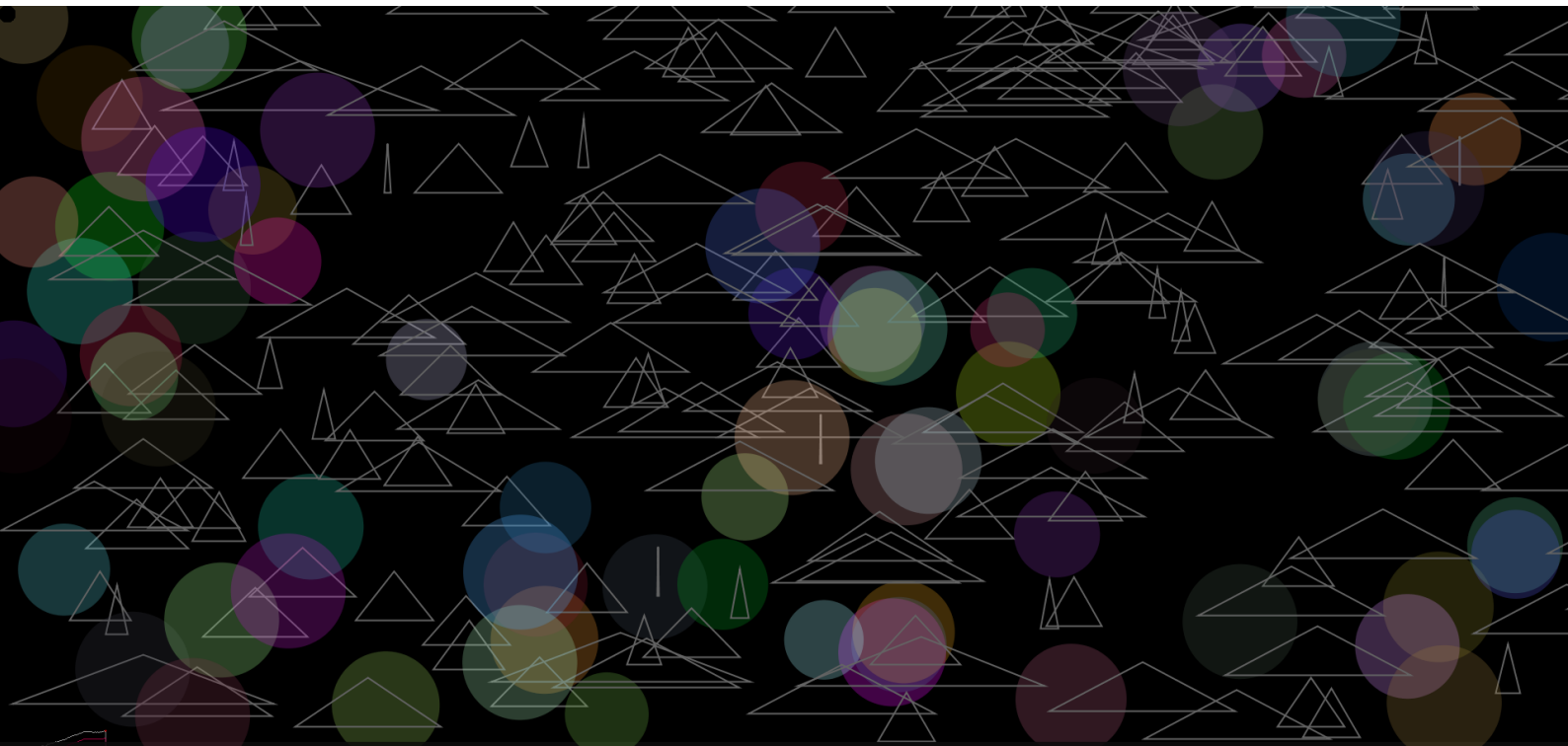


Designing for an Enhanced Body Relation

A Mindful Technology that
Encourages Adolescents to
Explore Emotions

Simone Marie Okholm Hansen



Thesis project / Interaction Design Master at K3 / Malmö University / Sweden

December, 2018

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Abstract

This thesis questions the idea that; quantified self technology can make us understand our bodies better and facilitate a healthy relationship to the body. Instead, it proposes that a healthy relationship to the body is developed through technology that facilitates a somatic practice, involving the bodily experience in the interpretations of the data. This is achieved by bringing in values inspired from mindfulness (the practice) as an alternative to the existing design values promoted in technological solutions dealing with the body. I have designed a first prototype, Inner Mirror, which explores adolescents' body relationship through screen based visuals. Inner Mirror detects adolescents' arousals to visualize their emotional changes in abstract representations that they are invited to connect to specific emotional experiences. The process of designing Inner Mirror will be described thoroughly in the paper. The process was a continuously negotiation between the ideas and values that I brought into the project and the adolescents' worldview. This is described through a first-person perspective and a participatory design approach. Two school classes of 43 adolescents (between 13 to 14 years old) have participated in the project through three workshops. In the end, I test the prototype in two different settings: on my-self, adopting the first-person perspective and together with the adolescents. Finally, three concepts that emerged in the design work are evaluated to suggest a direction for future work.

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1. Introduction

The body is exposed all over the media landscape - from buss commercials and novels to Instagram profiles and Netflix series - they all have something to say about the body. In this representation of the body there is a heavy attention on the physical appearance (Tiggemann and Slater, 2014). Furthermore, there is a tendency to represent a perfected version of the body in the media and form some kind of generalised standardization of the body (ibid.). At the same time, the present-day technology seems to dictate an agenda about optimizing the body whether that be through a food-logging app, a social running app where you can compare the progress with friends or a fitness wearable that measures daily activity and health conditions.

In this thesis, I will argue that these developments in the society have led to a distanced relationship with the body - the body becomes an object that we see from the outside instead of something we experience and feel from within our body. Making an analysis of the *quantified-self* technologies, I will highlight how they embed a distanced relation to the body when measuring the users' body only to translate the complex processes into simplified numbers, dictating a required action to improve the number-based outcome.

At the same time, there has been a new contra development in the western world, where a practice of eastern inspired mindfulness is cultivated to get in deeper contact with yourself and to be more conscious with the world around you. Using existing technology such as the smartphone to facilitate a mindful practice is in my view rather problematic because it is part of the problem itself and encourages a behaviour that is detached from your own body and the surrounding world. When people interact with their smartphones, they are not mentally present in their own body - they are not aware about their bodily presence in the situation.

Particularly, teenagers are exposed to these developments, as they are large-scale consumers of social media and technology (Lenart A. et al, 2015). It is a critical age that is characterized with big changes and new patterns of social well-being, while also health behaviour begins to emerge at this age which can be fundamental for their continuously well-being in their adult life (WHO, 2012).

It is my intention to create a technological solution that offers an alternative to the existing solutions designed for the smartphone, allowing the user to have a mindful meeting with the technology and letting the body be active and present. Wearables and other kinds of technological artefacts entails such a potential. However, existing designs, objectionably, create a distanced relation to the body by objectifying the body to an instrument that should be perfected or changes accordingly to an ideal.

Through my design, I want to encourage teenagers to focus on what is happening inside their bodies by supporting a non-judgemental exploration of the body that does not seek to optimize the body or reach a generalized standardization of the body.

1.1 Research Question:

How can a mindful technology help adolescents facilitate an open-minded and nuanced exploration of their emotions that enhances the relationship with the body?

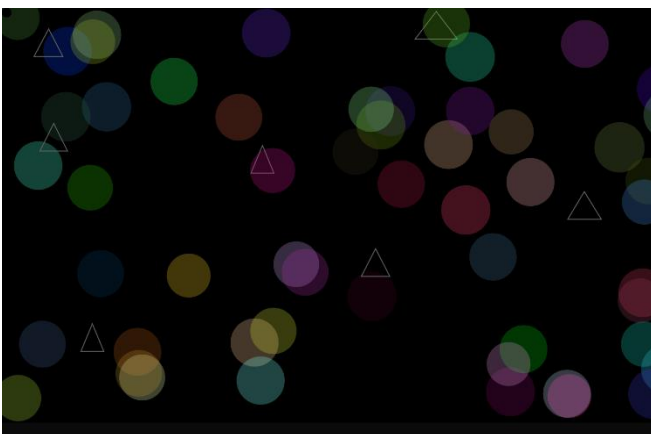
- *what is a mindful technology?*
- *what does it mean to have a strong relationship with the body?*
- *why should technology be a part of the solution, and if it should be, how?*

I will work with this design problem by applying a participatory design approach and a first-person perspective. The participatory design approach will involve 43 adolescents in the project to draw on their experience of the world in the design decisions. Applying a first person perspective, I will draw on my own experiences as an interaction design student, interacting with and designing systems that engage somatic experiences. Furthermore, I draw on my experiences as a competing athlete for fifteen years. Playing beach volleyball on a daily basis gives me a unique knowledge on body relations: I am trained in learning new techniques by transforming old bodily habits into new, improved movements in order to keep enhancing my sport performance. In my semi-professional carrier, I have also worked with mental training, for example learning how to identify emotions in my own body and accepting them rather than being the emotion.

1.2 Inner Mirror

Inner Mirror is the final prototype and the outcome of this research through design project. The design is a suggested solution for the problem stated above. In chapter 2 of this paper, I will present the theoretical background for designing Inner Mirror, a critical review of existing technologies dealing with body relations, and related design work. Chapter 3 presents the two methodological approaches that I have applied in the process. In chapter 4, I present the design activities that were conducted and the insights that they produced. I test the prototype in two different settings in chapter 5. Then in chapter 6, I evaluate on the three concepts that emerged during the process. In chapter 7, I will discuss the various insights highlighted in the two previous sections, and finally in chapter 8, I will make some concluding remarks.

Inner Mirror facilitates an exploration of emotions and can help adolescents improve their relation to the body. The adolescent can experience her emotional arousals expressed in an abstract visual representation (see picture 1). The circles indicate a relaxed emotional state while the triangles represent an emotional arousal. The size of the shapes reflects the individual differences in the general emotional response and can possibly bring a unique personal touch to the visuals. The Inner Mirror prototype is tested in this paper, and I suggest three possible practices that it could be a part of in section 6.2



Picture 1. Left side: visual representations. Right side: Adolescent testing the Inner mirror prototype

2. Theory and related work

2.1 Adolescents' body relation

Social media is used by 97% of the Danish adolescents (aged 15 to 18) and are the biggest consumers of the digital platforms (Tassy, 2018). It means that they are also more than any other group in society exposed to the effect that social media can have on body image. The strong peer presence and the large-scale exchange of visual images suggest that social media can significantly influence body image, increasing a negative self-image (Tiggemann and Slater, 2014).

Furthermore, it is well documented how the mass media communicates a cultural stereotype of body image (Tiggemann and Slater, 2014). Because the adolescents through the media are heavily loaded with pictures of the body in their everyday life that suggest how their body should look like, I found that the adolescents were an interesting age to work with in this project.

Another reason for working with adolescents in this project is that they are an "age of opportunity" because biologically and socially a lot happens in puberty (UNICEF, 2011). While the body develops a lot in this age, so does the adolescents' behaviour. They detach themselves from their parents and starts to form new patterns of behaviour, looking for influence outside of the home (UNICEF, 2011). Therefore, I believe that there is a great opportunity to establish a strong connection with the body in this particular age that could become pivotal to their relationship with the body.

Considering the before mentioned focus on the body among adolescents' media use and the related increase of dissatisfaction with their body, this design project seeks to shift the focus away from the body image and instead turn to less idolised parts of the body. The intention is to make the adolescents curious about what is happening inside their bodies to show that the body encompasses more than the stereotyped body imaged praised in the media.

Therefore, I will introduce a definition that distinguishes between the outside body, which can be experienced by others and the inside of our body, which only can be experienced by ourselves.

2.1.1 Definition of the outer body and the inner body:

The Outer Body

The outer body can be seen as the shell or the surface of our bodies. It is what we see when we look ourselves in the mirror but also what a doctor would see if he looked inside you. The outer body is our portal out in the world and we can use it to perceive with, like touching another person. For example, emotions can be associated with the outer body when they manifest themselves as physical evidence on the observed body (e.g. facial expressions).

The Inner Body

The inner body is what we feel and experiences from within our bodies. It is an intelligence that is not only connected to our minds but also our body. The inner body can only be

experienced from a first-person perspective and is the affect we get from perceiving things in the world. For example, emotions can be associated with the inner body when we talk about how they are experienced by a person.

This definition reflects a mutual developed conception of the body between the adolescents and I. Working with the inner body in this project, I attempted to make the adolescents that participated in the workshops talk about their body from a subjective view rather than discussing their own body as an object that they observe from outside of their body. Meeting the adolescents three times during a monthly period, they slowly developed a personal understanding of the inner body through activities such as peer-discussions, reflective writing, meditation, and breathing exercise. I will claim that working with this definition together with the adolescents, made it easier for us to express our bodily experiences. The definition of the Inner Body shares some resemblance with Merleau-Ponty's definition of the Lived Body: "*The lived body* is the body as experienced by a person as himself/herself, which is different from seeing the body in the mirror as an object among other objects in the world." as cited in Svanæs (2013).

2.2 The body relation in existing technology

In the past decade, the computer has been increasingly involved in our appreciation of our bodies – reincarnating the body in new ways but also trying to understand and learn from our bodies. In the process of making the computer understand the human body, a revolution of self-tracking technologies have emerged (Kersten-van Dijk et al., 2017). Personal informatics is the field of self-tracking technologies, also referred to as Quantified self (Swan, 2013), emerged from the HCI community and produces data on individuals, everything from conversations to facial mechanics but especially health related data like sleep states and heart rate. The bodily and behavioural data is analysed, informing the user of her health status and often reveals health related patterns, which the user had not noticed herself. The goal is to optimize the individual and even make her change behaviour based on the new information. (Li et al., 2010).

The industry of self-tracking has been proven successful on the market and customers can buy a wide spectrum of different wearables and mobile applications that tracks personal data. The fitness trackers such as FitBit, Garmin and Xiaomi are some of the most popular choices, focusing on providing information on health related data input such as weight, daily activity level, sleep quality, oxygen uptake, and heart rate.

But what is a healthy body? To whom is it a healthy body? Why does it need to be healthy? How healthy could it be? Who decides how healthy it should be?

These questions are obviously not either easy to answer or up to me to answer. So why do we trust the technology to answer them for us? The fitness trackers encourage users to optimize their body to fit certain standards in society (Tiggemann and Slater, 2014). They translate the body into simplified numbers that becomes a purpose in themselves, separated from the body. Using a fitness tracker, the experience of our own body is moved outside of the body itself. You are not encouraged to rely on your own bodily perception but to trust the numbers you see on the screen. Instead of feeling your body from within (I am feeling restless), you look at the technology to get the answer (did I exercise enough today?). In a sense, the technology has replaced our own sense of self. The instrumental view on the body results in a distanced relationship to our body, which I believe is reinforcing an unhealthy behaviour.

I think we should instead guide and help young people to develop a strong relationship to their bodies, teaching them to care for their body and maintaining it throughout their life. Adopting values from a practice of mindfulness into technology could transform our engagement with the body and be an alternative to the optimization strategies of the quantified self technologies. In the following section, I will clarify what values I have drawn on from the practice of mindfulness to dictate the design.

2.3 Mindfulness as the design goal

The critical view on the self-tracking technology calls for a response. The vision in this design project is to design for a mindfulness and reflective interaction with the technology. Mindfulness is a way of living and being in the world that can be practised through meditation. The practice of meditation has a long and complex history relating more than a thousand years back in time and is a deeply integrated part of many eastern cultures and religions. Recently the practice of mindfulness has experienced a renewed popularity around the globe and has been cultivated and marketed on a large scale in the western world. There are two core values of mindfulness that I want to highlight:

- 1) Being **present** in your body is an important practice in mindfulness because grounding your consciousness in the body; you will also be more present in the existing moment instead of letting your mind wander away. (Tolle, 2004)
- 2) Being **non-judgmental** to yourself and the people around you is a key to mindfulness. It is about accepting things as they are, weather it be your own thoughts, feelings or accepting the world order as it is right now. It is not because people that praise mindful values are afraid of development; quite the contrary, it is the believe that in order to move forward, we must see and accept what is given to us in the specific moment (Tolle, 2004).

Inspired from the idea of a conscious and bodily presence, the final prototype establishes a practice that lets the user stay connected to the body. Bringing attention inwards will, accordingly to Tolle (2004) also make you present in the here-and-now, experiencing the life in others. The design also embraces the non-judgmental value by embracing all kind of experienced emotions, not trying to encourage a certain mental condition or reach the best possible outcome. Compared to the quantified-self technology, it is a more explorative approach to the body that do not encourage a certain outcome and both negative and positive emotional stimulus can be explored.

2.4 Mindfulness build into an unconscious technological practice

Several technological products are designed to nourish a mindful practice. Market products that use the technology to facilitate a mindful behaviour seem to boom in the moment. The Headspace app has been particularly successful and is used by people all over the world to learn about a mindful lifestyle through animated videos, and to facilitate guided meditations by sound-files that can be played in the app. Also Gaia, an online streaming service of "conscious-expanding" videos, have reach a wide audience. Gaia wants to help people transform and start living a more conscious life by providing film, documentaries, and series on the subject but also provides guided video on mindful techniques like yoga and heart opening.

The problem is that these solutions try to establish a mindful practice through a digital platform where it is hard to interact with without losing contact to the body. The mindful activities that they want to cultivate is about getting closer to the body, the nature, and other creatures. How can that be united with the digital world that actually obstructs some of these relations? I do not believe that the digital platform that we have today are the right technology to facilitate a mindful practice. Instead, I have turned to the field of somaesthetics to look for ways to design technology *for* the body.

2.5 Somaesthetics and Soma-based Design

Somaesthetics is a theory and practice introduced by philosopher Richard Shusterman (2008) that views the body as the primary source to experiencing and acting in the world. The term somaesthetics is a contraction of *soma* and *aesthetics*. Soma is the Greek word for body and aesthetics that refers to our sensory perception (Shusterman, 2008). It deals with the body experienced in a first-person perspective – how you sense and experience your own body as opposed to an objective view on the body. The purpose is to enhance sensory appreciation through a practical somaesthetics, increasing the quality of experienced life through a reflective art of living. Bodily movement is seen as a way of thinking and being in the world, thus training the body in different techniques and disciplines on the motoric level and sensory level is a key-aspect in somaesthetics theory. His work is informed by established bodily disciplines that deals with the inner experience; from Yoga and Tai Chi to Alexander Techniques and the Feldenkrais Method.

Shusterman (2008) talks about the need to disrupt habits in order to become more aware of unconscious movements or emotions in the body. These habits are embedded in our body on a sensory level and are often unconsciously acted out, which make us capable of walking around without having to plan every single step. But some habits can cause pain and make us unrestricted in our movements. For example, using a smartphone makes us look down, tilting the neck, which leads to a new habit that can cause pain and injuries. Practicing different bodily disciplines can make you rediscover skills and even learn to use the body in a richer and more meaningful way. An important insight is that these new bodily movements cannot be putted into us as we can only learned by intentional, self-reflective practice. "It is only when we move ourselves that we can experience "being moved" emotionally, physically, and analytically, through our own somas" (Höök and et al., 2018, p.).

Even though the somaesthetics has been adopted by several interaction designers to create soma-based design, there is a call for more concrete designs that bridge the theory with actual design work (Höök and et al., 2018). This research is an attempt to make such a contribution. I will now introduce a series of soma-based designs collected from the academia and the industry, organized in three categories: These categories were made to be able to distinguish the broad spectrum of soma-based designs and to position my own design.

2.5.1 Using somatic input to encourage self-exploration

BrightHearts visualizes biofeedback from the heart rate on a mobile application. The more relaxed you are, the more bright and clear colours will show. Designed for children undergoing painful procedure at the hospital, it encourages the children to decrease their average heart rate through

muscle relaxation, slow breathing, and relaxing thoughts – decreases are rewarded with gentle chimes and new layers of colourful imaginary.

Pressure Mat visualizes subtle bodily movements. You lay down on the mat and as you move, you will evoke visualizations on the ceiling above you.

2.5.2 Give enhanced somatic experience

Soma-mat enriches the meditation experience by heating up different body parts. You lay down on the mat, listening to a guided meditation that takes you through a 'body-scanning', while the mat simultaneously heat up the part of the body that requires your attention.

Doppel influences your mental state by sending impulses through a wearable on the wrist. If you feel nervous, you can set the impulse to a low rate, making the pulse inside your body follow the pace of the impulses sent by the wrist-wearable.

T-jacket is a vest designed for children with sensory challenges. When needed, the sweater gives the child a "hug" by pressing with different levels of intensity, making the muscles relaxed.

2.5.3 Using somatic input to give enhanced somatic experience

Blim Light is a large lamp with long tassels that you lie underneath. The light synchronizes with your breathing, pulsing rhythmically with your inner state of mind, making you relax and focused on your inside.

Sonic Cradle allows you to create music through breathing. A sensor is placed on your chest and then you can control the musical outcome with your breathing rhythm.

The Touch is a market product that let you be closer to your loved one over distance during the day. Wearing a finger-ring that lets you see and feel the real-time heartbeat of a person who wears the matching ring.

2.6 Affective design

Affective computing is a field established by Rosa Picard in 1997 to enhance the interaction between human and machine. The purpose was to create computers that could detect human emotions and thus, better understand humans. Later on, affective computing have also moved into the field of AI, trying to teach robots human emotions through machine learning.

Where the soma-based designs are concerned with the bodily experience in general, affective design specifically deals with emotions. Both fields are relevant to my thesis and I found myself starting in the field of soma-based design, but moved into affective design through the design process.

Massumi (2015) have some interesting theories about affective design and I will use his theory about memory to later describe the practice around Inner Mirror. Massumi (2015) insists that there is at least three kind of memories that all creates the present moment in different ways: 1) *a memory of the present* which is an active memory that contributes to the experience of the lived world. We project the past experiences into the here-and-now in order to energize and make up

the present. Affect is not in time, it makes time. 2) *a memory of the past* which is a conscious memory that starts in the present but reactivates a past experience, bringing it into the now to recall it backwards 3) *a memory of the future* which is a quasi-causal force of tendency, activating the past to project it into the future.

3. Methods

In this section, I will explain how I approached the research problem. I will present the two main approaches: The first-person perspective and the Participatory design approach that has been essential for the design process, and thus, influenced the final design.

3.1 First-person perspective

Usually user-centered designers work from a third-person perspective; observing, interviewing, and testing on users. They closely study the users' behaviour and experience but will never be able to recount the experiences studied from a first-person perspective. The only way to do that is to bring in the designer's own sense of self, "using the designer's lived body as a resource in the design process." (Höök and et al., 2018).

This method was essential for the research because it allowed me to put my bodily experiences into play and rely on my own experiences with the designed system. I did this when I participated in a dance class, explored the sensor on my own body, refined the visuals, continuously, based on my own bodily experiences, and tested the final prototype on myself. I claim that the first-person perspective empowers the designer by letting her use her bodily skills and somatic experiences in the design process. Furthermore, I criticize the self-tracking technology for relying on third-person observations on the body, thus, embracing a first-person perspective is also a strategy to distance the research from this work.

In mindful practice, a bodily presence is practiced to be more aware of yourself, which will over time make you empathize more with other people, feeling closer connected to them. The end goal is, thus, the connection to other people and the surrounding world (e.g. nature). This self-practicing, which in a first meeting can seem rather narcissistic, is quite the opposite. I see the first-person approach in the same perspective; bringing in your own senses of self, investing your own body in the research will make you empathically engage with the designed system of the future users.

3.2 Participatory design

I-Thou relations (second-person perspective) is as a deeper relation that arises between two human beings, where I-It relations (third-person perspective) are how we relate to objects, however, we can also have an I-It relation to a person, objectifying her (Morgan and Guilherme, 2012). Most often, an I-Thou perspective is adopted in participatory design, collaborating with users to form a shared understanding of the design problem.

The core idea of participatory design is that the people who will be affected by the design should play a role in the process of creating that design (Bratteteig et al., 2013). The participating people bring in their unique knowledge and worldview, providing input in the design problem and a possibility for change (Binder et al., 2011). This is a shift from old

design traditions where the designer was the main author. The participatory design approach has turned this upside down, putting the designer in a facilitating role, bringing the users into the design process, embracing their values.

The users are seen as experts in the structures and services that the design tries to innovate, forming a relationship of mutual learning between the designer and user (Robertson and Simonsen, 2013). The designer brings in knowledge by facilitation design activities that encourage the participants to think in new ways. As a part of making the adolescents think in different ways, my role in the project was to facilitate bodily reflection and understand how they experience their body. It was a difficult subject for the adolescents to deal with considering that they do not yet possess the full capacity of their brain to deal with abstract thinking (UNICEF, 2011). Therefore, a great part of the workshops was focused on giving the adolescents the tools to understand the subject and express themselves about it. Nevertheless, I still saw the adolescents as expert in their unique bodily experiences. I needed to learn how they experience their body and what relation they have to it.

3.2.1 Involving Adolescents

Adolescents are undergoing major bodily and socially changes, where they are just beginning to form a picture of their own bodily self (Tiggemann and Slater, 2014). Therefore, I see them as a vulnerable group, especially in this soma-based-design research field. Their body is not fully developed and they are still in a process of exploring the limitations and possibilities of their bodies, which often results in insecurity. On the other hand, they are also a marginalized group that often are overseen (UNICEF, 2011) because they in some relations are still considered as children and do not have the same rights as adults. Thus, I find that a participatory design approach is a great way to empower this specific age group.

3.2.2 The collaboration with school classes

Two classes of adolescents in the eighth grade of the Danish public school (43 pupils aged 13 to 14) participated in the project. They are from a school called 'Vibehus Skole', placed in the eastern part of Copenhagen. I arranged three meetings with both classes over a monthly period, having 1,5 hour with each class as a part of their regular school schedule. I showed them concepts on establishing a strong contact with the body and facilitated activities for them to engage in the design process. One teacher was always inside the classroom during the workshop and had the pedagogical responsibility, which gave me the opportunity to focus on delivering the content and pay attention to all the inputs.

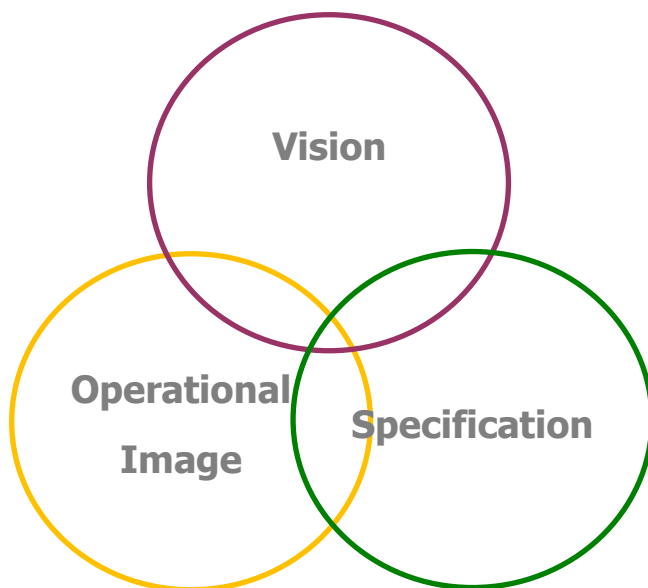
Loke and Schiphorst (2018) describe the challenge of collaborating with people who are not trained in somatic methods and explain how experiencing such methods your-self encourage active reflection on the close connection between body and mind. To deal with this challenge, I prepared a somatic exercise for each workshop that was supposed to make the adolescents aware of their own bodily presence and make them able to feel the abstract somatic concept on their own body. At the first meeting, they listened to a guided meditation that made them aware of the various body parts and put them into a calm state of mind. At the second meeting, they did a small series of movements that simulated a beating heart. In the final workshop, they did a breathing exercise that taught them how to control their breath in different areas of the body.

4. Design Process

In this section, I will unfold my design work to communicate the insights I got in the process and what decisions the insights initiated. I build up an argument for the decisions I made, and thus, validate the specifications of the final design outcome. I want to give you, the reader, a grounding to understand how the tensions between my designerly visions and the situation have formed the presented concept.

4.0 Design Model

Löwgren and Stolterman (2004) present a model (see figure 1) in their book "*Thoughtful Interaction Design*" that embraces the complex, abstract, and conflicting through the process, which characterizes the design process. The model shows how the designer's visions, ideas, and design manifestations play together in a complex, dynamic field that leaps between details and the whole, forcing creative work in response. I found this model particularly useful to describe the process in this project because it is an individual project, opposed to all the design projects that I am referring to in this paper (see 2.5) which are performed in teams, as it is most often the case in the field of Interaction Design.



The model entails the intangible ideas and thoughts happening inside the head of a designer and make it more clear how they exist in synergy with the situation and the more concrete design activities that form the design. When designing on your own, there are a lot of explicit actions going on as ideas are not discussed, negotiated and reflected in the other group members' worldviews. Thus, it is useful to express how the ideas are having a conversation with the situation and the concrete design outputs.

Figure 1. Model of the designers abstraction levels. Löwgren and Stolterman (2004)

The model consists of three abstraction levels: the vision, the operative image, and the specification (see figure 1). They represent the different forms of thinking that I have engaged in within the design process, and I will unfold the various work I did on each level in this chapter. *The vision* is the first organizing principle and the designer's first attempt to respond to the situation at hand. It is an elusive idea of the basic elements of a design that works as a common direction for the process but also entails conflicting possibilities. The operative image is the first externalization of the vision and develops from being diffused and sketchy at the beginning of the process to become more defined and work as a solid foundation. The specification is a sufficiently

detailed and refined representation of the idea that reduces uncertainties. It works as an anchor for the continuously work or as a specification of the final design.

The three abstraction levels influence each other continuously throughout the process. At the same time, there is a tension between the abstractions and the design situation forcing the designer to be creative. Delving into the complexity of the situation, the designer will adopt her vision and form a new operational image, which will then influence the specifications. The operative image bridges the abstract and elusive vision to the concrete and complex situation and vice versa.

Every subsection of this process chapter begins with a refined and more specific vision of the previous one, and thus, represents the state in the given time of the process. Followed by the vision, I will also present possible iterations of the operative image and the specification. I will not present an alteration of all three abstraction levels in every subsection but only mention the abstraction level that I actually changed in the given time of the process. Finally, each subsection, represented by a new vision, will contain a description of the design situation I looked into and what insight it gave me.

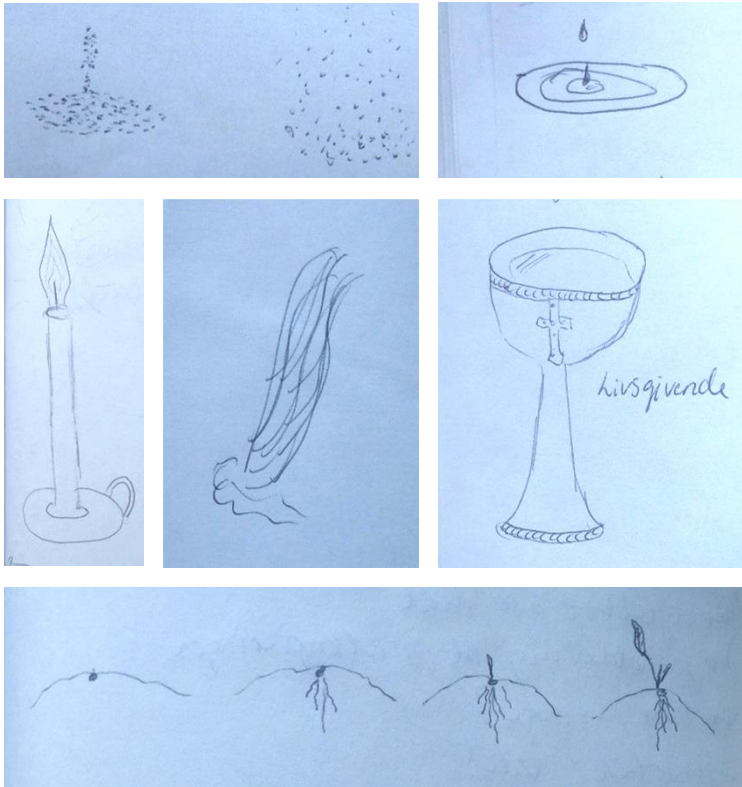
Design Vision 1: A Mindful Meeting with Technology

The initial vision was to bring mindfulness into technology. With mindful technology, I imagine a meeting with the technology that allows us to be present in the moment; being aware of our bodily being as well as the surrounding world. It would transform the current use situation with technology where people disappear from the offline world into a use situation where people are fully conscious while interacting with the technology.

The value of being present in your body while interacting with the world is one of the values I highlighted in section 2.3, which cultivates a mindfulness practice, however, the vision is also based on my view on the existing technology and the experiences I had from previous design projects. It is a rather distinctive vision and has at a first glance minimal connection to the final design. However, this vision has formed a great part of the design work in the following process and is embedded in the design concept, which I will discuss in chapter 6.

4.1.1 Operational Image

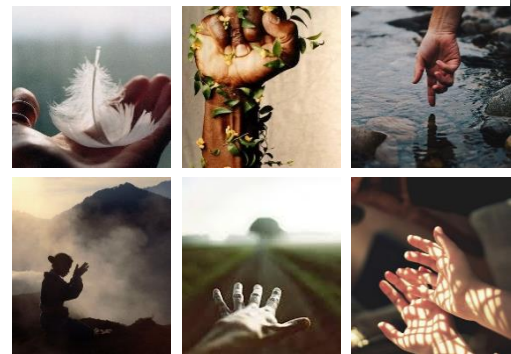
Sketching on what mindful technology could be helped me concretize the vision and was the first work I did in the abstraction level of the operational image. The sketches (see picture 2) were a material exploration of mindfulness – how does a mindful technology look like? I was inspired by elements in nature (see picture 4) and religious artefacts that embed a mindful practice (see picture 3).



Picture 2. Sketches on the form giving of mindful technology



Picture 3. Religious artefacts



Picture 4. In contact with natural elements.

In a previous project ("POUR RECEPTION," 2018), I discovered the mindful qualities of water and how it can turn the interaction with technology into a being in the world. Thus, my initial ideas were inspired by this project, using basic natural elements like earth, dust, and fire to create a mindful interface. I found it interesting how many religions use artefacts to create a mindful practice. For example, the prayer beads (see picture 3, middle picture on the lower row), allow the user to keep track of executed prayers in an undisturbed manner.

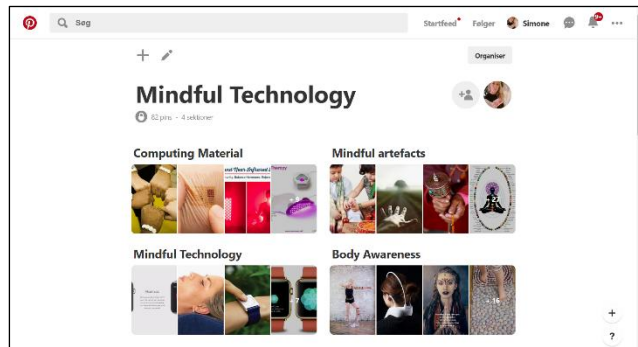
4.1.2 Situation: Researching

The first step was to look deeper into the problem field. Since the problem was about establishing a strong connection to the body and reinforcing a healthy body, I mapped out what a healthy body means today (see picture 5). This helped me narrow down the scope of the problem, constraining the problem to be about health-related activities that see the body and the mind as a whole. From this mapping, I decided to exclude all issues that dealt with decreased functionality or is life-threatening in any way (such as the hospital, injuries, and diseases) and only focus on health preventive activities that individuals can control on their own (such as exercise, nutrition, and meditation).

I collected knowledge about mindfulness and technology on a Pinterest board (see Picture 6) to establish an understanding of the 'Mindful Technology' concept, rooted in existing materials.



Picture 5. An association mapping on "Health"



Picture 6. Screenshot from Pinterest board

Design Vision 2: evoke a healthy relationship with the body in adolescence

Based on the design work presented in the previous section, I created a vision about supporting adolescents in establishing a healthy relationship with their body. At this point in the research, I was concerned with a healthy body in relation to everything from nutrition and exercise to sleep and mental health.

4.2.1 Situation: the First meeting with the adolescents

After an introduction to the project, the class was divided in two and asked to brainstorm on the concept of the body. Everything they associated with the body was written down on Post-its. The teacher and I would help the students by asking questions like: "How is the body used? Why do we have a body?" Subsequently, the students were asked to thematize the Post-its that they produced.

Insights: Already in this first activity, I noticed a huge difference between the two classes. One class was more behaved than the other class and they participated with great enthusiasm. The other class was more split and fuzzy but on the other hand, had some reflections on the body on a higher abstraction level. I expected from the beginning that running two parallel workshop events with two different classes would be a challenge because they could develop in completely different directions. On the other hand, it was a great opportunity to compare the outcome of the workshops. Comparing the results also gave me an idea of what insights were unique and what insights were more representative for the group in general.

4.2.2 Questionnaire

The adolescents individually filled out a single-page questionnaire, which made them reflect on their own bodily experiences and what influences these experiences. See Appendix 1 for a full overview of the answers. The first part focused on, what they feel inside their body and the second part focused on, what affects their body (school, media, friends etc). It was an opportunity to share some more private reflections on the topic and, even though, not everyone seemed to write openly about their thoughts, some of the answers were dealing with sensitive dilemmas.

The first question, I want to analyze is: "What affects your body and how?" (see figure 3). Several had a hard time relating to the question and simply answered that nothing affects their body. When they asked for my help on the question, I found that it was too abstract for them to see

Even though the workshops were facilitated in the classroom setting as a part of the adolescents' school day, it was already clear from the first meeting that I was not making a design for the classroom but the memory context. When I initiated the collaboration with the school, however, the purpose was not to find a context but to involve the adolescents in the design project. Participatory Design projects are usually bringing people together, forming new relations (Simonsen and Robertson, 2012). Instead, I took advantages of the existing social constellations in the classroom. Hence, the adolescents had an existing social hierarchy, which influenced their behavior (e.g. how much of themselves so they feel comfortable sharing). One of the teachers also pointed out that her presence at the workshop induced some of the adolescents to be less willing to express themselves about the sensitive subject of the body while it would make others feel more comfortable with the situation.

Design Vision 3: Positive Connection to the Inner Body

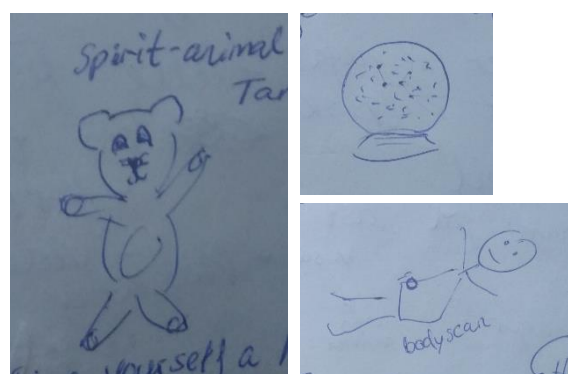
The first meeting with the participants led to many new insights, affecting the vision. I decided that the design should be dealing with two transitions: 1) From a negative contact with the body to a positive contact with the body based on the body-map activity, where there seemed to be a lot of negatively associated connections to the body. 2) From the outer body to the inner body, changing the heavy focus on the outer body that showed in the individual questionnaires.

Adapting the vision to the design situation, I constraint the design situation and let go of some of the initial ideas about focusing on the feeling of bodily needs such as feeling hungry or feeling restless as a sign for exercising.

4.3.1 Operational Image

Sketching upon the meeting with the adolescents resulted in three ideas (see picture 6).

1) A stuffed animal that expresses the mental state of the user. If the user feels stressed, the teddy bear would look sad, encouraging the user to take care of herself when recognizing her bodily experience in the teddy bear. 2) A crystal ball that resembles an inner mirror, showing how relaxed the user is. The particles inside the crystal ball would behave accordingly to the stress level of the user, e.g. if stressed the particles would whirl wildly. 3) A robot ball that rolls around on your body, supporting the user to focus on the areas being touched. It would be an enhanced experience of a mindful body scanning like the Soma-Mat (see 2.5.2).



Picture 6. Left: 1) the stuffed animal. Right, top: 2) the crystal ball. Right, bottom: 3) the robot ball

4.3.2 Situation: Personal Dance Experience

Contact Improvisation is an improvised dance-form where the dancer explores her body in relation to others by using elements of body awareness such as touch, breathing, body weight, and the counterweight of the floor. It originates from America in 1972 and has spread to all parts of the world except the Antarctic. There are various definitions of Contact Improvisation from the time it originated but I found a more recent definition interesting:

Contact Improvisation is an open-ended exploration of the kinaesthetic possibilities of bodies moving through contact. Sometimes wild and athletic, sometimes quiet and meditative, it is a form open to all bodies and enquiring minds. Ray Chung workshop announcement, London, 2009

As a part of my exploration of how to have a strong relationship with the body, I participated in a three-hour long workshop in Contact Improvisation. The first part was an introduction to the basic principles and skills, that I followed together with two other participants. We learned how to:

- become more aware of our body by focusing on the breath
- 'letting go of the mind' and simply letting the body move on its own
- use the floor as a counterweight that holds up our body by rolling on it or pushing against it, making us more aware of our bodily presence in the room
- initiating contact with other dancers and follow each other's movements
- play and improvise with each other through one strong contact point

The second part of the workshop was an 'Open Jam' where we could dance freely, building on the new skills that we just learned. Two experienced dancers joined us and at first, we just observed how they danced together and sort of having a conversation between their bodies. Then we joined them and danced in a group of five persons. All the time someone would spontaneously drop out of the group to have a one on one connection, sometimes for a short interchange/exploration but other times it evolved into a long dance between two people. Here are my reflections upon trying contact improvisation for the first time:

It was a rather intense and transcendent experience for me. I tried to put away all my barriers and allowed myself to be completely indulged in the present moment without judging and without thinking. The expressive movements were new to me but were easy and natural to become a part of. The experimenting and playful nature of following the body without trying to control it felt quite liberating. I got a feeling that my body was super strong and capable of anything – it resulted in a strong connection between my body and me. This connection was built up during the dance class but seemed to stay with me, and I had a strong sense of a bodily presence the rest of the night.

Furthermore, I had a strong feeling of social cohesion with the other dancers. There was a transformation from when we walked into the room as strangers and could barely look into each other's eyes to slowly getting to know each other, touch each other, trust each other, and to finally ending the class feeling strongly connected. When the class ended, we were lying on top of each other, laughing and well aware of one another. One of the other girls was shy and her face was mute and silent when we started the dance class. I noticed how she looked like a completely new person when we finished – her face was warm, kind, open and she had a huge smile on her face. I recognized the expression of her face as something that also had happened inside myself. I was calm, balanced, and happy with a strange knowledge that everything is as it should be in the world.

This first-person dance experience was an important insight into the design process that taught me a new way of connecting with the body. If I want to design for an enhanced relationship with the body, I need to explore what that can mean. I can only fully experience that through my own body. Furthermore, it made me reflect on the technology - why do we need the technology to get a closer connection to the body? This will be discussed in section 7.1.

Design Vision 4: Emotions

The vision evolved quite a lot in this time of the process. The dance experience evoked strong feelings and I saw all the emotions that the adolescents expressed in the workshop. Hence, I decided to focus on emotions felt in the body.

4.4.1 Operative Image

Having a narrow scope of the vision, a design also started to emerge. Based on the first workshop, I decided that it should be an explorative and playful system. There seemed to be a common interest across different groups in playing games. From video and computer games to board games and physical games. Some of them even designed their own board games.

The contact improvisation class showed me that exploring together could initiate a strong relationship to the body. However, the adolescents had a hard time expressing and sharing the sensitive experiences with each other at the workshop, and thus, I decided that it should be a system designed for an individual interaction rather than a collaborative experience. Furthermore, I also wanted to create a system that cared for an individual experience of health, not comparing bodies to find the ultimate standardization of health.

4.4.2 Specification

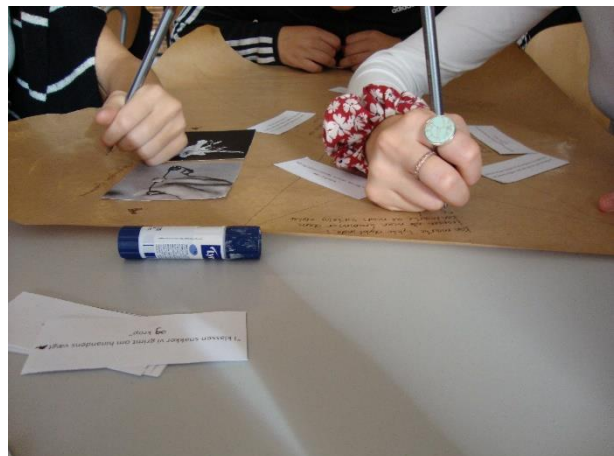
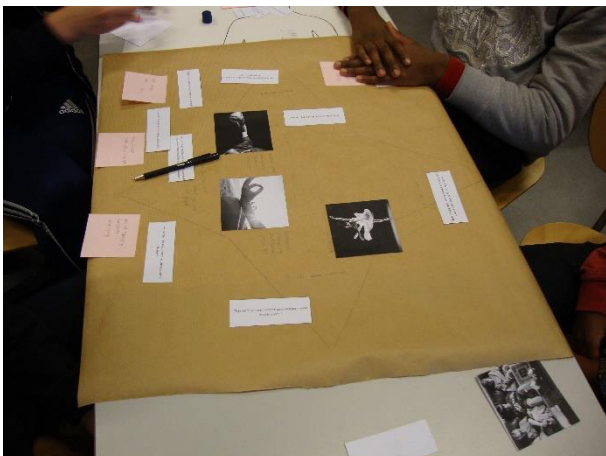
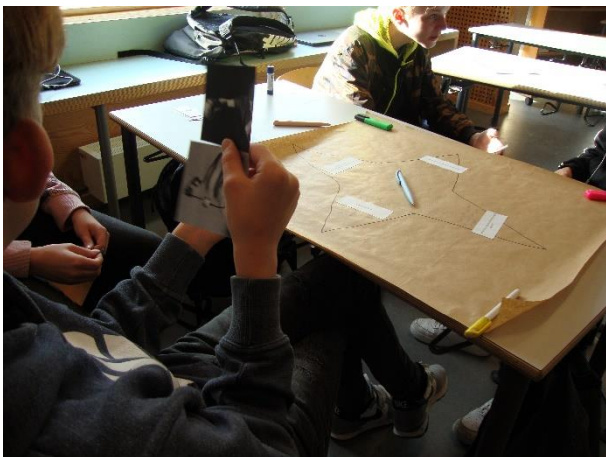
After working with different versions of the vision and the operational image, a first specification also came into place. I decided that the design should be a tangible artefact that the user can hold between her hands. The artefact should combine biofeedback and interaction feedback to tell something about the emotional state of the user. The real-time feedback would communicate and help the adolescent expressing what is happening inside her. Outputs such as light, sounds and haptic feedback were considered.

4.4.3 Situation: The Second Meeting with the Adolescents

At this workshop, I presented a design-game (see picture 7) for the adolescents inspired by their various engagements with games that I discovered at the first meeting. They sat in groups of 4-5 persons, gathered around a large paper where they drew a large star on. In the first round, they had to draw a 'citation' card on each turn and read it aloud. The Citation cards were a statement about the body, for example: "When I look at myself in the mirror, I try to compare with the girls I follow on Instagram" or "When I am listening to music, I feel happiness inside my body." The citations were heavily inspired by the participant's individual reflections at the first meeting (see section 4.3.2). The person who drew the citation card would share his/her reflections on it and try to explain the other group-members how he can or cannot relate to the statement. The person next to him would note down the reflections in one of the edges of the star.

In the second round, the group splits up in two and draws three 'picture cards' each. The cards picture different situations, all of them with some human aspect but were also relatively open for interpretation. They discuss what they see on the picture and tell how they personally relate to what they see. They chose two pictures to present for the other half of the group that writes notes for each picture in the middle of the star.

In the third round, they draw a 'question card' on each turn with questions such as: "What does it take for me to feel good in my body?" or "How do I get a close contact with my body?" Everyone contributes with ideas that approach the question. Each idea is noted on a little memory-cloud (a blue post-it) and placed next to the picture card or citation card that fits it the best.



Picture 7. Adolescents playing the design-game in workshop 2

4.4.4 Findings

The adolescents had a difficult time relating to the citations and many of them would mostly state if they agreed or not. The most interesting reflections and notes were those that could not relate directly but associated it with an experience of their own. For example, one participant did not recognize the feeling of anger in his fingers as stated in the citation card but feels it in his head when he gets angry.

While the citation cards did not generate many insights, the picture cards did. The adolescents saw different emotional states in the pictures that they could recognize. One girl looked at a picture of a hand holding a bracelet and said that she imagined that it was a middle-aged man

that squeezes the bracelet between his fingers because it meant something for him - maybe a person he was missing. She had a similar connection to a Japanese necklace that her father gave her. Another girl in the group could relate to this story as she had a ring from her dead grandmother that she would also sit and play with when she was alone.

In particular, one picture of a man boxing in the air sparked the discussion among the adolescents. Most of them could relate to the picture and viewed it as being about letting go of anger. However, they had very different stories of how they deal with the anger themselves. One of them always threw stuff when he got angry, and told that it was a good feeling when he threw the stuff in his room. A girl told that she would yell really loudly when she got angry at her siblings - sometimes in front of them but other times being alone to get the anger out. A boy said that he would squeeze his fingers together and knock them into something hard like a table or a door.

A picture of a ballet dancer was also something that several of them resonated with, however, it was quite different what they saw in the picture. One group saw it as an intense state of focus where everything else is blurred out. A participant saw it as being in control of herself and recognized it as a positive feeling. Yet another participant viewed it as being completely light (as in no burden) and free.

The ideation round was successful in the way that they produced many memory-clouds and began to think about coming up with solutions. The solutions were quite diffuse and varied a lot from more serious ideas to silly and funny ideas that did not have grounding in the problem that I was working on. Nevertheless, two ideas stood out and seemed to say something about the problem, I was working on: 1) Telling someone about your emotions is a great way to get them out of your body. It does not matter how the other person reacts to it - just getting them out is making you feel better. 2) Being surrounded with people that you care for is a great way to feel good inside your body. It does not matter what you do together as long as it is together with some friends that you feel safe around.

Design Vision 5: Non-judgmental

The vision has evolved further at this stage: I want to design an artefact that is not judging the user in any way – the system should appreciate all kinds of emotions, letting the user express the entire pallet. This is opposed to the fitness trackers that put a number on the body to compare it with the standardized norm – the "perfect" body. The design in this project should only express what is happening inside the body and involve the user in deciding what is good and bad.

4.5.1 Operational Image

The intelligent artefact should translate sensor data into aesthetic expressions. The goal is to enable the user to express what they have inside of them.

4.5.2 Specification

I will use an accelerometer to measure user interaction with the artefact and a GSR-sensor to measure emotional changes. A GSR-sensor (Galvanic Skin Response) measures arousals – changes in physiological activity including emotions. I can use it to identify emotional activity within the user.

The accelerometer can give feedback on how the user touches the artefact – is she rubbing it, gently tapping it or softly stroking it? This gives the user a chance to control the output. Sometimes you might look super calm and relaxed on the outside but inside you are boiling. The other way around, you could appear full of energy on the outside, but feel calm and focused on the inside.

4.5.3 Situation: the Third Meeting with the Adolescents

For this meeting, everyone brought an object that they could hold between their hands meanwhile explaining what it meant to them and how it feels to touch (see picture 8). Three finger rings, in particular, inspired me; the adolescents would not only wear it but also play with it. A boy had a ring that claims to change color accordingly to the mood of the wearer (the material responds to temperature). Furthermore, two adolescents brought a 'lucky stone' that they enjoyed holding in their hands, touching the smooth surface. Both the ring and the lucky stone were used as inspiration for sketching on the material form of the prototype.



Picture 8. Objects collected from one of the classes

Through several steps, I introduced the adolescents to *Bodystorming* - a well-established design method where participants have to use one or several artefacts together with their own bodies to come up with ideas (Schleicher et al., 2010). At first, they explored the artefact with new eyes to start seeing possible actions and activities that the artefact afforded. Then they started to ideate on the following problem:

How can you use an artefact to enhance the connection to your inner body?

First ideating on their own, then in pairs. In pairs, they would make a short video, showing their idea (see appendix 2). Showing their videos to the new group members, and then choosing the best idea to develop further. In the end, each group, casually, presented their concept to the rest of the class, the teacher, and I. Holding their hands all the way through the process, the intention was to guide them as much as possible through the abstract and unfamiliar process of idea generation.

From the very beginning, some of them struggled to think beyond the familiar use of the artefacts. Later on, they worked hard to create a beautiful video, even though it was clear to me that they simply presented the artefact as it was designed, and had not managed to find new ways of using it. (e.g. a massage ball: (appendix 3) and an activity dice (appendix 4)). Also, some of the final concepts were activities that they did not come up with but knew from experience. Nevertheless, other groups managed to come with rather creative ideas that were developed throughout several steps. Especially, the help-cards seemed to push them outside their original thinking. While some of them thought the cards were silly (for example: "What if you could float 10 cm over the ground?"), others embraced them and started to develop their concepts in new ways. A help-card asked: "What if the artefact could light up in different colors?". This particular help-card was

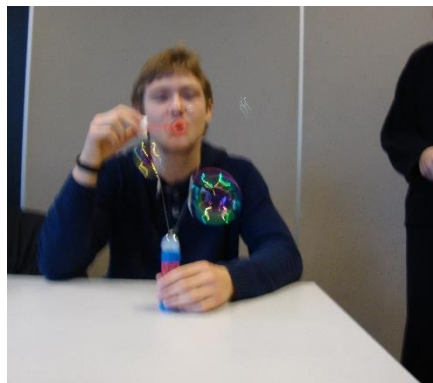
adopted widely across the groups and more than half of the groups used the idea of colored light in their concept to represent emotions inside their bodies. It was a key insight for me in the project as I had been searching for some kind of anchor that could ground my concept in the teenagers understanding. The idea with the lights representing colors was clearly a concept that was well understood by the adolescents.

I will highlight two of the concepts presented by the participants:

1. A scarf that shows your emotions (see picture 9). The tassels on the scarf light up in different colors accordingly to how you feel inside.
Probe: a scarf.
2. A chain around your neck measures how you feel inside, and you can blow a soap bubble to see the color, representing an emotion. (see picture 10).
Probe: a pocket watch and soap bubbles.



Picture 9. Idea 1, using a scarf as a probe



Picture 10. Idea 2, using a pocket watch and soap bubbles.

The group with concept 1, said that since it was a scarf it was mainly to wear outside your home. However, they thought it could turn out to have a negative influence because if the scarf showed you had a bad day others could take advantage of that. In concept 2, they imagined that the two artefacts could be used when you were on your own to get to know your own feelings better or when being with others to help you express feelings.

In general, translating different emotions into simple colors, seemed to be something that all of them could relate to. This gives me an idea about their existing conventions with expressing emotions into visual output.

Design Vision 6: Prototyping Phase

4.6.1 Operational Image

As I was deep down, working with the concrete prototype at this stage – the vision did not change. I drew several sketches of the form of the artefact. The artefact was inspired from the flat round lucky stones that two of the adolescents brought with them. I decided to strap the stone to the body so the GSR-data could collect data throughout the day and, hence, the artefact slowly turned into a wearable. I had an idea of the wearable being connected to something in the adolescent's home, making the context for engaging with the sensitive data more private. I thought that the data could be shown through a painting, a pillow, or a vase in the home.

I drew a user-scenario (see figure 3) with the wearable to evaluate the situation: what context will the wearable be a part of? How will the user interact with the wearable? And how are the behavior and practice revolving around the design? The user-scenario shows the wearable on the hand of a girl. On the top row, you see how she wears it all day, sitting in her classroom. On the bottom row, she gently touches the wearable, getting haptic feedback, telling her that it registered her input. Then she gets home, walking straight towards the mirror hanging on the wall. She puts the wearable on the hook next to the mirror, and immediately the abstract representations of her emotional experiences during the day are reflected back to her.



Figure 2. User-scenario of the wearable

The last frame of the user-scenario sparked many considerations around how a practice of exploring your everyday emotional experiences would look like. I imagined that the user would take a picture of the representations, share it to a close friend to express her day, or print it out to write her reflections about the day on top of the visuals. This reflective practice was not studied or tested in this research project, however, I think it would be interesting to look further into.

4.6.2 Prototyping: Making Sense of the Sensor Data

I started to prototype, focusing on the input data from the GSR-sensor measuring arousals. I used a microcontroller (Arduino-Uno) to make a simple circuit with the sensor, that was strapped around two fingers, measuring the resistance in the skin (see figure 3). I used the Arduino software to run a program (by cwwang.com) that maps the analog sensor input to values. The data was difficult to interpret in the beginning but slowly improved as illustrated in figure 3. When all the noise from the sensor readings was filtered out, the sensor got easier to manipulate.

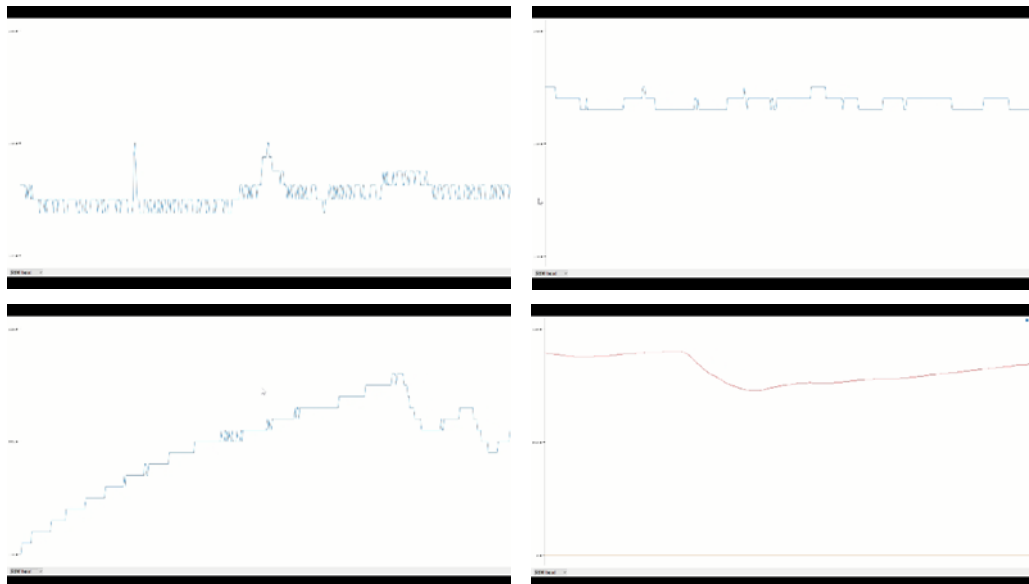


Figure 3. The plotted data readings from the GSR-sensor. It shows the improvements in the input data, from the first graph at the top left corner that was flickering all the time to the graph at the bottom right corner that is smoother.

Testing the sensor on myself, I observed that it was possible to recall emotions from previous memories, affecting the interaction with the system in the here-and-now. Letting other people try the prototype, I noticed that the values were different and some people seemed to be able to affect the sensor more than other people were.

It is interesting how the relationship to the sensor was turned upside down in this exploration of the technology. The sensor was meant to detect arousals as a result of me being affected (being moved), but instead, it became more about affecting the sensor, using my body as an instrument to create arousals. It was an exploration of the sensor rather than an exploration of the body.

Design Vision 7: Final Prototype

This is a final vision, which draws on the previous alterations, summing up the changes that were made and was kept in the end. The Inner Mirror should be an individual experience that facilitates a mindful practice of exploring emotional experiences.

4.7.1 Operational Image

Refining the vision, I realized that the concept has drifted too far away from the vision. It was an omnipresent technology that observes the user from the outside. Furthermore, it did not entail the somatic experience I was looking for, as the mirror would simply display the visuals, leaving the user to see her own body represented, and, thus, not enhancing her connection to the body. These two critiques of the concept fostered two new iterations of the concept that I will present and evaluated in chapter 6.

4.7.2 Prototyping: Designing the Interface of Inner Mirror

I started to map the input from the GSR-sensor to visual outputs on the screen, using the Processing software. The first mapping was based on the exact input values displayed on the plotted graph, and would, therefore, vary a lot from person to person. Figure 4 shows an early version of the visuals, where the size and color of a circle is mapped to the value of the GSR-data. A new circle would appear on the screen for every data reading (about two readings per second).

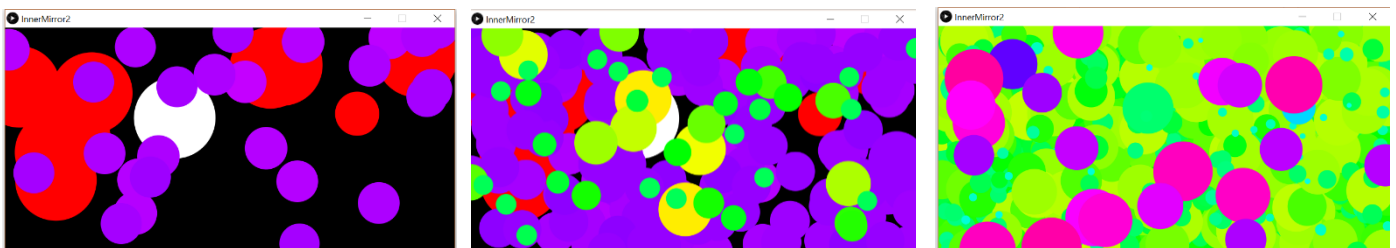


Figure 4. An early version of the visual output. Each circle represents a data reading from the GSR-sensor

I used breathing techniques (e.g. breathing slowly down in the stomach) or muscle tensioning (cramping my toes together) when I wanted to test an immediate visual response. When I tested the experience of engaging with the visuals, I would recall emotional memories or watch online emotional videos to trigger an arousal impact. My evaluation of this version was that there was a vague co-relation between my emotional experiences and the visual feedback. It was difficult to interpret the visual outcome into meaningful reflections about my emotional experiences since the circles only represented the sensor-reading, which does not tell if it was an emotional change. I needed to make a program that could relate the existing value to the previous values to detect emotional states.

Interpreting the values was important for the behavior of the system. Researching on the topic, I learned that a peak in the plotted values represents an emotional change. The values increase extremely fast, and then slowly stabilize again when an emotional change occurs. Playing with the

sensor, I learned that the peak occurs about one second after being affected. I coded a function that manipulates the GSR-input.

Having the function, I could calculate three states: 1) An arousal state that is activated when there is an emotional change, represented by a peak on the plotted graph. 2) A neutral state that occurs when you, for example, are talking or are busy with an activity. 3) A relaxed state that is activated when you are not affected by anything.

Figure 5 illustrates the first version of applying the three states to a visual outcome. When a relaxed state was registered, lines in different colors emerged. When an arousal state is activated, a triangle emerges.

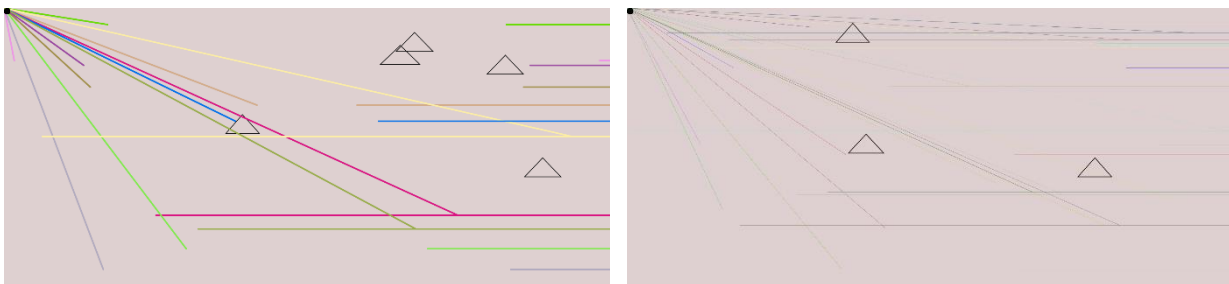


Figure 5. Updated version of the visual output. The lines represents state 1: relaxed, and the triangles state 2: arousal

Evaluating this version, I found that the behavior of the line was too random as the different directions encouraged some form of interpretation that could not be associated directly with the emotional experiences. However, the triangles, representing an arousal, was easy to relate to, and, furthermore, it was exciting to figuring out what emotions had triggered the specific triangle at a given time. This finding resulted in yet another modification of the visuals, leading to the final prototype presented in the introduction of this paper (section 1.2). See appendix 3 for a documentation of the final code of the Processing file.

5. Test of the Inner Mirror Prototype

5.1 First-person Testing

I have used first-person testing to develop the behavior of the system throughout the prototype phase as documented in the previous section. Now I will describe how I used first-person testing to evaluate the final design. The purpose was to explore the behavior of the system under different emotional affect.

The first test-result that I want to highlight is from wearing the sensor while working in a café (see figure 6). The figure shows a timestamp, illustrating the behavior of the visuals over time.

The many, rather large, circles showed that I was relaxed most of the time. I would have expected to see fewer triangles since I did not experience many emotional affects while working. Small things such as looking out of the window in the sunshine, getting eye-contact with another guest, and breathing differently could have triggered the arousal state, outputting a triangle. However, I still found that the number of triangles did not relate to my experience, and thus, changed the parameter for the arousal state in the program accordingly.

The second test-result took place in my living room while watching a six minutes video clip that promised to make me cry. As I was immersed in the video, my mood changes drastically and I was feeling sad. Figure 7 shows the abstract visualizations produced while watching the story. Clearly, only a few, and tiny, circles appear, truthfully suggesting that I did not feel relaxed while watching the story. The many triangles reveal the many emotions that the story evoked in me. Some triangles are bigger than others, representing the strong emotional arousals I experienced.

Testing the prototype on myself revealed some interesting patterns emerging in the visuals under different emotional influences. Based on the test, I can conclude that it is possible to reflect your own emotional experiences in the visual abstractions.

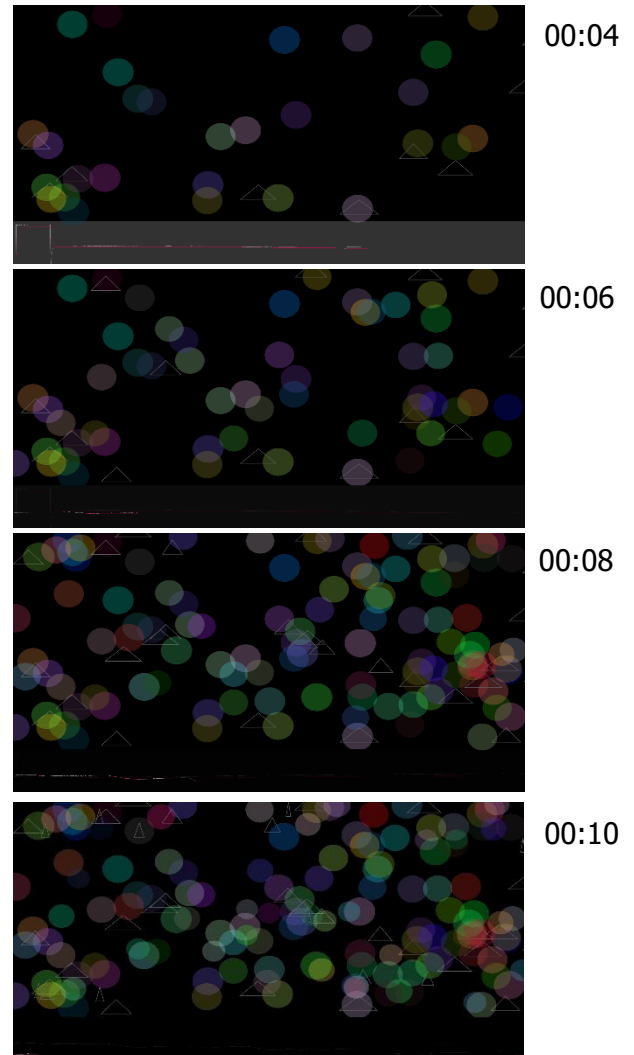


Figure 6. The visuals from working in a café. I took a screenshot four minutes after starting the test and following, every second minute. The plotted sensor values are displayed at the bottom of each frame.

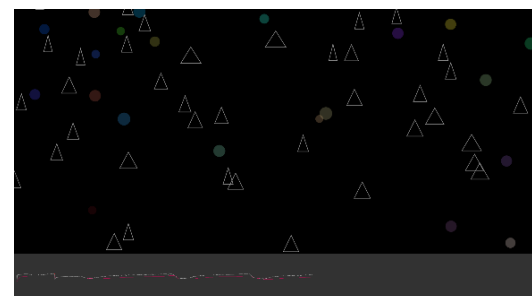


Figure 7. The visuals from watching a sad movie. I took the screenshot after six minutes when the short movie ended.

5.2 Testing with the adolescents

I went back to the school, visiting the two classes that participated in the workshops. While the adolescents had activities in their classrooms, I sat outside, inviting them to test the prototype in pairs (see picture 11). Even though the concept has been designed for an individual experience, the purpose of this test was not to explore the practice – such a test would be conducted in the memory context. The purpose was to test the concept of translating emotional changes into simple visual representations - would the adolescents be able to recognize their emotions in the visuals? Would they be able to relate to the concept and imagine it in a real-life context? Would they feel ownership and see how their contributions at the workshops had led to this design? Making the teacher pair the adolescents with a likeminded classmate, I attempted to create a comfortable set up, where the adolescents would feel safe to share and discuss their emotions. In one and a half hour, I had four pairs testing the prototype and a group playing with the prototype in the end.



Picture 11. Adolescents testing the Inner Mirror prototype

At the test, the two adolescents would take turns to wear the sensor. I would try to affect them by different methods: asking them to relax; asking them to take a deep breath; asking them to close their eyes and imagine being in one of their favourite places surrounded by their best friends; giving them a shock by clapping my hands close to them; making them watch a sad or funny video.

I went through the first four steps with all of the first test-persons and they did not see the visuals while being affected. All three of us would discuss the visual outcomes afterward – mainly the first test-person was asking questions, trying to understand his/her emotions in relation to the visuals. The second test-person, knowing the system, would try out different methods on her own while watching the visuals emerging on the screen. A few of the second test-persons was not motivated to explore the system on their own, and I instead showed them a video of their choice (e.g. funny cats).

5.2.1 Relating experiences to the visual representations

The first test-person in the pair, who did not see the visual output as it emerged, often asked me and the second test-person what the different visuals outcomes could be related to, such as "Is this triangle when you gave me a shock?" It told me that they are indeed curious and motivated to explore the visual representations of their bodily emotions. On the other hand, it also showed that

it was difficult for them to relate to – a time reference in the visuals would support this missed relation. In fact, a plotted graph displayed at the bottom of the screen provided as a time reference several times. For example, I used it in an attempt to help a test-person interpret the visuals: “You see this abrupt curve on the graph? This was when I asked you to take a deep breath after being totally relaxed and that must be this large triangle up here”.

However, the second test-persons who only watched a video clip did not have this frustration and was relating their personal experiences to the visuals on their own: For example: “This giant triangle must be when the baby swallowed the lemon – I was laughing so hard”. Thus, a solution could also be to focus on a single experience at a time, making it easier to map the visuals within the storyline of one isolated experience.

5.2.2 Evaluating the Ownership

I asked the four test-pairs if they could see a connection with the prototype and the workshops, we did together. Three of them mentioned how they saw a connection between the prototype and the concepts that they came up with, in the last workshop. They had a difficult time explaining the direct link between the workshops and the prototypes. Slowly recalling the concept that they came up with three weeks ago, some of them were able to highlight some similarities between their own concept and the prototype. For example, a boy mentioned how the colored circles on the screen expressing an arousal were similar to the concept of his group, where the circle shaped tassels on a scarf would light up in different colors, representing emotions.

5.2.3 Unique individual representations

While one test-person sat with earphones on, listening to an emotional song, the other person said to me: “Don’t expect too much from his output – he is different from me. I am a very emotional boy.” Even though I thought it was a spectacular comment in the situation, the visuals turned out to reflect what he was claiming (see figure 8).

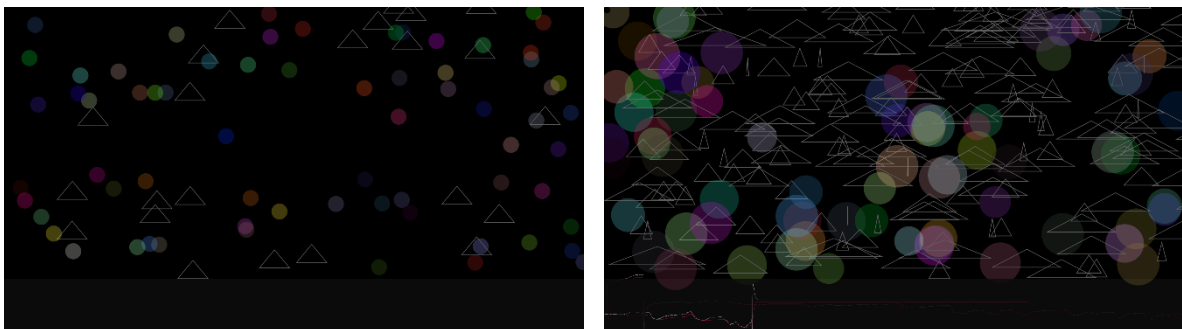


Figure 8. Left: Screenshots of visuals from boy listening to a sad song. Right: screenshot of boy labelling himself as “emotional”.

In general, there seemed to be a wide variation in the visual expressions. A girl noticed how her visuals looked significantly different to her friend's visuals. She insisted on seeing the same video to compare the visual outputs (see figure 9). Her values were way lower at the relaxed state and furthermore, the peaks appearing in her readings were less steep. Whether the individual differences appearing in the visuals say something about the person's emotional state is unknown and would have to be invested further. However, I see a great potential in the individual differences, which would be interesting to express even more clearly in the outcome.

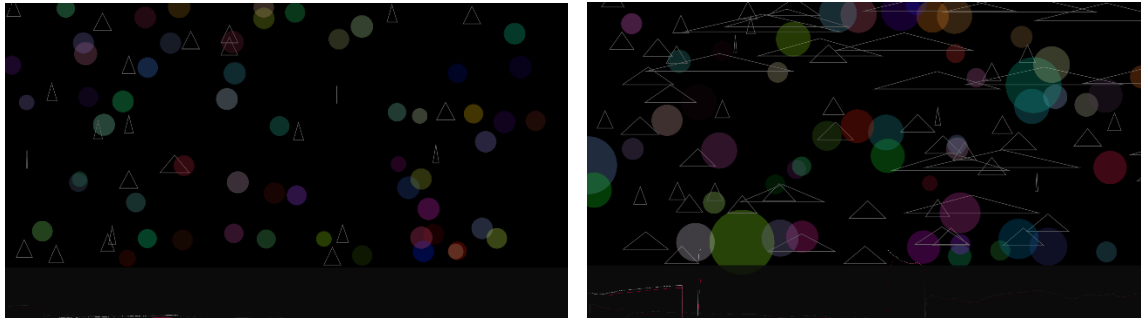


Figure 9. Left: Girl that tried to find out why her visual was different from her friend's visual. Right: The visuals of the friend.

5.2.4 Emerging behavior in the test set-up

I stepped away from the test-setup to do some filming and slowly the adolescents took over the scene. With me standing in the background, some of their friends got curious and joined the table to play with the prototype. One girl was wearing the sensor while the others would try to affect her, watching the screen to see how it manifested in the visual output. They took turns in wearing the sensors, being in the center of the others.

This emerging behavior in the test-setup was a fascinating twist. It was clear that these girls felt more attached to the prototype than those who only tried it under the more controlled test structure that I facilitated. The girls started to discuss how they would use the prototype in their everyday life. One girl said that she would find out when she was the most emotional relaxed during the day. Another girl said that she would try it on when sleeping to see emotional affects caused by her dreams. Yet another girl said that she would like to see the visuals after being together with her boyfriend.

6. Concept Evaluation

I see the Inner Mirror prototype as a first design speaking into the problem by exploring the technology and the aesthetics of the body representations on the screen. If this project should continue, new prototypes exploring other parts of the design would be produced. This chapter is dedicated to present and evaluate the three concepts that emerged working on the design.

6.1.1 The Wearable: Omni-presence

This concept is also described in section 4.6.1 when it first emerged in the design process.

The adolescent put on a wearable in the morning (e.g. an arm wrist, a necklace, or a fingering). Wearing it all day, emotional changes are registered throughout the day. When the adolescent comes home from school, she connects the wearable to the Inner Mirror that shows her a visual landscape, representing the emotional changes she experienced during the day in a chronological time order. A reflective practice in front of the mirror is encouraged; she note down what kind of emotions the different visuals refer to and compare the visuals to previous days, trying to find patterns in her emotional behavior (Is there always a lot of activity right after lunch? Does Mondays in general look different from the rest of the weekdays?)

6.1.2 The Artefact: User Controlled

The adolescent has a small artefact in her pocket, formed like a flat stone that fits in her hand palms. The artefact measures arousals whenever it is in contact with the skin. She sits with the artefact in between her hands while the teacher speaks. She also takes it out of her pocket when she and her friends are talking about the boys in the lunch-break. When she comes home from school, she connects the artefact to Inner Mirror and sees the visual representations of the emotional changes from the two episodes previous that day. She is encouraged to explore the visuals by noting down reflections or comparing the different situations.

6.1.3 The Memory: User Owned

When the adolescent comes home from school, she stands in front of the Inner Mirror, where she is encouraged to recall emotional memories that she experienced during the day. When she touches the specific area on the panel of the mirror, visuals will appear on the mirror. A silhouette of her own body can still be seen "underneath" the visual landscape. She is encouraged to identify the emotions from the situation she memorizes and to locate the emotion to a specific body part (just like the adolescents did in the first workshop with the body-maps). Noting down these reflections on top of the visuals, she can learn to recognize her emotions, maybe even when they occur in the situation.

6.2 Evaluation

I do not think that I have sufficient ground to decide on a specific concept since I have not explored the conceptual part of the prototype in this thesis. I will present and evaluate on the different concepts that occurred in the process to form a direction for further work.

Each of the concepts represents a unique engagement with the technology that I will evaluate by identifying the possibilities and challenges of the practice afforded by the technology:

	Possibilities:	Challenges:
<i>The Wearable</i> (<i>Omni-presence</i>)	<ul style="list-style-type: none"> • Find patterns in arousals • Compare between days 	<ul style="list-style-type: none"> • "Watch" the user • Detects uninvited situations
<i>The Artefact</i> (<i>User controlled</i>)	<ul style="list-style-type: none"> • The user can control the input /decides the situation 	<ul style="list-style-type: none"> • Inconvenient to bring up in social situations • Easy to miss out on the desired information
<i>The Memory</i> (<i>User owned</i>)	<ul style="list-style-type: none"> • Relate emotions to specific body parts • Enhanced relation to the body 	<ul style="list-style-type: none"> • Take practice to recall emotions

The Wearable concept is omnipresent, measuring the body constantly just like the fitness trackers. While the design does not simplify the body into numbers or set up generalized goals, it still holds this quality of objectifying the user as it sits like a spy on the body detecting all changes.

The Artefact concept puts the user back in control and completely letting her decide which situations should be detected. The downside with this solution is, however, that emotional changes happen quite fast and we are usually not aware of it before we are in it. Thus, many of the situations the user would want to explore would most likely not be possible to track.

The Memory concept facilitates a single contact point with the technology through the interface of the mirror that can only be accessed in the memory context. It distinguishes it-selves from the other two concepts because the visuals are shown to the user in a real-time feedback loop. The Memory concept gives the opportunity to relate experienced emotions to specific body-parts, which makes the user deals with the emotions, forcing her to feel it inside of her own body and not just look at the emotions inside the mirror, distancing herself from them.

Based on this evaluation, I will conclude that the Memory concept seems most promising, and would thus, be the first concept to explore in a future prototype. I will look at the concept through the presented theoretical framework (chapter 2) in the last part of the following chapter.

7. Discussion

The discussion consists of three parts: the first discusses the design process and the insights I gained about designing a soma-based technology. The second part discusses the role of the technology in mindfulness. The third part discusses the artefact in relation to the theoretical framework.

7.1 Design Theoretical Considerations

7.1.1 A vision-driven design process

Reflecting on the process I went through, I believe it was partly a user-driven process and partly a vision-driven process. With a partly vision-driven process, I mean, that one of the key-motivation for solving the problem has been the greater vision behind the specific design situation. Löwgren and Stolterman (2004) explain that a design project always entails a vision – a vision of a change from a less preferred state of the world to one that is more preferred. However, what I am suggesting is that while the vision is always a part of the design process, the role it plays might vary depending on the project. One could also imagine a material-driven process (e.g. Stienstra et al., 2011), where it is a specific technology that is the motivation for the design. A context-driven process (e.g Kirk et al., 2010), where a particular place and community are the key-motivation, which leads the design process forward. A user-driven process, where engaging with the future users of the design is in focus, just like I have done in this project. I believe that each of these motivations plays an important role in most interaction design projects, where they inform and constrain the design, giving the designer a path to follow. Nevertheless, they can be weighted differently accordingly to the type of project - either required from the type of problem or intentionally angled by the designer or the sponsor of the project. Categorizing the driving forces of the process helps to understand the intentions and purpose behind the design.

This project started as a vision - a vision about designing technology that creates mindful meetings between humans and technology. This rather broad and abstract vision has been altered into visions that are more concrete. The final design, nevertheless, also speaks back to the bigger vision that initiated the project.

7.1.2 Uniting the envisioned world with the world of the users

The project was also partly user-driven since working together with the adolescents, has indeed also dominated the decision-making. Thus, the presented design process can seem like a clash between two different epistemological approaches: On one hand, the participatory design approach empowers the adolescents to construct knowledge in collaboration with me. On the other hand, the first-person perspective recognizes my personal self-reflection and experiences as knowledge construction. I will argue that it is in the meeting between the two sides that the design arises. Furthermore, I think that there is a tendency in participatory design to put the user in the center but at the same time neglect the designer's influence. The first-person perspective from Höök and et al., (2018), legalizes what I have already done in previous student design projects but have not been able to express and communicate. Making the first-person experiences explicit, the value of it is easier to see and express but also makes it more clear what insights came from the situation and the users compared to what insights came from my own explorations.

On the other hand, I think that the participatory design approach has helped me ground my decisions and made the final outcome more valuable because it means something for someone. This value could not have been reached through the first-person perspective alone. I claim, based on this thesis, that the two different approaches complement each other beautifully.

7.2 Technology Paradox

I kept raising the question of whether technology has a stance when it comes to designing for a somatic connection to the body and it has been a recurring paradox throughout the project. So, why should we use technology to foster mindful values and establish a strong connection with the body? There seems to be a conflict in the question itself since mindfulness is associated with peace and the spiritual world whereas technology is associated with productivity and science. However, the technology do not hold these values in itself, the humans that designed the technology embed them. If technology only reflects the values of humans, it means that any value could form a technology. Thus, it should be possible to create technology that reflects the values of mindfulness, which the design examples, presented in 2.x, is an excellent proof of. But why is it necessary to bring technology into the world of mindfulness? I believe that there is a natural drive in humans to constantly move forward, developing us for the better (which sometimes means taking one step back before taking two step forward). The humans will always be in movement and keep developing new tools and new comprehensions of what is valuable and a preferred way of living. I believe that technology plays an important role in this development, forcing us to see new versions of the world. The technology could help us to understand our conscious/presence in a new way to reach even deeper within ourselves.

7.3 Inner Mirror in relation to the theoretical framework

I will now discuss how the final prototype, the Inner Mirror, looks through the lenses of the theoretical framework presented throughout chapter 2.

7.3.1 Bodily Presence

The interaction with the Inner Mirror shows potentials for embedding the mindful value of bodily presence (2.3). However, this aspect was not evaluated properly through the prototype as the visual output was displayed on a computer screen. Engaging with the screen, it is difficult to keep a conscious connection to the body, just as I pointed out with the smartphone screen (see 2.4). In the third concept design (Memory), the user sees the outline of her body in the mirror and is encouraged to recall emotions, experiencing what (Massumi, 2015) calls a memory of the past that is consciously activated. Thus, I will claim that interacting with the mirror in this concept affords the user to feel the presence of her own body, which will enhance the connection to the body. Furthermore, the user interacts with the visuals by connecting them to their own felt experiences, forcing them to stay present in their body throughout the reflective practice of engaging with the visualized arousals.

7.3.2 Challenges with Visual Output

Reflecting on the visual output of the Pressure Map, Höök et al., (2015) found that the visual feedback took too much attention away from the felt bodily experience and they conclude that the system needs a different output such as music. I recognize this challenge from my own work with the prototype. Representing the body in visual abstractions on the screen also resulted in a focus outside of the body in my test session. The technology becomes redundant because simply feeling these emotions inside of your body would create a stronger somatic connection. Nevertheless, deliberating on the three different concepts, I find that the interaction with the technology is crucial for the somatic connection. As discussed above, I think that the third concept, where the user interacts with the visuals, trying to map them to her own body, is enhancing the relationship to the body. Thus, I see a potential for designing visual outcomes that gives a somatic experience as opposed to Höök et al., (2015).

7.3.3 Non-judgmental Behaviour

I will claim that the mindful value of being non-judgemental is embedded in the final prototype or rather in the practice that the design cultivates. The visuals in concept one and two let the user explore emotional changes without judging the emotion in any way. The practice in concept three, furthermore, focuses on accepting the presence of an emotion, accepting the nature of it, whether it is a positive or negative experienced emotion. Recognizing the emotions in the body is a part of a non-judgmental practice of accepting them as they are, and, consequently, feel more comfortable with the emotions.

7. Conclusion

In Personal Informatics, the body is viewed as an instrument to be measured and optimized. Even though the Inner Mirror prototype is also a technology that reads body related data with the purpose of a healthier body, it takes a remarkable step away from the self-tracking devices. Inner Mirror transforms the body into a subjective landscape to be explored, opposed to the fitness trackers that view the body as an objective subject to be observed and modified. The design helps to put focus on the somatic experience in the adolescents' everyday life by letting the body be present and not forgotten when interacting with the visuals. It encourages the adolescents to pay attention to the emotional changes and embrace the life happening inside of them.

The three concepts, evaluated in this research, shows that the practice, which the technology affords is crucial to the somatic experience. The evaluation of the concepts suggest that the third concept variation – the Memory – would work best. In the Memory concept the mirror is seen as an interface that the user interacts with by recalling emotional memories and following identifying the emotions in specific body parts. The Memory concept seems to entail a possibility for engaging the body in the meeting with the technology and enhance the general relationship to the body. However, this will need to be explored further through a new version of the prototype tested in the memory context.

Even though I have designed Inner Mirror for and with adolescents in this project, I see a potential in presenting the solution to other age groups. However, there is a special need for adolescents to explore their emotions because they are in a phase of building an understanding of themselves.

Next step is to work on the aesthetic expressions of the visuals and further explore different mappings of the GSR input data that can support the mapping, which I created in this project. For example, it would also be interesting to look at arousals peaks over time instead of only looking at one arousal at a time. Furthermore, I saw a potential in the individual differences of the measurements that would be interesting to explore further and embrace in the visual outcome.

In this further process, it would be interesting to test the artefact on my own for a longer period to learn how it can facilitate a bodily practice when entering the everyday life. Would it some sort of ritual in my daily life or how could it create value? Also testing it with the adolescents in their domestic setting is relevant to explore what kind of practice would evolve with the prototype and how it would affect their somatic relation.

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Appendix

Appendix 1:

<https://drive.google.com/open?id=1U6Ak2kqv9ECTFFLZiGIETGXIt5RVm2ug>

Appendix 2:

<https://drive.google.com/open?id=1DIhoOL1wg4kzQ4JsC0hoRtLUHpoCYhUV>

Appendix 3:

https://docs.google.com/document/d/1mq8Wc8FhvC_etTtDIk_Y2KqBamPSawTVZNLmbBXs9E/edit?usp=sharing