van 1 - 7, hoe rustgevend verwacht u dat concept 1 is voor kinderen?	Op een schaal van 1 - 7, hoe effectief verwacht u dat concept 1 is om kinderen te helpen slapen?	Op een schaal van 1 - 7, hoe interessant vind u concept 1?	Licht alstublieft uw antw op de vorige vraag kort Waarom vindt u het cor weinig interessant?
7-12-2021 12:57:59	2	2 en 4 jaar	Knuffel(s), Nachtlampje, Speen, Voorlees boekje	Veiligheid, rustgevend, knuffelbaar, dat het of vanzelf uit gaat of op afstand uit gaat.	3	5	5	4	Ik zou ervaringen willen horen/ lezen, maar voo oudste dochter lijkt het mogelijk wel wat. Wat n ook doet twijfelen is de van het matras, als je k van ledikant naar een p bed naar een groot bed gaat, bekend het wel keer een nieuw matras kopen, mocht het kind willen blijven gebruiken in slaap te komen.
7-12-2021 15:05:42	3	2, 5, 6	Knuffel(s), Nachtlampje, Product met (slaap) muziekje, Voorlees boekje	Vertrouwen van het kind	6	1	2	1	Lijkt mij niet fijn
7-12-2021 15:14:13	1	2 jaar	Knuffel(s), Speen, Voorlees boekje	Veiligheid	2	3	2	2	Op latere leeftijd hebbe dit niet, het is iets waar dan aan gewend raken als het er opeens niet is het moeilijker zijn om in slaap te vallen. Mocht j kind het toch niet fijn vi dan heeft het geen ruim om ergens anders geer trillingen te voelen. Ook handig om mee te nem rels of bij logeren.
7-12-2021 15:56:08	2	1 en 4	Knuffel(s), Nachtlampje, Voorlees boekje	Dat ze zich er fijn bij vinden.	3	4	4	7	Wel intressant of dit hel
7-12-2021 19:13:29	3	1, 3 en 6	Knuffel(s), Nachtlampje, Voorlees boekje	De structuur en veiligheid die het aan kinderen geeft.	2	5	5	1	Voor mijn kinderen is h niet nodig.
7-12-2021 20:18:25	2	3 en 5	Knuffel(s), Nachtlampje, Voorlees boekje	Ze zijn beide erg gehecht aan een labeldoekje	1	4	4	1	Mijn kinderen slapen makkelijk dus voor mij overbodig
9-12-2021 8:15:30	3	15 jaar 12 jaar en 2 jaar	Speciale knuffel (vink graag "anders" aan en licht toe wat voor knuffel), Voorlees boekje, Een konijntje die de jongste al vanaf zijn geboorte heeft	Dat ze veilig zijn.	2	3	3	5	Mijn kinderen slapen o het algemeen goed in .
15-12-2021 16:20:58	2	1 en 2	Knuffel(s), Nachtlampje, White noise product of knuffel, Speen, Voorlees boekje	Veiligheid, en flexibiliteit (moet bv ook op de opvang te gebruiken zijn)	6	5	4	5	Klinkt interessant, maar wel lastig met bv logere als het kind aanleert on alleen maar met trilling slapen kan dat buitensl voor problemen zorgen
16-12-2021 22:42:59	3	7-5-3	Knuffel(s), Nachtlampje, Product met (slaap) muziekje, Voorlees boekje	Dat het rust uitstraalt	5	2	2	1	Is kind afhankelijk, maa denk dat het boven leer 2-3 jaar juist averechts
16-12-2021 22:56:52	2	4 en 2 jaar	Knuffel(s), Speen, Zelf erbij gaan liggen, arm om kind heen	Voor de een de knuffel en mama, voor het andere kind alleen mama of papa	6	6	5	7	Mijn kinderen worden v wakker doordat ze allen zijn, misschien dat de trillingen het gevoel kun geven dat papa of mam ook ligt. Mijn zoon gaat nachts ook vaak "wippe op handen en knieën ritmisch heen en weer bewegen en maakt zich hier soms ook wakker r Zo'n matras lijkt me voo hem heel fijn, dit is voo ontspanning en zo'n ma zou hem hier misschien helpen.
17-12-2021 6:17:48	2	3 en 1	Knuffel(s), Product met (slaap)muziekje	Dat ze wel zelf in slaap leren vallen	1	5	5	3	Concept is mooi. Maar niet werkt heb je voor n een nieuw matras aangeschaft.
17-12-2021 7:33:41	2	5 en 2,5	Knuffel(s), Nachtlampje, Voorlees boekje	Dat het werkt haha	4	4	4	4	De jongste viel nooit in wagen en amper in de in slaap. Dus kheb gee idee of dit bij alle kids z werken.. en ook meer v doe je na die 5 jaar dar moeten ze er ineens zo mee slapen. Alles wat j aanleert kwa extra bijzonderheden is weer lastig om uit hun systee krijgen. Dit is dus ook n mee te nemen naar opa oma, voor logeren en vakanties.
17-12-2021 9:15:05	1	3	Knuffel(s), Nachtlampje, Product met (slaap) muziekje, Voorlees boekje, Tot kort geleden nog een speen, maar net mee gestopt.	Dat het een kind rust en vooral vertrouwen geeft.	5	3	3	2	Ik zou niet goed de fun snappen van het tillen e hoe hard is het trillen? I wat onduidelijk en ik verwacht niet dat het m kind zal helpen.
21-12-2021 17:44:36	1	1	Ik heb geen specifieke slaap producten voor mijn kind	Dat het werkt, maar niet heel duur is voor maar een korte periode (zoals met veel baby producten)	5	6	5	7	Omdat ik me kan voorst dat het voor kinderen h rustgevend werkt
21-12-2021 18:02:23	1	14 maanden	Knuffel(s), White noise product of knuffel, Speen	Duurzaam, knuffelbaar	2	5	5	5	Ik ben bang dat het erg kostbaar zal zijn, maar daarvan misschien wel mooi concept.
10-1-2022 11:20:27	2	2 en 4	Knuffel(s), Voorlees boekje	nvt	5	7	7	7	Omdat jonge kinderen door wiegen in slaapva Zodra je ze neerlegt wo ze dan weer wakker
					3,625				

Op een schaal van 1 - 7, hoe rustgevend verwacht u dat concept 2 is voor kinderen?	Op een schaal van 1 - 7, hoe effectief verwacht u dat concept 2 is om kinderen te helpen slapen?	Op een schaal van 1 - 7, hoe interessant vind u concept 2?	Licht alstublieft uw antwoord op de vorige vraag kort toe. Waarom vindt u het concept wel/niet interessant?	Op een schaal van 1 - 7, hoe rustgevend verwacht u dat concept 3 is voor kinderen?	Op een schaal van 1 - 7, hoe effectief verwacht u dat concept 3 is om kinderen te helpen slapen?	Op een schaal van 1 - 7, hoe interessant vind u concept 3?	Licht alstublieft uw antwoord op de vorige vraag kort toe. Waarom vindt u het concept wel/niet interessant?	Welke van de twee vormen van concept 3 heeft uw voorkeur?	Waarom verkiest u de hierboven gekozen vorm boven de andere vorm?	Welk concept lijkt u het meest effectief om jonge kinderen te helpen slapen?	Waarom lijkt u dit concept het meest effectief?	Welk concept lijkt u het minst effectief om jonge kinderen te helpen slapen?	Waarom lijkt u dit concept het minst effectief?	Welk concept trekt u het meeste aan; zou u het liefst willen hebben?	Waarom zou u deze het liefste willen hebben van de drie conceptenl?	Welk(e) element(en) van het ontwerp zou u anders willen zien? En waarom?	Welk(e) element (en) van het ontwerp vind u het meest waardevol? En waarom?	Hoe zou u het liefste de trilling van het product aan- en uitzetten?	Hoe lang zou u willen dat de trilling aan blijft?	Zou het product nog andere functies, naast een slaap trilling, moeten bevatten? En zo ja, welke functie (s)?	Hoeveel zou u betalen voor concept 1, als bewezen is dat het kinderen helpt in slaap te vallen?	Hoeveel zou u betalen voor concept 2, als bewezen is dat het kinderen helpt in slaap te vallen?	Hoeveel zou u betalen voor concept 3, als bewezen is dat het kinderen helpt in slaap te vallen?
3	3	6	Hoe raar het klinkt zou ik dit eerder willen proberen om vervolgens een groter matras te kopen. Afhankelijk van de prijzen uiteraard. Maar zou eerst iets willen proberen. Echter kinderen bewegen veel met name mijn jongste dochter dus die zou er minder baad bij kunnen hebben.	6	6	7	Ze kunnen zelf het product vasthouden of wegleggen. Kunnen het zelf op een plek leggen waarbij ze het willen voelen, in de armen tegen de buik of bij de rug.	Vorm 1, de knuffel	Weet niet goed wat ik zou kiezen, beide hebben wat dus voor nu heb ik een lichte voorkeur voor de knuffel.	Concept 1	Omdat zij een knuffel niet goed kunnen vasthouden of bewust kunne gebruiken. En het is overal voelbaar dus wanneer een kind erg bewegelijk is.	Concept 3	Omdat een knuffel soms moeilijk vast te houden is of op een plek te leggen waar ze er tegen aan kunnen liggen. En door bewegingen zullen ze de knuffel niet meer tegen zich aan hebben dus misschien weer wakker worden.	Concept 3	Mijn kinderen houden de knuffels vast en pakken ze wanneer ze ze weer vast willen houden.	Misschien bij keuze nog een lief en zacht muziekje erin?	Denk het gehele plaatje.	Combi van een app en automatisch en evt een zelfbediening voor het kind.	30 min - 1 uur	Zacht muziekje of geluid van het kloppen van het hart wat ze altijd hebben gehoord als baby in de buik.	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro
1	2	1	Mijn kinderen bewegen veel. Dus op een kleine piek trillingen, lijkt mij niet werken	2	1	4	Gematigd positief	Vorm 2, een abstracte blob/boon vorm	Wijkt af van bestaande knuffels	Concept 3	Geeft kinderen houvast	Concept 1	Zou ik zelf onrustig van worden	Concept 3	Zo er hierboven	Geen	Liever effectief dan een waardevol ontwerp	Vla een afstandsbediening buiten de kamer van het kind	Voor een tijdsduur die zelf in te stellen is	Muziek	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro
5	5	5	Makkelijker toe te passen of te verwijderen. En het kind heeft genoeg ruimte ergens anders zonder de trillingen	6	6	6	Als het kind het fijn vind, kan het overal mee naartoe genomen worden, dus ook grootouders of vakantie.	Vorm 1, de knuffel	Knuffel is echt kind eigen. Misschien kan je een concept maken voor in een eigen knuffel naar keuze.	Concept 3	Kinderen bewegen in hun slaap veel. Maar een knuffel houden ze dichtbij hun.	Concept 1	Het kind kan er niet van houden en heeft dan geen plek zonder de trillingen	Concept 3	Deze is overal mee naar toe te nemen. Is heel handig met logeren, vakantie of ergens heen gaan.	Misschien ook toepasbaar op bestaande knuffels maken?	Veiligheid.	Automatisch: het product moet aan gaan zodra mijn kind onrustige geluiden begint te maken of te huilen, en dan uitgaan zodra hij/zij weer stil is.	Totdat mijn kind niet meer huilt/praat/actieve geluiden maakt	Muziek, geluidjes of hartslag die je kan instellen (vooral bij baby's)	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro
4	4	4	Vind het lastig of dit iets is	7	7	7	Omdat knuffels hier goed werken denk ik dat dit ook kan helpen	Vorm 1, de knuffel	Omdat ik denk dat iets dat ze vast kunnen houden helpt.	Concept 3	Zichtbaar	Concept 2	Omdat ik geen idee heb of dit iets doet	Concept 3	Omdat ik benieuwd ben of de jongste beter is slaap valt hier mee	Alle 3 ben nieuwsgierig of dit werkt jongste valt moeilijk in slaap altijd eerst huilen.	Alle 3.	Vla een afstandsbediening buiten de kamer van het kind	Voor een tijdsduur die zelf in te stellen is	Nee denk ik niet	Tussen de 50 - 100 euro	Tussen de 50 - 100 euro	Tussen de 50 - 100 euro
4	4	1	Niet nodig bij ons het het is minder veilig.	7	7	6	Mijn kinderen hebben veel rust en veiligheid bij de vaste knuffel. Het hoeft niet perse te trillen.	Vorm 2, een abstracte blob/boon vorm	Een abstracte vorm is wat makkelijker te vervangen bij het stukgaan of kwijtraken van de knuffel.	Concept 3	Een knuffel kan ze veiligheid geven, ook als ze niet hoeven te slapen.	Concept 2	Minder veilig laat het een ios object is en meer geoentreerd op 1 plek	Concept 3	Zie vorige antwoorden	iets persoonlijke of herkenbaars bij de abstracte knuffel, zoals een poezengezicht of ogen, neus en mond. Wel de knuffel in abstracte vorm houden.	Handzaam en makkelijk te geven, ook als ze niet hoeven te slapen	Vla een app	Totdat mijn kind niet meer huilt/praat/actieve geluiden maakt	Muziek of een geur?	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro
4	4	1	Zelfde al het vorige punt	6	6	6	Hier kan ik me eerder wat bij voorstellen	Vorm 1, de knuffel	Omdat ze knuffel vaak wel leuk vinden	Concept 3	Het is tastbaar en ze kunnen zien waar het uitkomt	Concept 2	Omdat het maar een klein stukje tritt. Moeten ze er net op liggen	Concept 3	Het kan ook gewoon een knuffel zijn	Geen Idee	3	Vla knoppen of touch screen op het product zelf	30 min - 1 uur	Nee of misschien een lampje	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro	Tussen de 20 - 50 euro
3	3	4	Ben wel benieuwd of het echt helpt	2	2	4	Ik zou wel willen weten of het werkt Ik denk dat ze er mee gaan spelen	Vorm 1, de knuffel	Knuffel is denk ik toch fijner	Concept 2	Ik denk dat door de trillingen dat dat beter werkt dan een trillende knuffel	Concept 3	Dan gaan ze er denk ik mee spelen	Concept 1	Ik denk dat die het beste werkt	Geen	Geen	Automatisch: het product moet aan gaan zodra mijn kind onrustige geluiden begint te maken of te huilen, en dan uitgaan zodra hij/zij weer stil is.	Totdat mijn kind niet meer huilt/praat/actieve geluiden maakt	Zachte slaapliedjes	Tussen de 50 - 100 euro	Tussen de 100 - 150 euro	Tussen de 100 - 150 euro
5	4	5	Het is makkelijker mee te nemen, al vraag Ik me af of de trillingen dan sterk genoeg zijn	6	6	6	Mijn baby houdt van een bewegende hand op haar rug, dat zou deze knuffel misschien kunnen vervangen	Vorm 2, een abstracte blob/boon vorm	Idealiter een vorm die ook op de rug van de baby kan (en blijft) liggen	Concept 3	Handig mee te nemen	Concept 1	Misschien wel effectief maar niet zo handig	Concept 3	Omdat die op verschillende plekken gebruikt kan. Maar die moet dan wel draadloos zijn ivm veiligheid	Ideaal zou iets zijn dat de beweging van de hand van een ouder imiteert (BW wrijven, kloppen op onderrug/billen)	Het bewegende aspect	Automatisch: het product moet aan gaan zodra mijn kind onrustige geluiden begint te maken of te huilen, en dan uitgaan zodra hij/zij weer stil is.	Minder dan 30 min	Misschien white noise of een zacht muziekje. Eventueel ook de functies van de baby monitoren, bv temperatuur en hartslag	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 50 - 100 euro
3	3	3	Nu is er lokale trilling wat juist de oudere kinderen denk Ik interessant gaan vinden	4	4	4	Interessanter, maar wellicht ook vooral voor jongere doelgroep?	Vorm 1, de knuffel	Is wat concreter voor het kind	Concept 3	Zie boven	Concept 1	Teveel trillingen	Concept 3	Omdat ik denk dat die het best werkt/past bij een kind	-	Vorm	Vla een app	30 min - 1 uur	-	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro	Tussen de 20 - 50 euro
6	5	7	Zelfde als bij de vorige vraag	4	3	7	Mijn dochter slaapt met haar eigen knuffel, dus Ik verwacht nirt dat ze iets anders accepteert. Mocht dit wel zo zijn Ijkt het mij voor beide kinderen ontspannen	Vorm 1, de knuffel	Moeilijk, mijn dochter zou denk Ik een knuffel aantrekkelijker vinden, mijn zoon heeft niks met knuffels dus iets abstracts zou hem denk Ik meer trekken	Concept 1	Ik zeg optie 1 maar kan eigenlijk niet klezen tussen de 3 opties. Mocht de eerste optie too much zijn, zou optie 2 beter zijn. Optie 3 is weer heel anders. Ik zou ze alle 3 graag proberen.	Concept 2	Zie antwoord hierboven	Concept 1	Ik kan nog steeds niet klezen, maar optie 1 is wel heel origineel.	Geen Idee	Geen Idee	Vla een app	Voor een tijdsduur die zelf in te stellen is	Misschien white/pink noise of meiodietjes die je zelf kunt toevoegen via een app. Dus de favoriete liedjes van je kinderen. Of misschien wel zelf liedjes inzingen	Tussen de 150 - 200 euro	Tussen de 150 - 200 euro	Tussen de 150 - 200 euro
4	3	5	Iets laagdrempeliger omdat je niet een nieuw matras hoeft aan te schaffen	6	6	5	Ik denk dat kinderen dit heel prettig vinden.	Vorm 1, de knuffel	Kinderen houden denk Ik meer van een concrete knuffel.	Concept 3	Hangt vd leeftijd af. Voor een baby zal t matras het beste werken, voor een peuter de knuffel, denk Ik.	Concept 2	Idem	Concept 3	Past beter bij leeftijd kinderen	Niets	Dat het een knuffel is, mijn kinderen hechten erg aan een knuffeltje in bed	Automatisch: het product moet aan gaan zodra mijn kind onrustige geluiden begint te maken of te huilen, en dan uitgaan zodra hij/zij weer stil is.	Totdat mijn kind niet meer huilt/praat/actieve geluiden maakt	Nee	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 50 - 100 euro
2	2	2	Straks koop je dit en tritt je kind door bijv een dun matras half uit z'n bed en Andersom.. met een dik matras voelen ze het misschien amper.. misschien met een goed flimpje en goede uitleg met om matras enzv wat de voelbaarheid ervan is?	5	5	5	Vaak worden de kids al rustig als ze in bed een knuffeltje hebben. Als dit dan een beetje tritt tritt het matras vast ook wel een beetje.. makkelijk mee te nemen naar logeren of vakanties.	Vorm 1, de knuffel	M'n kind gaat toch niet graag met een boon knuffelen.	Concept 1	Als jullie hier onderzoek naar hebben gedaan zal optie 1 denk Ik het best werken.. dan tritt heel het matras goed mee en maakt het niet uit waar ze liggen. Alleen als je dus je kind gaat laten logeren of op vakantie ben je daar des te langer bezig met het in slaap brengen doordat het niet mee te nemen is. En bijv een knuffel wel en bij een knuffel hoer je het na het 5e jaar die af te leren, die knuffel kunnen ze dan daarna ook wel bij zich houden.	Concept 2	Lijkt me onhandig ofzo..	Concept 3	Lijkt me de meest logys aan de hand van m'n vorige antwoorden	Geen Idee, Ik ben er toch geen voorstander van.. beetje aandacht voor de kids en ze daarna zelf in slaap laten vallen lijkt me toch de beste manier. Niet weer een niet uitprobeerseltje die je daarna weer af moet leren	Geen	Vla een app	Minder dan 30 min	Nee. En nog antwoord op de vraag hierboven.. als je kind dan na 30 min niet zou slapen zo het niet werken. M'n kinderen slapen zeker na 15 tot 20 min wel.	Tussen de 20 - 50 euro	Onder de 20 euro	Tussen de 20 - 50 euro
3	3	2	Zelfde als vorige. Mij is niet duidelijk waarom trillen zou helpen en ik verwacht niet dat het mijn kind helpt.	5	5	5	Klinkt interessant omdat het kind zelf wat meer keus heeft of die hem vasthoudt of niet.	Vorm 1, de knuffel	Het zou denk Ik interessanter zijn voor mijn Kind en het is wat herkenbaarder.	Concept 3	Het trillen van de matras lijkt mij niet prettig . Een knuffel geeft ook meer een vertrouwd gevoel.	Concept 1	Het lijkt mij niet prettig en juist (vooral voor iets oudere kinderen) wat meer onrust kunnen geven m.	Concept 3	Klein, praktisch meenemen en geeft het kind de keuze om wel of niet vast te houden.	Is de knuffel ook op afstand te bedienen? Als het kind ermee in de armen slaapt is het anders lastig uitzetten.	Het is knuffelbare en is relatief klein dus makkelijk meenemen voor logeren bijvoorbeeld.	Vla een afstandsbediening buiten de kamer van het kind	Voor een tijdsduur die zelf in te stellen is	Rustig en zacht muziekje die aan en uit kan.	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 50 - 100 euro
6	4	4	Klinkt interessant, maar hoe weet je of jouw matras geschikt is voor het apparaat en wat als dat niet zo is?	2	1	1	Mijn kind wil geen knuffel, dus zal hij dit idee ook uit bed goolen denk Ik. Wel handig dat je het mee kan nemen op bijv. vakantie (is met concept 2 ook makkelijker natuurlijk)	Vorm 1, de knuffel	Ziet er leuker uit	Concept 1	Ziet er het meest uit alsof het werkt	Concept 3	Heeft met mijn kind te maken, die alle knuffels uit bed goolt	Concept 1	Zie eerdere antwoord	Concept 1 zou ook makkelijk mee te nemen moeten zijn op bijvoorbeeld vakantie	De trilling regulleren op afstand klinkt heel handig	Vla een app	Voor een tijdsduur die zelf in te stellen is	White noise zou ook een mooie toevoeging zijn	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro	Tussen de 20 - 50 euro
3	4	2	Ik denk dat het voor mijn dochter averechts zou werken en ze wakker zou blijven/worden. omdat ze tijdens het slapen het hele bed door gaat. De ene keer ligt ze overdwars, de andere keer bij het voeteind.	3	4	3	Ik vraag me af of een knuffel die tritt slaap bevorderend is.	Vorm 2, een abstracte blob/boon vorm	Een trillende knuffel daagt uit om te spelen.	Concept 1	Dit is algehele trilling en niet plaatselijk	Concept 2	Als een kind erg beweeglijk is is de plaatselijke trilling niet handig.	Concept 1	Zelf bedienbaar matras klinkt interessant	Geen	De afstand bestuurbare functie, niet uit bed moeten als de baby huilt.	Vla een afstandsbediening buiten de kamer van het kind	Voor een tijdsduur die zelf in te stellen is	White noise	Tussen de 100 - 150 euro	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro
6	5	3	Vraag mij af of dit voelbaar is met de dikte van matras	7	7	7	handig mee te nemen als je ergens heen gaat	Vorm 2, een abstracte blob/boon vorm	dit lijkt me makkelijk vast te houden	Concept 3	kun je overal mee naar toe nemen, vertrouwd	Concept 2	zie bovenstaand antwoord bij concept 2	Concept 3	zie bovenstaand antwoord	2 een groter en platter ding wat je evt mee kan nemen en ook bij een campingbedje kunt gebruiken	het trillen	Automatisch: het product moet aan gaan zodra mijn kind onrustige geluiden begint te maken of te huilen, en dan uitgaan zodra hij/zij weer stil is.	30 min - 1 uur	evt warmte?	Tussen de 150 - 200 euro	Tussen de 50 - 100 euro	Tussen de 20 - 50 euro

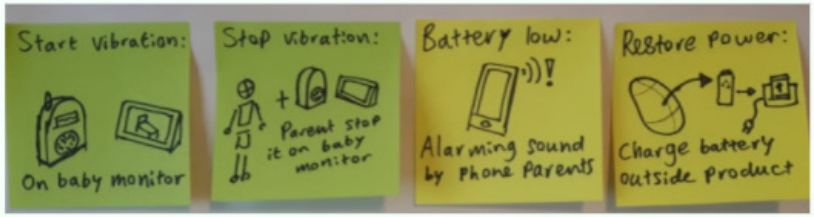
Appendix 11: Scenario post-its

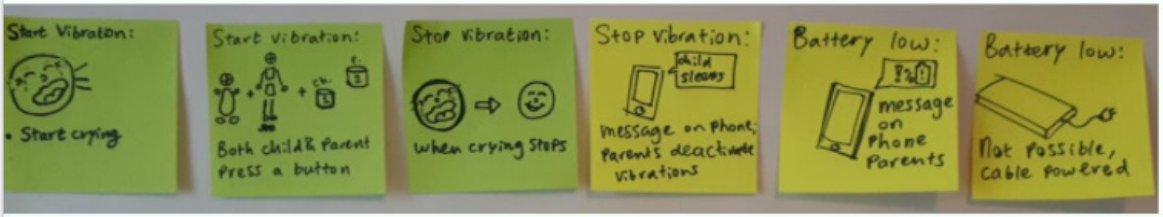

Start Vibration:
• Start crying
Start Vibration:
Child Awake
message to Phone Parents,
Start Vibration:
Both child & Parent press a button
Stop Vibration:
X +
When crying stopped + X-time later
Battery low:
message on Phone Parents
Battery low:
Not possible, cable powered


Start Vibration:
• Start crying
Start Vibration:
Both child & Parent press a button
Stop Vibration:
X +
When crying stopped + X-time later
Battery low:
message on Phone Parents
Battery low:
Not possible, cable powered

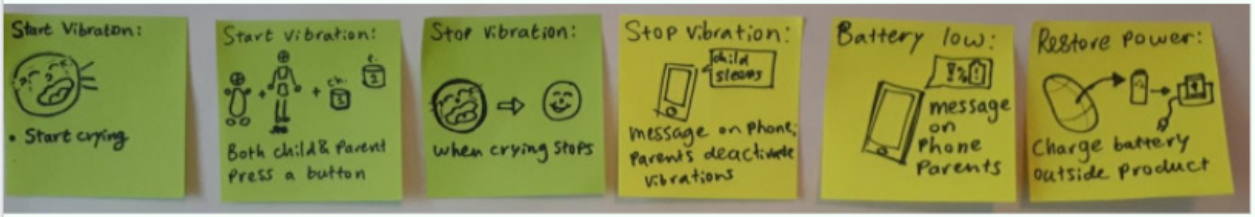

Start Vibration:
• Start crying
Stop Vibration:
When crying stops
Battery low:
Alarming sound by the product
Restore power:
X
Replace battery

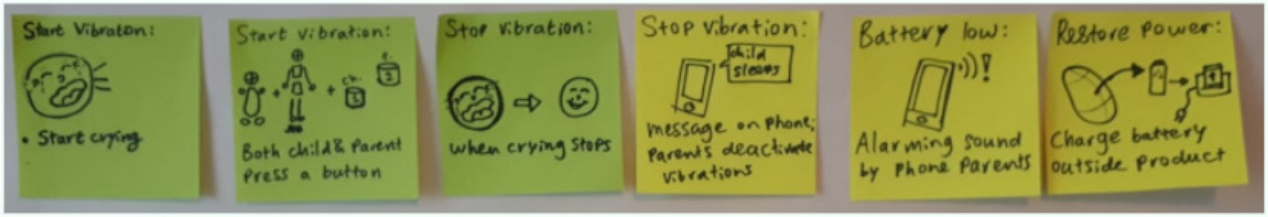

Start Vibration:
• Start crying
Start Vibration:
Both child & Parent press a button
Stop Vibration:
When crying stops
Battery low:
message on Phone Parents
Battery low:
Not possible, cable powered


Start Vibration:
On baby monitor
Stop Vibration:
Parent stop it on baby monitor
Battery low:
Alarming sound by Phone Parents
Restore power:
Charge battery outside Product


Start Vibration:
• Start crying
Start Vibration:
Both child & Parent press a button
Stop Vibration:
When crying stops
Stop Vibration:
Child sleeps
message on Phone; Parents deactivate vibrations
Battery low:
message on Phone Parents
Battery low:
Not possible, cable powered


Start Vibration:
• Start crying
Start Vibration:
Child Awake
message to Phone Parents, they activate
Stop Vibration:
When crying stops
Stop Vibration:
Child sleeps
message on Phone; Parents deactivate vibrations
Battery runs low:
"blink"
red LED on Product
Restore power:
Charge battery outside Product


Start Vibration:
• Start crying
Start Vibration:
Both child & Parent press a button
Stop Vibration:
When crying stops
Stop Vibration:
Child sleeps
message on Phone; Parents deactivate vibrations
Battery low:
message on Phone Parents
Restore power:
Charge battery outside Product


Start Vibration:
• Start crying
Start Vibration:
Both child & Parent press a button
Stop Vibration:
When crying stops
Stop Vibration:
Child sleeps
message on Phone; Parents deactivate vibrations
Battery low:
Alarming sound by Phone Parents
Restore power:
Charge battery outside Product


Start Vibration:
• Start crying
Stop Vibration:
When crying stops
Battery runs low:
"blink"
red LED on Product
Restore power:
X
Replace battery
Start Vibration:
When child moves a lot + makes (crying) sounds
Stop Vibration:
X + X
No crying + no movement
Battery low:
message on Phone Parents
Restore power:
X
Replace battery
Start Vibration:
• Start crying
Stop Vibration:
When crying stops
Battery low:
message on Phone Parents
Restore power:
X
Replace battery
Start Vibration:
When child moves a lot in bed
Stop Vibration:
X + X
No crying + no movement
Battery low:
message on Phone Parents
Restore power:
X
Replace battery
Start Vibration:
• Start crying
Stop Vibration:
When crying stops
Battery low:
"Blinking"
RED LED ON Baby monitor
Restore power:
X
Replace battery
Start Vibration:
When child moves a lot + makes (crying) sounds
Stop Vibration:
X + X
No crying + no movement
Battery runs low:
"blink"
red LED on Product
Restore Power:
Charge on Plateau
Start Vibration:
• Start crying
Start Vibration:
Both child & Parent press a button
Stop Vibration:
When crying stops
Stop Vibration:
child sleeps
Message on Phone; Parents deactivate vibrations
Battery runs low:
"blink"
red LED on Product
Restore Power:
Charge battery outside Product
Start Vibration:
When child moves a lot + makes (crying) sounds
Stop Vibration:
X + X
No crying + no movement
Battery runs low:
"blink"
red LED on Product
Restore power:
Charge battery outside Product
Start Vibration:
• Start crying
Start Vibration:
Child Presses Button
Stop Vibration:
X-time later, Preset
Battery runs low:
"blink"
red LED on Product
Restore power:
Charge battery outside Product
Start Vibration:
When child moves a lot + makes (crying) sounds
Start Vibration:
child Awake
message to Phone Parents, they activate
Stop Vibration:
X + X
No crying + no movement
Stop Vibration:
child sleeps
Message on Phone; Parents deactivate Vibrations
Battery runs low:
"blink"
red LED on Product
Restore power:
Charge battery outside Product
Start Vibration:
When child moves a lot in bed
Stop Vibration:
When crying stops
Battery low:
message on Phone Parents
Restore power:
X
Replace battery

Appendix 12: List with links to sound files

Heartbeat: File: Heartbeat Sound Effect 01. Retrieved from: https://www.soundjay.com/heartbeat-sound-effect.html
White noise, pink noise and brown noise: Made in Audacity by using Generate > Noise > White, pink or brownian types, 0.8 amplitude. A Low-Pass Filter of 40.0 Hz and 6 dB roll-off was put over all three noises.
Lullaby sound file: *10 Minutes Baby Bedtime Music Soothing Lullaby to go to Sleep Relaxing Music* by Wonderful Lullabies. Retrieved from: https://youtu.be/arz-Y2N_LjQ
Bedtime story: Nighty *Night Forest | Lovely bedtime story app for kids & toddlers*, by Fox & Sheep. Retrieved from: https://youtu.be/wFYGKOr1zi4
Rain rhythm: *30 Minutes Gentle Rain at Night, Rain Sounds for Sleep, Insomnia, Relaxing, Meditation, Yoga, Study,* by The Relaxed Guy. Retrieved from: https://youtu.be/CpS5Ex1Wx-4
Binaural beats: *Relaxing Theta Waves (15 min) - Binaural Beats - Slow Down Your Brainwaves,* by MusicMindMagic. Retrieved from: https://youtu.be/dxGU80Ny0JQ

Appendix 13: Research information test adults

Informatieformulier onderzoek slaap van kinderen & trillingen

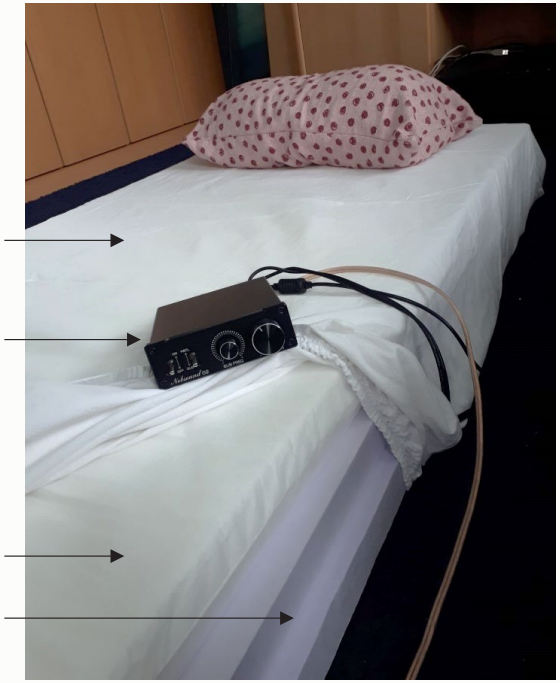
Het doel van het onderzoek is om te ontdekken hoe volwassenen reageren op verschillende soorten trillingen in een matras. Welke soort trillingen helpt hun het meeste om in slaap te vallen? Het onderzoek is onderdeel van het Design for Interaction Master afstudeer project van Marjolein Schoorl.

Het onderzoek zal worden gedaan aan de hand van een prototype in de vorm van een trillend matras. Een prototype is een test versie van een uiteindelijke product, en dus nog niet volledig af. Het is bijvoorbeeld nog niet volledig waterdicht, maar wel zo afgewerkt dat er geen gevaarlijke scherpe randen aan zitten. Het prototype matras is opgebouwd uit een laag hard schuim, met een Ikea PLUTTIG matrasje erbovenop. In het harde schuim zit een *Tactile bass shaker*, een speciaal soort speaker. Deze kan via de versterker (het kastje met die knoppen) verbonden worden met een audio apparaat zoals een mobiel, mp3, computer of laptop.

Er geen aannemelijk risico verbonden aan deelname aan deze studie.

Contactgegevens onderzoekster: Marjolein Schoorl, *[email]*

Datum: 26-11-2021



Appendix 14: Consent form test adults

Toestemmingsformulier voor onderzoek met prototype naar de “slaperigheid” van trillingen

Selecteer alstublieft de gepaste rondjes	Ja	Nee
Deelname aan de studie		
Ik heb de informatie over de studie gelezen op [/ /], of het is aan mij voorgelezen. Ik heb de kans gehad vragen te stellen over de studie en mijn vragen zijn naar tevredenheid beantwoord.	○	○
Ik geef vrijwillig toestemming om deel te nemen in deze studie en begrijp dat ik mag weigeren om vragen te beantwoorden, of opdrachten uit te voeren, en ik op elk moment me kan terugtrekken van deelname, zonder opgaaf van reden.	○	○
Ik begrijp dat deelname aan deze studie een gebruikerstest aan de hand van een prototype bevat. Van de gebruikerstest zullen geschreven notities worden gemaakt door de onderzoeker. Persoonlijke informatie wordt anoniem gemaakt voordat data wordt geanalyseerd.	○	○
Gebruik van informatie in de studie		
Ik begrijp dat informatie die ik geef gebruikt gaat worden in het afstudeer project van Marjolein Schoorl, en dat resultaten van het onderzoek gepubliceerd worden in het afstudeer rapport (Graduation Thesis) voor de TU Delft. De resultaten van de gebruikerstest zullen gebruikt worden om het productontwerp te verbeteren. Data wordt tijdens het project beveiligd bewaard in de OneDrive van de TU Delft.	○	○
Ik begrijp dat persoonlijke informatie die mij kan identificeren (zoals naam), niet gedeeld wordt buiten de onderzoeker.	○	○
Ik geef toestemming voor het gebruik van geanonimiseerde quotes in onderzoeksuitkomsten.	○	○
Ik geef toestemming voor het maken van foto’s tijdens de test en het gebruik van deze foto’s in geanonimiseerde vorm in onderzoeksuitkomsten.	○	○
Toekomstig gebruik en hergebruik van de informatie door anderen		
Ik geeft toestemming voor het opslaan van geanonimiseerde data, namelijk mijn reactie op de trillingen, en de ranking en rangschikking van de verschillende trillingen, in de online databank van de TU Delft, repository.tudelft.nl. Dit is de plek waar afstudeer documenten en universitaire onderzoeken op worden bewaard en gepubliceerd, zodat ze voor verder onderzoek en leren op de TU Delft kunnen worden gebruikt.	○	○

Handtekeningen

_____	_____	_____
Naam deelnemer	Handtekening	Datum

Ik heb accuraat het informatieformulier voorgelezen aan de deelnemer en, tot het beste van mijn kunnen, verzekerd dat de deelnemer begrijpt dat ze vrijwillig deelnemen en toestemmen.

_____	_____	_____
Naam onderzoeker	Handtekening	Datum

Contact onderzoeker voor verdere informatie: Marjolein Schoorl,
[email]

Appendix 15: Results test adults

Participant \ vibration	Single frequency	rate singl.	Frequency 36 Hz	rate 36	Frequency 40 Hz	rate 40	Frequency 60 Hz, fade in and out	rate 60 fade	Heartbeat	rate heart
1	50 is wel nice. Opvallend geluid. Is iets luider misschien. Dan doe ik m gewoon zachter. 80 is ook wel nice. Bij 50 voel je nog losse vibraties, dit is meer een geheel. 50 & 80 chill. 80 zet hun iets harder, maar net voor het punt dat je m harder gaat horen. 80% mobiel, iets over 50% ampl. 50: rate 7. 80: rate 6.	7	geluid lelijker. Tikkie zachter, voordat ie overslaat. Aanwezig, maar als je t niet had gezegd had t even geduurd voor doorhebben. Ligt aan je doel of dat goed is. Kan je wel niet wakker houden. Rate: 7	7	36 was meer slaperig. Deze vibe ik niet mee. Verschil van 4 Hz is groot. Rate: 4	4	Volume omhoog is heel nice. Weg en dan is t even van huh. Varwarring is in dit geval actief, dus geen slapend brein. Opvoeren: 8, wegvallen: 5. Rate: 6. Niet helemaal wegvallen zou beter zijn.	6	Het is een hartje (vrolijke stem). Hij klinkt wat gestresst, en hij lijkt sneller te zijn dan mijn hartslag. Het matrasje voelt wel leuk, lief, knuffelbaar en levend. Net een beetje sneller dan ik. Rate: 6. Nu hun nog wakker is voelt het gehaast. Nu ik er wat langer op lig begin ik m meer te waarderen.	6
2	Eerst laag, 20 Hz, voelde hij niet veel. Boven 60: o nu voel ik daadwerkelijk wat. Het is moeilijk om te voelen. 40 Hz heel naar geluid. 50 alweer beter. Redelijk laag, net had ik 33 Hz. Te snel, dan gaat voelt t meer als kriebelen, overprikkeld kan raken ervan. Rate: 7. Zou niet weten waar de andere. Hoort vibraties meer dan je voelt. Ik vind het niet per se een probleem, als je lange tijd ligt, zal t in de white noise categorie vallen. Zal balans in zitten. Te luid is niet nice. Maar geluid valt denk wel mee. Omdat t een nieuw geluid is soortvan gewenningsperiode.	7	33 is meer gentle dan 36. Rate: ietsje slechter, onder de 7 dus. Wel voldoende. 6 dus.	6	Vind m wat heftig. Misschien omdat ie harder voelt dan anderen. Niet per se nice. [gaat even liggen ipv zitten]. Te lang iets vasthouden wat trilt (geeft voorbeeld van bollen zeef machine), dan voelt dat niet nice. Rate: 5.	5	Volgensmij nu op luidst. Het is een trilling. Volgensmij best wel hoog? Ah ik snap m, hij golft in en uit. Ik kan t wel waarderen. Ik loop nu nog niet in sync ermee ofzo. Associatie van in golvend water liggen. Komt de trilling van 1 punt? Want over hele matras zou denk heel soothing zijn. Rate: best nice, 8 of 9? 8,5. Heel gentle. Ondanks dat ie hoger voelt, heeft het golvende effect meer invloed.	8,5	Niet nice dit. Misschien vanuit games dat als het slecht gaat, dat je dan hartslag gaat horen. Nee ik ben geen fan. Het hele klok ding, als je bij iemand slaapt en er is een klok. Heel aanwezig geluid. En als je m zachter zet? Nog steeds meh. Misschien dat ie te snel gaat, de hartslag. Weet niet wat slaaphartslag is? Zachter beter. Rate: 5.	5
3	100 voel ik ook al niks meer bijna. Voelde eerst niet zoveel, te zacht staan. 50 Hz, o dit doet iets met mij. Dit ontspant mij spieren voor mijn gevoel. Beetje massage stoel achtig, denk dat dat is waar ik naar zoek. 30 Hz voel ik opeens niet meer. 40 Hz schrikt ze van. 40 meest powerful. 30 voel ik m al bijna niet meer. 40 meest door mij heen. Positief of negatief? ja dat probeer ik ook te bepalen. volume staat hard. misschien een beetje heftig. Hz langzamer minder merkbaar of veel sneller minder merkbaar. Moeilijk om te beslissen. liever naar beneden. Rond de 35, maar wel hard volume. I can imagine this working. Niet over uit. Misschien maakt het me misselijk. Rare tension in borstkas. Wil op mn rug liggen. Rate: 7. Meer ontspannend dan slaperig. Weet niet hoe ik dat zou vinden. Wel ontstressend dit.	7	Ik voel m duidelijker. Meer intens. I feel like... meer massage chair, iets te heftig voor slapen. Wel nice. Rate: 7. Deze ontspant harder, vorige slaapt beter.	7	Deze minder. Rate: 5. Iets hoger, minder intens. Nog steeds erg aanwezig. Merk t meer maar niet in mn spieren.	5	Ik merk eigenlijk helemaal niks. Ik hoor met oor tegen kussen t net aan. Ook als ik m harder zet merkt ze het niet.		Ik merk instantly dat ik er rustiger van wil ademhalen. Dit is wss een gewone hartbeat, maar het voelt een beetje gejaagd. Weet je die momenten in een horrorfilm or verhaal, dat ze een hartbeat aanzetten om te simuleren dat je hartslag in je oren zit. gestresst. Maar het brengt wel mn attention naar mn ademhaling. Positief. Rate: 4.	4
4	50 Hz heftig massage geluid. 40 voelt zacht en dan voelt 45 heel heftig. Qua geluid slaap ik sowieso stil. Qua trilling voelt 50 Hz decent. Lager beter qua gevoel. 80 is ook heel relaxed. 80 voelt chill, maar 45 a 50 voelt t als massage, dus dat is relaxed maar niet slaapverwekkend. Rate: 8. Zou hier wel relaxed bij kunnen slapen. Boven 90 Hz irritant.	8	deze beetje op je zenuwen werkend. Je voelt de individiuele trillingen teveel. Rate: 3 Doet me ook een beetje denken aan een koelkast, het geluid, zou mij wakker houden.	3	Hetzelfde gevoel als eerder, voel je veel heftiger, massage, dus zou mij zeker wakker houden. 36 was nog chiller. Rate: 1	1	Fading in en fading out zeker. Doordat het een dusdanig andere frequentie is als mn ademhaling, niet chill. Matcht nu niet, misschien wel als ik ga slapen, dan langzamer ademhalen. Als ik m kan matchen aan ademhaling, rate: 8. Niet te matchen, rate: 4.	4	Ja dat is ehh. Totaal niet mijn ding om slaperig te zijn. Voor mn gevoel is mn eigen hartslag meer enkelvoudig (niet zo sterk die dubbele beat). Rate: 1.	1
5	50 Hz: dit is lekker voor mn rug. Hij moet niet heel hard, want dan heb ik het idee dat ik weg tril. 150 dan gebeurt er niks. 80 Hz, trilling zelf is best oke, maar de hoge toon van het geluid is niet fijn. Maar moet hem eigenlijk harder zetten om goed te voelen. 65 ene kant wel oke. te hard hoor je speaker aanslaan, zachter volume iets beter. Anders focus je op het geluid. Verder is dit wel rustgevend. 45 whooooow. Dit is wel echt een heftige vibratie, echt te. 50 is nog best relaxt, 45 echt niet. 65 tot nu toe beste. Ook al is 55 ook wel fijn. Verschil in intensiteit, 55 voelt intenser bij zelfde volume. 40 trilt wel heel erg. al doe ik hem zachter dan is het wel wat beter. Ik heb t idee dat hij te onrustig is, 40. Bij 30 doet hij niks meer. 35 is gewoon irritant. Qua toon. en qua trilling meer idee dat ik uit bed getrild wordt dan dat er iets gebeurt. 45 meer massagestoel, niet slapen. Beste: tussen 55 en 60. Rate: 7,5	7,5	Aan de ene kant is het wel fijn, want meer massage iets, maar aan de andere kant vind ik hem niet slaapverwekkend. Rate: 5 of 4, omdat het wel fijn is maar niet slaperig.	4,5	1,5 als ie net zo hard staat. Zachter is beter. Rate: 3. Ik heb nu het idee dat ik in een stoomboot zit boven de machinekamer.	3	Door het geluid zou ik hem lager geven. De trilling zelf eigenlijk ook wel onder de 5. Rate: 3. Net geen fijn herhalend patroon. Herhaalt zich te langzaam.	3	Volume stond luid. Toen 1,5. Bij laag volume nog steeds 1,5. Onrustig. Snap de game je bent op laag leven wel die iemand anders omschreef.	1,5
6	het geluid is erg afleidend. Lagere f wordt de toon minder hard, hoger is irritantere toon. Rustgevender is lager. 40 Hz prima. Rating: ergens tussen de 6 en 7.	6,5	Ik voel hier heel weinig. Nog aan het afvragen of minder sterk voelen beter is. Dit is minder intens dus misschien ietsje beter. Rating:	7	-	6,5	het klopt dat deze in intensiteit toeneemt en afneemt toch? Ik denk dat ik een voorkeur zou hebben voor monotoonheid, omdat dit me zou afleiden. Het voelt wel weer leuk, maar weet niet of je voor de massage trilling ging. Rating: 5,5	5,5	dit doet me aan een hartslag denken. Niet negatief. Maar weet niet of ik ervan in slaap kan vallen. Op zich rustgevend, maar niet rustgevender dan de 1e. Rating: 6 ongeveer.	6
7	heel hoog is gewoon geluid, dat is niet fijn. Boven 100 is niet fijn. Hele lage is ook niet fijn, rond de 50. Heel laag rond de 35 zou nog interessant kunnen zijn. Zat net rond de 7, nu 60. die niet vervelend. Voor gevoel snel te hard. Rond 35 meest slaperig. 25 is vaag achtergrond gevoel, ook wel oke. grappig dat je dat niet hoort. moet het ook eigenlijk niet horen. 25 of 35 beide goed. Beide Rating: 6.	6	hetzelfde	6	minder fijn. Rating: 4	4	dit is heel irritant dat het steeds harder wordt. Dat je denkt het wordt rustgevender maar dan komt t terug. Rating: 2	2	alsof mn hart gaat kloppen, maar dat doet hij al. Zachter eigenlijk ook niet fijner. Dan hoor ik liever een muziekje dan hard geklop. Rating: 2, niet slaapverwekkend	2
8	het punt is dat ik niet zo tegen herrie kan. Dus zo'n brom als bij 80 Hz val ik niet bij in slaap. 40 voelt leuker dan 80. en lager? 25 voelde ze niet. 35 is zo zacht dat je er niet echt iets aan hebt. Klein beetje geluid kan lekker zijn om andere geluiden minder te horen. 33. lage toon is lekkerder dan hoog. 90 is gewoon annoying. 33 beter dan 40. hoger hoor je meer dan voelt. 30 voel je niet meer zo. 33 lekker diep dreuntje. 32 hoor je m al niet meer. Weet niet of het slaperig is, als ik moet kiezen is dit het beste, omdat ik eigenlijk niks zou willen horen bij het slapen. Waarschijnlijk zal ik alles laag scoren. Rating: 3	3	33 beter. Rating: 1 want deze rammelt.	1	deze is veel te hard. Voel hem nu op een ander plek in het bedje. 33 beter. Rating 2	2	dit is ook een hele donkere. Heeft wat weg van de 33? Niet heel prettig dat het steeds wisselt. Rating: 2	2	heel annoying, iets van - 20 qua rating. Gooi dat matras uit het raam. Rating: 0	0

Participant \ vibration	White noise	rate white	Pink noise	rate pink	Brown noise	rate brown	Lullaby	rate lullb	Bedtime story1	rate story
1	Dit is er ook zo eentje die ik niet zo snel zou doorhebben. Denk stiekem dat als ik in mn eentje slaap, van het voor mezelf comfertabel maken. "yes ik ben een veilig babytje". Liever duidelijk iets van hij staat aan voelen. Rate: 6, niet positief, niet negatief. Denkt niet dat het helpt, houdt ook niet wakker.	6	Het voelt alsof er een hele grote kat onder me ligt. I like it. Deze vindt ik echt heel nice. Rate: 8. Big kitty.	8	Denk dat deze beetje hetzelfde is als 2 hiervoor, dat ik hem niet merk. Beetje hetzelfde. Rate: 6.	6	"oew" (positief klinkend). Ik ben in een fantasy wereld, in like een bos met fairies. Of het is een lullaby, dat kan ook. Beetje efteling als t had gepowerbuild op op de achtergrond zijn. Dit is ook een 8, ga er goed op.	8	Hier is iemand aan t praten. Is het david attenbourough? Ik heb niet zoveel met iemand die praat, maar kan voorstellen dat t voor kleine kinderen anders is. Als je als ouders iets zou kunnen inspreken kan ik voorstellen dat het voor het kind nice is. Muziekje op achtergrondje nice, klinkt als animal crossing. Praten houdt mij wakker. Rate: 7. Intrigeert me toch wel. Over time zou ik er denk wel goed op gaan.	7
2	Is deze gewoon statisch? Oke hij is niet statisch. Ergens de asociatie naar snurken. Het doet me denken aan slapen omdat ik weet dat ik snurk. Lage frequentie ook. Niet onprettig, niet positief. Neutraal. Rate: 6	6	Kan weer niet helemaal plaatsen wat het is. Misschien iets van wind ofzo. Voel de trilling niet echt in mn lichaam, dus voor mij vooral audio nu. Weet niet of ik het meer zou willen voelen. Chiller voor slapen? Dan juist prima dat t niet te intens voelt. Ik ben een zijslaper en met oor op t kussen hoor komt t teveel op de voorgrond. Wel ietsje nicer dan vorige. Rate: 6,5	6,5	Er zit hier weer een hartslag in. Ik vind m wel iets relaxter, ik merk dat ik een ritme in probeer te vinden, wat werkt als schaapjes tellen. Voelt zacht als in lief. Ben fan, 7,5.	7,5	Je bent gewoon muziek aan t spelen nu toch? Je bent nu serieus slaapliedjes aan t spelen. Voelt nice. Ik slaap wel vaker met muziek op achtergrond. Tool om te focusen op iets anders, minder bewust van wakker zijn. Volume tweaken en dan is melodisch nice. Maar vraagt niet teveel je aandacht. Weet niet of ik de vibraties erin echt voel, vooral de lagere. Weet ook niet of t nodig is. Cozy & gezellig, rate: 8.	8	Teskt erbij werkt voor mij minder, want dan probeer ik mee te pakken wat ze zeggen. Zou ik wakker van worden. Vind ik wel iets soothings hebben. Het klinkt alsof je al half in slaap aan t vallen bent, dat je niet meer duidelijk hoort wat er gezegd wordt, is wel nice. maar werkt niet voor mij om in slaap te vallen. Ik voel ook geen vibraties. Kan bassigheid van stem wel waarderen. Rate: 6,5.	6,5
3	Heel subtiel gevoel. Gevoel dat ie subtiel is, maar wel nice. Little small extra relaxation without bothering me too much. Not like having a nice massage, but nice sleepy time. Denk dat deze hoger scoort. Geeft me het gevoel dat er meer is dan massage gevoel. Kan mezelf voorstellen hierop te slapen. Rate: 6.	6	Ze zet m harder dan bij white noise. Ik heb moeite met iets halen uit dit patroon. Beetje onprettig gevoel. Heb het gevoel dat ik op het patroon wil kunnen ademhalen. It keeps interrupting me in the wrong places of my breath. Rate: 2	2	It reminds me of footsteps. Alsof er iemand is die van je wegloopt. Ik voel me niet per se heel relaxt als ik iemand om me heen heb lopen. Rate: 3	3	Ik vind dit heel nice, ik wordt er heel gelukkig van. Ik vind dit echt heel goed. I can completely imagine myself dreaming myself on this one. In a happy way. Rate: echt een 9. I find it distracting in exactly the way zoals ik wil als ik ga slapen.	9	Oke.. Oew. Zo het ding is, ik luister echt heel graag naar podcasts. Maar voor mij werkt deze ge-edite stem niet zo goed. Ik wordt niet afgeleidt door het verhaal, ik luister liever naar het verhaal. Nu is het alleen maar onvoorspelbaar, maar het is er wel. Rate: 1. Ondanks dat ik denk dat er wel potentie in zit, maar nu is t alleen maar weird.	1
4	Dit is een of andere white noise zeker. Slaapverwekkendheid zeker een 9 geven, want hoogste tot nu toe. Is chill.	9	Ja deze is wel stuk minder, een 6 ofzo. Weet niet waarom, voelt wat onrustiger ofzo.	6	I guess een rate: 1. er zit een soortvan rumbling ondertoon, dat is niet chill vind ik. Net iets te a ritmisch, maar voelt ook als iets van hartslag in verwerkt ofzo.	1	Ik let bijna meer op t geluid want ik voel de trilling niet heel erg. Dit voelt alsof de buren muziek aan hebben. Zou ik wakker van worden. Rate: 1.	1	moet lachen, kan ik ook min getallen geven? Kan niet tegen het gevoel van praten. Rate: 0	0
5	Denk dat ik deze een 2 geef. Ik heb het idee dat ik naast een spoor lig waar een goederentrein overheen rijdt.	2	Ik moet hem best hard zetten voordat ik hem voel. Deze doet niet zoveel met me. Niet per se storend maar ook niet relaxend. Dus Rate: 5	5	bij deze een beetje hetzelfde. Idee dat het in de verte onweert. Dus ook een 5 dan.	5	Ik voel meer trillen bij de vloer dan bij het bed. Heb meer het idee dat de buren harde operamuziek op hebben. Het melodietje is wel slaapverwekkend. Trilling doet me niet zo heel veel. Combi doet me neigen naar een 6. Al weet ik niet of ik uiteindelijk helemaal gek wordt van het melodietje	6	Nu heb ik het idee dat de tv beneden veel te hard aanstaat. (lacht) Omdat je echt zo'n stem erdoor hoort zonder dat je verstaat wat hij zegt. Dit is meer een 2, omdat ik dan ga focusen op wat de stem zegt. Rate: 3. Omdat ik toch ook wel gewend ben van vroeger dit geluid, verjaardag of tv of zusjes tv	3
6	ik weet niet zo goed wat ik van deze vind. Dit doet me niet zo heel veel. Eerder onrustig, maar kan niet beschrijven waarom. Rating: 5. misschien zelfs lager.	5	hier voel ik niet zo iets. Weet niet wat ik hiervan vind, weet niet wat ik voel. Maar leidt niet zo af. Minder onrustig dan vorige. Rating: 6. neutrale 6 want weet niet zo goed.	6	dit lagere ietsje beter. Rating: 6,5	6,5	dit is een melodietje. Uhm leuk dat het semi trillt muziek, maar ik slaap niet met een muziekje. Ik kan begrijpen dat als je met muziek slaap dat dit chill kan zijn. Rating: 5 plingel plingel mag echt weg.	5	is dit een verhaal? Oke dat vind ik dus nog irritanter. Ook omdat ik niet kan verstaan wat hij zegt. Rating: 4 Leidt me af.	4
7	dit zou ik meer als een slaapverwekkend patroon herkennen. Omdat het een soort afleidend gevoel is op de achtergrond. Rating: 7 of 8. dus 7,5	7,5	hij is ietsje geleidelijker, wel vergelijkbaar. Iets minder dan de vorige. Soortvan monotoon geruis ipv iets wat afleidt en ontspant. Rating: 6	6	lijkt weer iets meer op de eerste van de reeks. Prettig dat het wat meer afwisselt voor de ontspanning. Deze zelfs wel ietsje beter. Rating: 8	8	gewoon een gezellig muziekje met achtergrondgeluid en gevoel. Ik vind dat nooit vervelend, dus is voor mij wel rustgevend. Combi geluid en trilling? Is wel goed, want alleen het muziekje zou wat truttig zijn. Rating: 8	8	nee dat praten erdoorheen vind ik echt helemaal niks. Leidt enorm af. Op de verkeerde manier. Rating: 4 ofzo.	4
8	Ik hoor hem vooral. Dit heeft een beetje het effect van de zee. Beetje rollend effect. Dit is prettiger dan alleen 33. deze tot nu toe het leukste ja. Lijkt soortvan hartslagje in te horen? Rating: 4 ofzo?	4	nee dit is weer iets teveel ruis. Rating: 1 soortvan annoying. Dit klinkt als de airco van de buren die draait.	1	hier vind ik niet zo heel veel van. De andere waren duidelijker beter of slechter. Zou hier niet specifiek voor kiezen. Rating: 1 dan maar een 1 ofzo	1	neeh doe maar niet. Moet lachen. Geen muziek. Geluid zachter geen mening verandering. Rating: 1	1	nee dit is ook weer een 0, niet praten door mijn slaap. Rating: 0	0

Participant \ vibration	Rain	rate rain	Binaural beats	rate binau	Breathing 40 Hz	rate brth	General remarks	Hand	Arm	Upper leg	High chest	Belly	Back	Other?
1	Ik lig op een vulkaan die gaat uitbarsten. Klinkt zoals t onderwater klinkt maar dan sneller. Hier meer blubblubblub. Het is of dat of marine. Klinkt als natuurlijk grinding geluid. Rate: 5. Het voelt en klinkt natuurlijk, maar t grinding klinkt onrustig.	5	Oh fairies. Dit voelt als een muziekje wat aanstaat in Corpus. Beetje scifi. Ik vind dit een beetje voelen en klinken als de ruis in je oren. Beetje galm. Voelt op buik chill, maar klinkt minder nice. Rate: 5.	5	Gevoel is best wel nice, maar geluid niet. Doet me wel meer dan de vorige, dus rate = 6.	6	Idee: breathing + nicer geluid.					Buik voelt denk meest nice. 1) bed is safe space. Dus juist in bed mag je aan mn zachte buik zitten. Net als katten. Buik is ook best wel gevoelig. Dus daar voel je t. 2) trillingen in buik doet met denken aan wanneer je iets warms op je buik legt als je ongesteldheidspijn hebt. dus mn hoofd legt de link buik is geruststellen. 3) associatie van kroelen met katten in bed, is nice.		
2	Voelt gewoon als buiten geluid ofzo. Of juist alsof je diep onder water zit. Voelt wat doffer, oren onder water of muren. Geluid is wel nice, klinkt als white noise natuur geluid. Denk dat ik ze dan liever uit mn raam dan uit een kussen hoor. Voor mij doet ie t niet. Rate: 5,5 net aan voldoende. Weet niet wat een nacht zou doen.	5,5	[moet lachen] klinkt als een wii menu. Voelde net een vibratie bij mn onderrug, best wel nice. Het is chill, maar meer een chill dan slaap chill. Voelt te wakker. Rate: geluid en vibe is nice, 7. maar eigenlijk niet slaap, dit is chill cijfer.	7	dit is daadwerkelijk snurken toch? Iets wat klappert hieronder. Ik wil mn ademhaling erop matchen, en dat is nice. Denk ook wel dat het geluid zelf, wat ademhaling golf heeft. Geluid heeft comfi white noise vibe. Soothing. Het trekt je aandacht wel, maar dat is wel oke, dan ga je erin mee. meer natuurlijke golf. Rate: 8,5.	8,5	Idee: kat! Snurken.							
3	Dit herinnert me aan storm, onweer van buiten. Wat prettig is aan regen is dat het ver weg voelt, en nu voelt het gewoon alsof je kussen boos op je is, en dat is niet zo'n fijn idee. Onweer en regen klinken ook donker en boos. De reden dat t goed voelt is omdat je beschermd bent door je huis. En nu heb je niet die afstand en voel je je exposed. Rate: 4.	4	Ze zit niet veel aan de volumeknop merk ik]. Het gevoel dat ik hierop zou kunnen ademhalen. Het voelt wel een soortvan omringend en afleidend. Het doet me denken aan een orgel in een kerk, alsof iemand meerdere tonen van een orgel aan t indrukken is. [verbaasde ha]. Lastig om te zeggen [of het prettig is of niet]. Net een beetje creepy geluid overall. Rate: 6. Best wel hoog, maar onherkenbaar en ongemakkelijk. Over time zou ik er misschien aan kunnen wennen.	6	Ze ademt duidelijk mee. Oke I like dat ik erop kan ophalen. But I kind of hate the specific sound. Zou het nice vinden als het ook een lieve meditatiedroom was. Dit klinkt als snurken. Rate: 4.	4							Begon op rug, switchte naar zij. Fijner. Voelde via mijn wang.	
4	Zelfde als met brown noise, teveel rumbling, niet heel chill. Rate: 3 denk ik.	3	Rate: 6. het is net als die 80 Hz lekker vloeiend, merkt niet teveel verschil erin zegmaar. Lekker constant, niet teveel interval zegmaar. Het is net iets extremer, die gons. Dus net iets te ruw vergeleken met anderen.	6	moet lachen. Dit is heel apart. Vooral het geluid. Qua trilling, op zich wel relaxt, maar meer massagestoel relaxt, niet slaapverwekkend. Rate: 2.	2							Eerder op rug dan ergens anders ja. Maar slaapt niet op rug.	
5	Combi van onweer. Onweer die eraan komt terwijl je in een tent ligt. Maar op een of andere manier wel een beetje dicht bij het strand. Denk een 7. Omdat ik onweer, regen en harde wind rustgevend vind. Het is alleen net te onnatuurlijk. Harde wind heeft ook wegvallende windvlagen enz. Met dat erbij had het hoger geweest.	7	(moet lachen). Meer het begin van een film heb ik het idee. Is niet per se storend, maar ook niet slaapverwekkend. Dus denk een 5. Trilling is wel oke, geluid maakt het een 5. Anders een 6.	5	nee dit is een 1,5. ik heb het idee dat ik een hommel of bij of wesp om me heen vliegt.	1,5						Lag eerst op rug, daarna buik. Op mn buik eigenlijk net niet fijn dat ie zo op mn buik trilt. Misschien 65 beter dan 55? Voor buik 65 fijner, omdat ik dan niet het idee heb dat mn organen ergens heen getrild worden. Maar op rug voelen trillingen beter.		
6	[bedenkelijke hm] weet ik niet zo goed. Ik heb niet het idee dat ik hier relaxter van wordt, ook niet onrustiger. Ik heb hier niet zoveel mee. Rating: 5,5	5,5	zit hier veel zachtere muziek bij? Dat is wel beter dan dat je de pling, pling, pling hoort. Dan is het rustgevender. Dit is wel nog prima. Beter want zachter en subtieler. Bij de ander was het trillen en geluid meer aan of uit, afleidender. Rating: 6,5 Deze het beste.	6,5	kraakgeluid is raar. ik heb het idee dat hier intervals bij zitten. Kraak heel irritant. Rating: 5,5	5,5								
7	nee dit geluid lijkt teveel op een vliegtuig. Kan wel slapen in vliegtuig, maar is een brommend achtergrond geluid, maar is niet rustgevend. Rating: 5	5	deze is prettiger dan het eerste melodietje, omdat het hoge repeterende melodietje er niet bij zit. Dat is een soortvan oorwurm ipv nu ga ik slapen. Rating: 8,5	8,5	tsja dit weet ik eigenlijk niet. Beetje vaag achtergrond gevoel. Niet ontspannend maar ook niet irritant, beetje tussenin. Rating: 6 ofzo.	6								
8	ja... deze was niet zo prettig als de meer rollende zegmaar. Wel beter dan de 0 en 1. Rating: 3	3	het tacoyo deuntje aan het eind. Wel ontspannen. Ja deze vind ik ook nog een soortvan pretting, want doet me aan het laatste rust momentje van tacoyo denken. Rating: 4	4	dit is heel diep. Nee dit is weer te diep, dit is een 2.	2								

11

Score	Comment	Score	Comment
9	45 Hz: o dit is fijn. Meer wat lager, geluid in het midden. 47 is net iets intenser, beetje hetzelfde. Vanaf 45 voel ik hem erg, hoe hoger hoe lichter het gevoel. 45 lekker op de achtergrond. (gaapt veel) Rating: 9	10	hoge piep is vervelend, dan let je meer op de piep ipv gevoel. Ik zou hem dan eerder zachter zetten. Onder de honderd sowieso. Bijvoorbeeld 200 voel ik niet, hoor alleen en dat is afleidend. 60 a 70 beste. Gevoel heb ja hier voel ik wat van, maar is niet afleidend of iets dergelijks. 70 minst afleidende. hele neutrale toon en trilt wel, maar niet afleidend ofzo. Rating: 6,5
9	dit teveel op de achtergrond, ik voel dat het er is, maar voor mijn gevoel heb ik dan net niet die ontspannende trilling. Dit voelt alsof er een veertje ofzo, lichte tinteling over je rug. Rating: 7	6,5	deze is fijner dan de 70 Hz. Misschien net een tikkeltje harder. Rating: 7,5 denk ik. Waarom beter? Geluid heb ik er geen last van. Qua trilling, eigenlijk heel erg rustig. Waardoor je rustig gevoel krijgt. Wel aanwezig, maar dermate rustig dat je er denk ik wel van zou kunnen slapen.
7	deze is wel fijn. Wel ongeveel zelfde intensiteit, wat ik zoek. Maar ietsje meer op de achtergrond. Rating: 8	7,5	qua trilling vind ik deze vrij onrustig. Voelt net net lekker zegmaar. Qua geluid vind ik deze ook net niet lekker. Rating: 3,5
8	het voelt wel slaperig aan. Het is alleen voor je gevoel dat het heel langzaam omhoog komt en zwakt dan heel snel weer af. Tussen periodes minder. Te dynamisch. Rating: 5	3,5	qua tril intensiteit vind ik heb wat onrustig. Niet iets waarop ik echt lekker lig. Opzich wel fijn dat ie niet compleet constant is, maar op het hardste punt vind ik hem net te hard, kan zijn dat ik hem zachter moet vinden, maar dan wordt de tussenpauze te lang. een vaste lijn vind ik dan beter om op te slapen. Rating: 5, niet goed of niet slecht.
5	dit is een kloppend hart he? Nee. Lekker om bij te liggen maar niet wat helpt slapen. Rating: 4	5	qua trilling voel ik er vrij weinig van, verwacht dat dit fijn kan zijn als de frequentie (minder snel na elkaar) lager is. Maar omdat het een hart nabootst kan dit denk wel een rustig gevoel geven. Rating: 7
4	nee dit zou mij niet echt slaperig maken of iets. Beetje gerommel op de achtergrond. Beetje alsof je in bed ligt en je hoort de wasmachine naast je. Qua trilling voel ik bijna niks, geluid wasmachine. Rating: 4	7	deze voelt heel fijn en niet storend aan. Beetje het gevoel alsof ik op het strand zit. Aan de zee, alsof de golven om me heen slaan zegmaar. Zeker voor mensen die van het strand houden fijn. 8 of 9. trilling is erg onregelmatig. Qua gevoel is het heel erg rustgevend. Rating: 9
4	staat ie al aan ? (geluid moet best hard) hetzelfde als die ander. Rating: 4	9	ik merk eigenlijk vrij weinig verschil, behalve dat ie misschien iets sterker is. Dus exact hetzelfde als net. Rating: 9
4	ik heb echt het gevoel dat hij niet verandert. Voelt hetzelfde. Bij volume harder voelt ie wel iets fijner, maar misschien een 5. voelt iets meer dan die ander. Rating: 5	9	hier ook ongeveer hetzelfde idee. Misschien net iets andere frequentie naar mijn idee. Rating dus ook een 9
5	ik vind het geluid heel nice om naar te luisteren. Iets te zoetsappig, iets te klassiek. Heeft wel iets van die lofi streams, maar die hebben iets meer deuntje. Dit klinkt als zo'n muziekdoosje. Maar wel relaxed. Rating: 6	9	ik vind het fijn dat je een soortvan muziekje hebt. Maar qua trillingen een beetje intens bij de lagere. Muziek zou ik net iets harder willen hebben. Aan de andere kant ook fijn om de muzieknoten te hebben. Nu is de trilling beter doordat er minder hoge tonen in de muziek zitten. Rating: 9 Muziek is fijn om te luisteren tijdens het slapen. fijn om in de muziek mee te worden genomen ipv van buitenaf te luisteren.
6	neh een verhaaltje doet t m niet voor mij. Dit klinkt heel dof. Ik ga ernaar luisteren maar kan het niet verstaan, dus ik zou actief gaan luisteren. Dus denk dat ik wakkerder blijf dan in slaap val. Rating: 3	9	ik probeer er iets in de verstaan maar eeehh. De vorige vond ik heel fijn omdat het met muziek temaken heeft, maar ook de lange tonen. Maar nu voel ik de korte tonen van spraak, die ik eigenlijk erg afleidend vind. Houd meer van tonen die 1 sec duren dan de korte tonen en spraak. afleidend. Rating: 3
3	dit is gewoon fijn. Goede donder of regen op het raam, dat is best relaxed om mee in slaap te vallen. Meer vanwege het geluid en hele lichte trilling. Dit wel een 7 in vergelijking met de rest. Rating: 7	3	ja dit geeft me weer hetzelfde idee als de zee. Maar nu heb ik wel meer dat zee effect, door de tonen die ik hoor. Echt een golf effect. Op deze manier vind ik deze net ietsje fijner. Rating: 9
7	dit is gewoon 1 hele lange toon. Dit zou mij op een gegeven moment gek maken. Een variatie van deuntje is lekker afwisselend en als het een hele avond is dit te hetzelfde. Zou gaan irriteren, gek worden van toon in je hoofd. Slaperig nu wel, maar op lange termijn niet. gaat vervelen. Rating: toch wel een 6, want nu slaap verwekkend.	9	qua trillingen voelt deze wel fijn, maar qua toonhoogte ligt deze net niet, ligt misschien aan mn muziek achtergrond. Toon die nog moet oplossen. Daardoor kan ik er eigenlijk niet aan wennen. Heb het gevoel dat er meerdere tonen door elkaar heen klinken. meer onrust dan rust. Rating: 2
6	was dat het geluid? Ik dacht dat ik honger kreeg. Ik zou me echt afvragen of ik gewoon honger heb. Hiervan zou ik mn bed uit gaan en een broodje pakken. Rating: 3	2	deze geeft me ook niet echt een rustig gevoel, meer omdat het een krakend geluid is. Ja vanwege het geluid geen rustig gevoel. Wilde zeggen trillingen gevoel valt wel mee maar meh. Is geen rechte lijn, dus zou de eerste nog prefereren van de computer dingen. deze frequentie met de eerste golfbeweging. Rating: 2
3		2	

total:													
total:	67.5	56	42	41	36.5	58.5	53.5	52	61	31.5	54	56	40.5

single freqency	67.5
36 Hz	56
40 Hz	42
60 Hz, fade in and out	41
heartbeat	36.5
white noise	58.5
pink noise	53.5
brown noise	52
lullaby	61
bedtime story	31.5
rain	54
binaural beats	56
breathing 40 Hz	40.5

Appendix 16: Research information test children

Informatieformulier onderzoek slaap van kinderen & trillingen

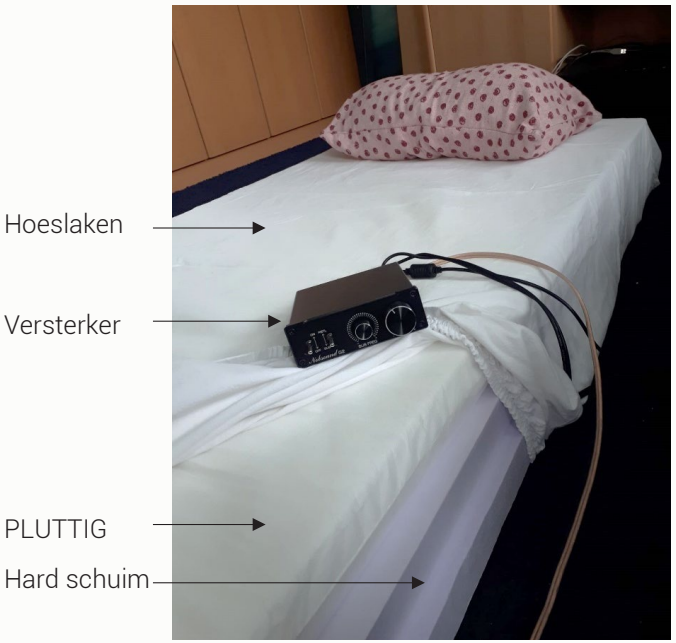
Het doel van het onderzoek is om te ontdekken hoe jonge kinderen tussen de 1 – 5 jaar oud reageren op een trillend matras. Welke soort trillingen helpt hun het meeste om in slaap te vallen? Het onderzoek is onderdeel van het Design for Interaction Master afstudeer project van Marjolein Schoorl.

Het onderzoek zal worden gedaan aan de hand van een prototype in de vorm van een trillend matras. Een prototype is een test versie van een uiteindelijke product, en dus nog niet volledig af. Het is bijvoorbeeld nog niet volledig waterdicht, maar wel zo afgewerkt dat er geen gevaarlijke scherpe randen aan zitten. Het prototype matras is opgebouwd uit een laag hard schuim, met een Ikea PLUTTIG matrasje erbovenop. In het harde schuim zit een *Tactile bass shaker*, een speciaal soort speaker. Deze kan via de versterker (het kastje met die knoppen) verbonden worden met een audio apparaat zoals een mobiel, mp3, computer of laptop.

Omdat het prototype nog geen volledig product is, wil ik nog niet hele nachten slapen met kinderen testen. Verder zal er tijdens de test, samen met de ouders, gelet worden op het geluidsniveau dat het prototype produceert. Met de volumeknop op het kastje is gemakkelijk een niet-schadelijk geluidsniveau in te stellen. Net als bij elke speaker in uw huis is het niet goed voor het gehoor van u en uw kind om de volumeknop zeer luid te zetten.
Er geen aannemelijk risico verbonden aan deelname aan deze studie.

Contactgegevens onderzoekster: Marjolein Schoorl, *[email]*

Datum: 26-11-2021



Toestemmingsformulier voor onderzoek met prototype naar trillingen & slaap van kinderen

Selecteer alstublieft de gepaste rondjes	Ja	Nee
Deelname aan de studie		
Ik heb de informatie over de studie gelezen op [/ /], of het is aan mij voorgelezen. Ik heb de kans gehad vragen te stellen over de studie en mijn vragen zijn naar tevredenheid beantwoord.	○	○
Ik geef vrijwillig toestemming om met mijn kind deel te nemen in deze studie en begrijp dat ik en/of mijn kind mag weigeren om vragen te beantwoorden, of opdrachten uit te voeren, en dat mijn kind en ik op elk moment ons kunnen terugtrekken van deelname, zonder opgaaf van reden.	○	○
Ik begrijp dat deelname aan deze studie een gebruikerstest aan de hand van een prototype bevat, die zal worden uitgevoerd door uw kind. Van de gebruikerstest zullen geschreven notities worden gemaakt door de onderzoeker. Persoonlijke informatie wordt anoniem gemaakt voordat data wordt geanalyseerd.	○	○
Ik begrijp dat het gebruik van het prototype op eigen risico is, en dat de onderzoeker niet aansprakelijk is voor enige schade door gebruik.	○	○
Gebruik van informatie in de studie		
Ik begrijp dat informatie die ik geef gebruikt gaat worden in het afstudeer project van Marjolein Schoorl, en dat resultaten van het onderzoek gepubliceerd worden in het afstudeer rapport (Graduation Thesis) voor de TU Delft. De resultaten van de gebruikerstest zullen gebruikt worden om het productontwerp te verbeteren. Data wordt tijdens het project beveiligd bewaard in de OneDrive van de TU Delft.	○	○
Ik begrijp dat persoonlijke informatie die mij kan identificeren [zoals naam of woonplaats], niet gedeeld wordt buiten de onderzoeker.	○	○
Ik geef toestemming voor het gebruik van geanonimiseerde quotes in onderzoeksuitkomsten.	○	○
Ik geef toestemming voor het maken van foto's tijdens de test en het gebruik van deze foto's in geanonimiseerde vorm in onderzoeksuitkomsten.	○	○
Ik geef toestemming voor het maken van video's tijdens de test en het gebruik van deze video's in geanonimiseerde vorm in onderzoeksuitkomsten.	○	○
Toekomstig gebruik en hergebruik van de informatie door anderen		
Ik geeft toestemming voor het opslaan van geanonimiseerde data, namelijk de reactie van mijn kind op de trillingen, en de ranking en rangschikking van de verschillende trillingen, in de database 4TU.ResearchData, zodat het gebruikt kan worden voor toekomstig onderzoek en leren door de TU Delft.	○	○

Handtekeningen

_____	_____	_____
Naam deelnemer	*Handtekening*	*Datum*

Appendix 17: Consent form test children

Ik heb accuraat het informatieformulier voorgelezen aan de deelnemer en, tot het beste van mijn kunnen, verzekerd dat de deelnemer begrijpt dat ze vrijwillig deelnemen en toestemmen.

_____	_____	_____
Naam onderzoeker	*Handtekening*	*Datum*

Contact onderzoeker voor verdere informatie: Marjolein Schoorl, *[email]*

Appendix 18: Revised planning

Shortly before the midterm, a more detailed, revised planning was made for the second half of this graduation.

week	Tasks	Meetings
41	- Interviews - Iterative prototype research with children: make research plan & contact Mathieu for feedback - Analyse interviews with statement cards → think what the final outcome should be	
42	- Analyse interviews & draw conclusions →: choose product functions & commit to a product/concept form (keeping final outcome in mind) - Prepare prototype session of 22nd Oct	Feedback + prototype meeting: 22 Oct, 11.30, at IDE
43	- Conclusions interviews: final design frame - From chosen concept form→ think backwards from final outcome on how to get there → what type of vibrations & technology is needed? So what do I need to prototype & research? - Contact bad sleepers from interviews for prototyping research - Prepare & prototype for child research	
44	- Contact bad sleepers from interviews for iterative prototyping research - Prepare & prototype for child research - Pilot test child research - Search literature/information on diffusing vibrations for meeting with Laura	Feedback meeting
45	MIDTERM - Prototype with Laura: effect of bass shaker in silicone - Test other bass shakers	MIDTERM Nov 8

week	Tasks	Meetings	Deadlines/goals
46	- Finalize prototype after pilot test - Elaborate on and/or evaluate scenarios		
47	- Evaluate safety prototype → leave vibrating for a few hours while working - Buy sheet for around the mattress - Test prototype with peers, family, friends → select promising vibrations & pilot test method for testing - Prepare test instructions & data gathering form for parents	Meeting 22nd	- Neatly looking & safe to use prototype + research materials prepared - Insights from adults: which vibrations are promising? test setup & prototype work?
48	- First prototype research with child; test Nov 30 - Analyse first results prototype test - Make images of several concepts for online survey - Make online survey for parents about concepts - Sent out online survey for parents to gather information about concept desirability - Start writing thesis report: summarize early research; write literature & interview chapters		- First prototype test conducted & analysed - Report: literature & interview chapters ~50% done
49	- Second prototype test with child, Dec 7 - Analyse & draw conclusions prototype test(s) - Update prototype with insights test - Write thesis report!	Meeting Dec 6; 15u	-Report: literature & interview chapters done -Report: prototype exploration chapters ~50% done

week	Tasks	Meetings	Deadlines/goals
50	- Third prototype test with child, Dec 13 - Write thesis report - Analyse & draw conclusions from prototype research with children - Analyse results & draw conclusions from online survey - Formulate future controlled trial and/or future research		-Two tests with children conducted; - Insights survey - Report: chapter prototype explorations done
51	- Third prototype test with child, attempt 2, Dec 24 - Analyse results & draw conclusions from online survey - Final vibration, final product design, final use scenario - Write script/scenario for video & ask feedback on it - Write thesis report → 80% should be done!	Meeting 20th	-Final product & vibration design -Report: start with online survey & first prototype tests chapters -Report total: 80% done!
52	Christmas Holiday		
1	- Write thesis report - Analyse research with children - Prepare video shooting - Thesis deliverables 80% done	~~GREEN LIGHT Jan 3~~	80% of thesis done
2 & 3	- Finalise video script/scenario - Finalise thesis report - Shoot & edit product video - Final vibration, final product design, final use scenario	GREEN LIGHT Jan 10	-Report 90% done -Video 90% done
4& 5	- Finalise thesis report - Finalise video - Prepare thesis defence presentation		Feb 4 = deadline all materials Everything 100% DONE!
6	THESIS DEFENCE ~~7 feb~~ FEB 11	DEFENCE	

Sleepy Vibes for Young Children — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 06 - 09 - 2021 — 07 - 02 - 2022 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Young children often have problems sleeping. Some are afraid of the dark. Or wake up multiple times during the night. Another just does not want to go to bed or lays awake for a long time (Galland, 2010). Whatever the reason, a lack of sleep makes the children tired during the day. For parents, the child's wellbeing is important, so they want their children to sleep well and be energised during the day at school. A lack of sleep or low quality sleep can not only have a negative influence on daytime functioning, but also on a child's cognitive development or behaviour (Galland, 2010). When a child wakes up often during the night, it influences the wellbeing of the parents, as they sleep worse too (Galland, 2010). According to Galland et al., establishing a good sleep hygiene is a solution to sleep problems. (Galland 2010). Something a lot of parents do, is walk with a stroller till their baby sleeps. Driving around in a car is done with older children. Studies have indicated that rocking vibrations during sleep can be beneficial (Perrault, 2019). Inspired by this phenomenon, I want to research if and how vibrations can help young children fall asleep, and design a product around that. Research needs to be done on which frequency or pattern of frequencies is most sleep inducing.

Design solutions can tap into why children have difficulty (wanting to go) sleeping, or into improving the process of falling asleep. A main opportunity is the will parents have to get the best for their children. So if a product exists that helps their children, parents are likely to be interested. For ease of writing, I will use the word parents. However, I do not want to exclude children taken care of by other caretakers than their parents, by one parent or one other caretaker. The children and their parents or caretakers are the main stakeholders in this project.

The current product market of child sleep products involves many interesting products. Weighted blankets; white/brown/pink noise or nature sound emitting devices, and warming blankets are available. Other products focus on learning the child if it is time to wake up or not by using visual images or giving the product a personality. The Somnox is a well known product that is not specifically for children, but interesting nontheless. It interacts with its user through a breathing pattern. Little sleep products involve vibrations. Baby swings and bouncers do involve them. Some research has been done on mechanical vibrating beds, of which one is inspired by car driving vibrations and noise (Kimura, 2017). However the research focused on adults, and was not focused on children (Kimura, 2017) (Utami, 2018). An opportunity lies in combining approaches or product features and research their combined effects.

A limitation could be getting parents' allowance to observe their child's sleeping behaviour; something very personal & private. Collecting anonymised data of the children could improve the willingness of parents. Especially during the current COVID-19 pandemic, arranging visits and user tests can be a challenge. An alternative is to give test instructions with prototypes to the parents and perform interviews online, instead of visiting myself.
When user testing a design with children, one should be aware that their communication and way of giving feedback is different than adult users. Especially young children have a different capacity to explain the why of their actions.

Galland, Barbara C., & Mitchel, Edwin A. (April 19, 2010). Helping children fall asleep. Published by group.bmj.com
Kimura, Hitoshi., Kuramoto, Akisue., Inui, Yuma., and Inou, Norio (June 1, 2017). Mechanical Bed for Investigating Sleep-Inducing Vibration. Journal of Healthcare Engineering Volume 2017, Article ID 2364659, 9 pages.
Perrault, Aurore A., et al. (February 4, 2019). Whole-Night Continuous Rocking Entrains Spontaneous Neural Oscillations with Benefits for Sleep and Memory. Current Biology 29, 402–411, Elsevier Ltd.
Utami, Desak Ketut Indrasari., et all. (May 2018). Building design and performance test of vibration beds with Whole Body Vibration. Journal of Global Pharma Technology

space available for images / figures on next page

Initials & Name M.B.M. Schoorl Student number 4553985

Title of Project Sleepy Vibes for Young Children

introduction (continued): space for images

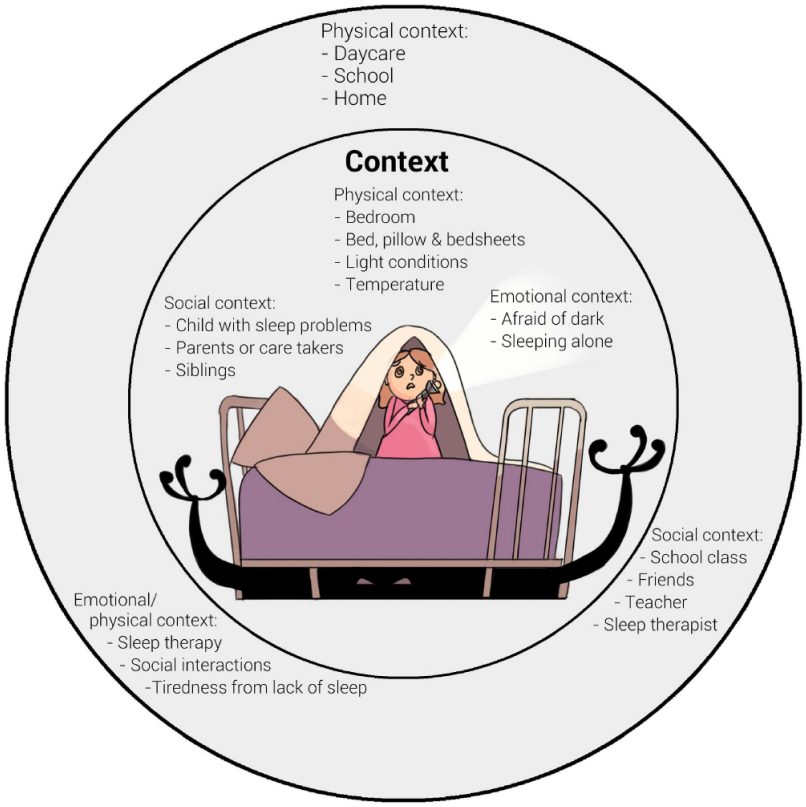


image / figure 1: Context of children with sleep problems

image / figure 2: Current (children) sleep products on the market

Initials & Name M.B.M. Schoorl Student number 4553985

Title of Project Sleepy Vibes for Young Children

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

My graduation project focuses on the context of young children, living in the Netherlands, who have difficulty with falling asleep, staying asleep during the night or who wake up too early. The age of the children should be researched and defined more specific during the first phase, as there is a balance between availability and relevance. For instance, young babies can not communicate much about an experience. Also, certain age groups could have more problems than others. Literature mentions a number of possible causes for sleep problems in children, such as a low level of daytime activity (Nixon, 2016) or fear of being separate from the parents (Kerr, 1994). Too much daytime napping or early bedtimes; consumption of caffeine in food or drinks; and physical discomfort or illness are other causes (Galland, 2010). It is the role of the parents to help the child establish a healthy sleep routine, but it can be difficult to find out why the child is not sleeping well, or to overcome the unwillingness of the child to go to bed.
Within this scope, the project goal is to research if a vibrating product can help young children sleep better. In the end, a design concept will be developed, alongside a proof-of-concept prototype. Thoughts should be put into the safety of children during use, and possible long term risks on aspects like health & development. Research questions are:

Main question: Can a vibrating product help young children fall asleep more easily, and if yes, how?
Sub question 1: What are relevant context factors of young children with sleep problems?
Sub question 2: Which vibration(s) is/are or vibration pattern is most sleep inducing for young children?
Sub question 3: What kind of product shape and interaction matches with those vibrations and the users?
Sub question 4: Can other sensory outputs enhance the vibrations? For example white noise; nature sounds, lights, temperature, weight or colours?

Galland, Barbara C., & Mitchel, Edwin A. (April 19, 2010). Helping children fall asleep. Published by group.bmj.com
Kerr, S. and Jowett, S. (May 17, 1994). Sleep problems in pre-school children: a review of the literature. Child: Care, Health and Development.
Nixon, G M., et all. (September 18, 2016). Falling asleep: the determinants of sleep latency. Published by group.bmj.com

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

1) Research the context of young children going to bed and falling asleep, with as outcome an understanding of the problem context.
2) Research in co-design sessions with parents and children what the most sleepy vibration is.
3) Combine the two researches into one product concept with prototype to validate with a user test, and improve.

The intended outcome is a physical product concept with (a) testable prototype(s) that at least includes some vibrating element. Other sleep-inducing elements could also be part of the solution, but do not have to be included. I also do not exclude a product-service outcome or an app to accompany the physical part as possible outcomes. The final design should help young children sleep better, eg. fall asleep more easily, waking up less during the night and/or waking up less early. During the project, the best age group will also be researched.

To be able to design the best sleepy vibes, research has to be done on which vibrations are perceived most sleepy by the children. This can be done in co-design sessions with children and their parents, and through literature research on previous studies. Multiple, iterative user tests will also be planned to improve the design. To find participants, I want to contact local child (sleep)therapists, general practioners and/or pediatricians. Contacts from my personal circle or from university (like professors or other coaches) could also be asked. The form and shape of the product can be designed when a thourough understanding of the context is gained. Therefore context research needs to be done, for example through questionnaires or interviews.

Other sleep-inducing variables could be included in the final design. For example temperature, weight of the product, sound (eg. white noise or nature sounds), movement or colour have the potential to enhance the interaction between children and the sleep product. However, designing the vibrations should stay the main design challenge and focus.

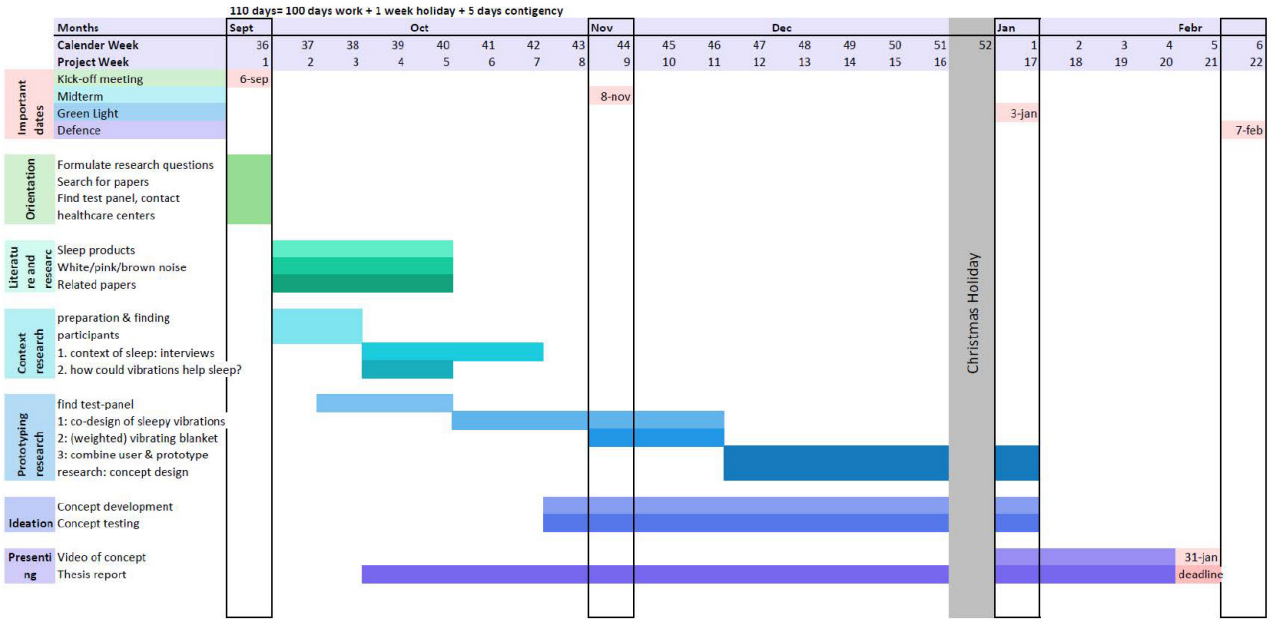
Initials & Name M.B.M. Schoorl Student number 4553985

Title of Project Sleepy Vibes for Young Children

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 6 - 9 - 2021 7 - 2 - 2022 end date



Orientation: In the first week, preparation steps are planned like finding papers or formulating research questions if they are not formulated in this brief yet. Effort should also be put in finding test panels for later project phases, as this can take up a lot of time. A possible way of finding participants is through local healthcare centres, child (sleep) therapists, general practioners and/or pediatricians.

Literature research: In this phase I want to gain a basic understanding of sleep problems in children, and current solutions. An interesting topic to look into is white noise, and related sound vibrations like pink or brown noise. Inspired by walking with strollers or driving around in a car, I also want to do some research on why vibrations might help fall asleep to gain insights into the problem and its context.

Context research: Through interviews or interactive sessions with children and their parents, I want to gain indepth knowledge of the context factors. During these sessions, insights can also be gained on what the most relevant and fitting age group is.

Prototyping research: Through iterative co-design sessions, I want to research what kind of vibration or vibration pattern is most sleep-inducing for the children. The second step is to put those vibrations in a product form, for example a (weighted) blanket. Lastly, the insights of this should be combined with the context research into one concept design. This concept can then be prototyped, tested and improved into a final design.

Presenting: Apart from the thesis report and defence, I want to present my graduation project, prototype and final design in a short video. I think this medium can be helpful to clearly show an interaction between product and user.

Initials & Name M.B.M. Schoorl Student number 4553985

Title of Project Sleepy Vibes for Young Children

~ Thank you for reading ~