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Mobile health applications for young male athletes

Negotiating self-quantification and lifeworld

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Abstract

Background: The potential of mobile health technology is increasing with the development of smartphones. Realizing the potential for specific user groups is something that has not been the focus of either research or development. The specific user group for this thesis is young male athletes, and it will explore the process of designing a health application for them.

Objective: Through a design process with the participants, the thesis explore how the participants experience their bodies in the context of design and use of health applications.

Methodology: Participatory Design is the methodological framework for this thesis, which motivated the inclusion of five young athletes between the age of twenty to twenty-three. The methods chosen constitutes a Participatory Design approach, consisting of a scoping interview, semi-structured interviews, two workshops, and prototyping.

Theory: The theoretical framework for the study consists of two concepts and an analytical tool. The concepts are Self-Quantification and lifeworld. The analytical tool is Activity Theory. Together with the methodological framework, it formed a research design that guided the process.

Results: The results from the study indicate that the participants experience their bodies in the tension between the theoretical concepts of Self-Quantification and lifeworld. The results are useful to see how the participants express themselves and their everyday lives through the design process.

Conclusion: The implemented research design shows that rich data about the participant's lifeworld can be used to explore how they experience their bodies through health applications. Also, how the participants expressed their experience through the participatory design process is a contribution to the research field.

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Abbreviations

- App: Application
- mHealth: Mobile Health
- AT: Activity Theory
- SQ: Self Quantification
- PD: Participatory Design
- HCI: Human-Computer Interaction
- PDA: Personal Digital Assistant
- SDK: Software Development Kit
- API: Application Program Interface
- BLE: Bluetooth Low Energy
- OS: Operating System

Chapter 1

Introduction

This thesis explores the design of mobile health applications for young male athletes and presents a process where a proposed design of a mobile health applications was made with the participant's everyday lives in mind. Mobile health applications, from now on called health apps, fall under the umbrella of mHealth, which is a concept that refers to mobile computing, sensors, and technology used in healthcare, as defined by Liu et al. [39]. I locate my definition of health apps in the research of mobile devices, sensors, and wearables that are empowered by software to present personal health data to the user. The growth of the number of health apps has been evident for quite a while now [38, 39, 59, 67], some have even called the growth exponential [70].

A generation of athletes growing up with the possibility to track their activities from an early age might prove favorable if the technology meets its intention. On the other hand, there have been some signs of difficulties when the use evolves into an intrusive addiction where the numbers and results from the app become the only sign of progression for the user [19, 91]. My research investigates the implication of health apps by exploring how athletes interact and experience their health data presented by the apps.

1.1 Motivation

My motivation is the opportunity to gain insight to athletes thinking when it comes to performance, experiences, health data and their bodies. I have, for as long as I can remember, been impressed seeing how athletes use their skills to exceed their limits, to become better and perform on the day of competition. Whether it is playing soccer, running, cycling, cross-country skiing or any other kind of competitive sport, the goal is to be the best, exceeding the physical capabilities of the opponent(s). To many, I believe, the insight and appreciation for the preparations are overlooked, and not interesting compared to the actual competition. Moreover, yes, I do think that it is dreadfully boring, thinking about all the hours training and preparing to compete, compared to watching the results of the preparations. At the same time, intriguingly interesting and impressive. The results are impossible without hours upon hours of training and preparations, which

is quantified and broken down into small tasks and numbers which coaches and the athletes themselves use to get ahead of the competition. How can new technology aid the athlete in becoming better? What design challenges are faced when making the health apps?

From the perspective of research on mHealth technologies, my research motivation can be found in Liu et al. [39] and the author's concern that the development of mHealth technology is far exceeding the research being done in the research communities. They address the need for guidelines for developing health apps for smartphones.

Considering every smartphone owner between the ages thirteen to twenty-four in Norway, health apps have a potential of reaching ninety-seven percent of the age group based on numbers from 2015 [47]. From this sparked a motivation to specify the user group and make a contribution to the specific needs of that group. The choice of users was made based on my contacts in the community of athletes at a certain level of commitment or competitiveness. Choosing young male athletes as my user group motivates me, because I am, to a certain extent, in that same group.

The motivation behind the research was also driven by the KULU research project, based at the Design Group at the Department of Informatics at the University of Oslo [35]. Traditionally, the research is aimed at the design and implementation of cool technology for young patients between the ages twelve and twenty-five that are diagnosed with long-term or chronic health challenges. In my case, the boundaries regarding the user group were open, giving me the opportunity to choose my participants. The description of the assignment I chose was primarily related to research health-oriented mobile applications, not specifying the users' state of health.

1.2 Research interest

A quick search in a couple of academic search engines¹ revealed that there is hardly any literature on athletes use of health apps as a tool to track performance data. Given the particular demand that the athletes might have to health technology and the potentially significant role it might play in their lives, I think it is worth researching and including the athletes themselves in the process. Therefore, my research interest is:

By looking at the participant's lifeworld, develop an app design that reflect the lives and needs of the athletes through a Participatory Design process.

The research interest provokes many questions related to the lives and needs of the athletes. I want to study what kind of design the athletes prefer, enjoy, and like by including them in the process, but even more importantly, a design that gives meaning to the use of the mHealth technology in their lives. By including *Participatory Design* and *Activity Theory*, I seek to understand better how health apps can be designed for young athletes.

¹Google Scholar, Scopus, Oria

There is a theoretical tension that will permeate the thesis, through two concepts, namely *lifeworld* and *self-quantification*. Two perspectives of technology that brings out the tension between looking at the body as a quantifiable entity or as a qualitative lived body. Therefore, with the tension, and also the context of KULU in mind, my research question is formulated as follows:

How do young male athletes experience their bodies in the context of the design and use of health applications?

1.3 Chapter guide

- **Chapter 2: Background** for doing research. Provided by a presentation of two central topics. First, the technology that encompasses mobile health, then the user group, namely young male athletes.
- **Chapter 3: Theory and Methodology** included in my thesis is explained here. The theoretical framework consists of Activity Theory, Self-Quantification, and Lifeworld. Lastly, the methodological framework, Participatory Design is presented.
- **Chapter 4: Methods and Ethics** naturally follows after the presentation of methodology. Participatory Design guided my choice of methods as well as dealing with ethical considerations. This chapter presents all the methods used during my research to gather data from the participants.
- **Chapter 5: Implementation and Results** of the methods presented in the previous chapter is presented here. The presentation follows the process chronologically, creating a narrative for the gathering of data.
- **Chapter 6: Discussion** After the design process ended, a discussion regarding my findings from the previous chapter is presented with an emphasizes on the tension between two of the theoretical concepts, namely lifeworld and Self-Quantification.
- **Chapter 7: Critical reflections** In this chapter, a reflection on the strengths and weaknesses regarding my thesis is presented. The chapter ends with an explanation of the research design of the thesis.
- **Chapter 8: Conclusion** seeks to end the study by summarizing the findings to answer the research question. Also, contributions to the research field are presented, as well as suggestions for future work.

Chapter 2

Background

I will focus this background chapter on two subjects, first a technical presentation of the technology I am working with and researching. The technology is evolving every year, even through the course of this thesis, the technology has become more advanced, so my presentation is based on the contemporary landscape of the technology. Secondly, the choice of user group is presented with a focus on gender and previous research on male athletes in section 2.2.

Traditionally, the quantification of training has been done through manual training diaries often made in spreadsheets. However, as the tools for monitoring training are becoming more advanced with the emergence of ubiquitous computing, the task is becoming less manual, for athletes as well as the average consumer [59]. Vital signs are monitored with the same technology used in healthcare. Companies are developing mobile applications tailored for our health and fitness, whether it is good or bad. In 2015 there were 103,000 unique applications related to mobile health (mHealth) across the mobile platforms [59]. In other words, I am not planning an extensive content analysis of the marketplaces for health and fitness applications. I am rather interested in the design of mHealth applications for young male athletes.

This chapter will focus on the technical aspects and possibilities regarding health apps and their feasibility on smartphones. This includes handling sensor data from internal sensors as well as external, different protocols used for communication, how data is stored and computed, and also ethical issues regarding the technology and development. One of my goals is to determine if the technology is feasible to serve the purpose of creating health data the athlete.

2.1 Technology

In this section, I will explain the concepts of the technologies used in health apps. The selection of concepts determines the capability to capture, use and calculate health data, or biometric data, to offer a service to the user. However, being a technical section, I will have the perspective of a developer, rather than a user.

2.1.1 Smartphones

Mobile devices traditionally include a large number of different units having specific purposes, such as PDA (Personal Digital Assistant), pedometer, MP3-player, and cell phones. As the hardware and software capabilities of phones improved, it gradually made the specific devices obsolete by embedding the functions of those devices into the phone [39], for example, making the phone able to play MP3-files. To reduce the confusion regarding the use of the term “smartphone,” I agree with Zheng and Ni [90]. The authors describe it as a contemporary term describing the most recent computational power of a mobile device, which is important to keep in mind when looking at the current state of smartphones and their environment.

The development of modern smartphones seems to have found its form factor in regards to hardware infrastructure and interaction, with a large touch based interface and computer-like hardware specifications. What puts them apart, other than differences in form factor, is what kind of platform and environment it belongs to, which again decides which applications are available for that type of smartphone. The three largest distributors of operating systems for smartphones are Android, iOS and Windows Phone, which I consider to be the benchmark for the modern smartphone regarding software. They all have centralized markets for applications, which consist mostly of third party applications developed by external companies [39].

2.1.2 Applications

Apps are essential to the concept of smartphones, which allow developers to utilize the computational power of the device through writing code that compiles with the smartphone’s operating system (OS). Apps are software running on the smartphone’s OS, utilizing the phone’s computing capabilities to act as a service to the user. More specifically, the apps related to my work are organised under the “Health and Fitness” category found in the three largest app stores, Google Play (Android), Apple App Store (iOS) and Windows Phone Store (Windows Phone).

Health apps are characterized by being able to handle biometric or biomechanical data, including contextual and positional data, saying something about the human body. As already mentioned, there were 103,000 unique health apps in 2015 across all app stores. Google and Apple offer software development kits (SDK) for developing apps using the application program interfaces (API) specifically for developing health apps, for example, getting sensor data to display in an app using the Sensor API in Android. This may have stimulated the enormous growth in the “Health and Fitness” category over the years. The possibility to visualize data in the app adds value to the concept [39].

There are several ways to make an app for a smartphone. Schobel et al. [69] presents four different ways of development and discusses them, namely “Web Applications”, “Hybrid Applications - Web”, “Hybrid Applications - Mixed” and “Native Applications”. The authors argue that only a “Native Application”, meaning an app that has full access to the

standard API to the specific OS, is sufficient when developing an app that needs the specific functionality a health app needs.

2.1.3 Sensors

Internal sensors

In addition to the computer like specifications, smartphones have many different sensors and antennas that allow the device to detect movements and positions. Developers can use these sets of data to give the app specific behavior depending on the context the user is in. The context is merely an interpretation done by the sensors in the device, estimating the actions of its user. For example, while driving, the smartphone can recognize movement and the use GPS-location to know that the user might need to use an app for navigation, and if the user allow it, it might bring up the navigation automatically. This is an example of passive context acquisition, made possible by the device's sensor hub, which I will come back to in section 2.1.4. An example of active context is the use of sensors to interact with a game by tilting or moving the device as a part of the controls.

These are both examples that should be familiar to most smartphone users, as those functions have been around for some time. However, they are important functions to illustrate why sensors are essential to modern smartphones, and the apps that are developed for them. The roles of the sensors are critical to feed the smartphone with serial data, saying something about the user's activity, as illustrated by figure 2.1. Looking at the microarchitecture in current high-end smartphones, a sensor hub is integrated as a part of the processor. In Qualcomm's Snapdragon 820 and Apple's A9 processors, the sensor hub acts as part of the coprocessors to their respective chips, which is a low power alternative to the CPU, allowing applications and sensors to always be active. This allows smartphones to be specialized to handle sensor data while using as little power as possible [75]. Smartphones are ideal for handling sensor data, both from internal and external sensors [56]. Physical internal sensors include: accelerometers, gyroscopes, magnetometers, barometer, humidity, pressure, light and proximity sensors [72]. Most widely used in activity related apps are the accelerometer and gyroscope.



Figure 2.1: Sensors (Qualcomm [75])

An accelerometer can sense the force with which a device moves in a linear direction, measuring this movement in g-force. This is useful for example when determining how fast an athlete is moving. Accelerometers in smartphones are triaxial, which means they can measure the force along the x-, y- and z-axis. A gyroscope has different characteristics than an accelerometer, where a gyroscope measures the surroundings in a radial sense, rather than linear [5, 46]. This means that it knows the orientation of the device, whether it is up, down or sideways. By itself, it is not ideally used to measure activity, but together with the accelerometer it provides rich data to more accurately calculate the distance covered, and altitude climbed. While the sensors themselves provide rich data, they rarely work alone, given the vast and powerful features of a smartphone. To make a full feature-packed app for tracking activity, features like GPS, 4G and Wi-Fi are implemented to complement the sensor data.

External sensors

While the internal sensors often give a sufficient amount of data for an activity app to work by itself, there are some important data that can only be monitored by external sensors, often in the form of wearables. Wearables are defined here as health technology wore on the body, communicating with a smartphone. These wearables might have features and sensors the smartphone does not have, for example, a heart rate monitor, and they often have the same sensors as the smartphone, but might in some ways give more precise data about biomechanical movement.

The sensors in on-body wearables have the possibility to for example monitor vital signs, mostly used in healthcare or physical activity, to monitor oxygen, sleep quality, blood sugar levels as well as heart rate [69]. These features depend on the device, whether it is a fitness watch, wristband, waistband or smartwatch. The standard for communicating with an external sensor in smartphones is Bluetooth, using protocols such as ANT+ and Bluetooth Low Energy (BLE), which can effectively transfer data at a low

rate from many devices while being power efficient [45]. The way in which data are generated in external sensors is similar to internal. They create an array of serial data which allows monitoring in real time. The next section will look at how data is handled, communicated, processed, and stored, as well as a discussion related to the challenges regarding data.

To summarize why sensors are necessary: Sensors make it possible to monitor the environment the smartphone is in, as well as its external sensors and generate data that can be applicable in the different contexts the user might be in; referred to as tracking. Tracking happens when the data is captured over time, making statistics and graphs of the data, and would not be possible without the sensors. Tracking sleep, exercise or vital signs in different contexts, whether it is used in healthcare or by professional athletes, is important to learn about the body and the technology in use.

2.1.4 Data flow and communication

In this section I will make a brief, comprehensive overview of the concepts mentioned above, explaining how they communicate and how the flow of sensor data allows an app to use those sets of data to track the user's activity. I will also briefly discuss how the data is handled and stored by looking at some of the issues that may arise.

Sensors are essentially hardware components, having no real control of itself meaning it cannot capture or send data unless a controller, meaning the app, asks for it. To explain the relation between the controller and the sensor, the Android Sensor Stack (Figure 2.2) provides a coherent illustration of the data flow. In the stack, the layers can only communicate with the layer above or below. The control is within the app, sending commands down the stack to the sensor, and the sensor sends the data back to the app, going through all the layers of the stack. This structure allows an app to be very powerful and modifiable in the way it uses sensor data and also allows sensor fusion, simulating sensors that are not a part of the hardware by combining sensor data [71].

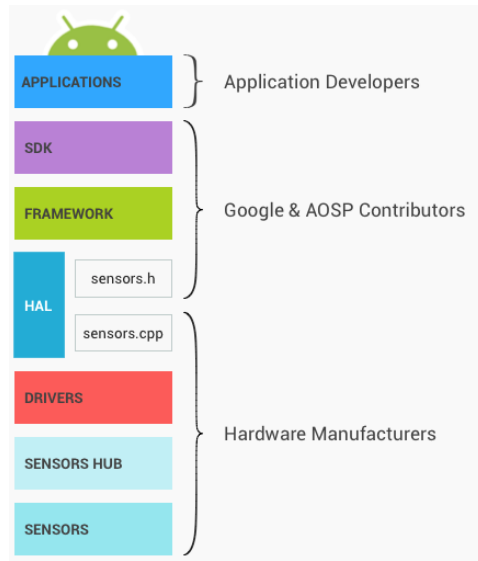


Figure 2.2: AndroidSensor stack [71]

When it comes to external sensors and other external communication done by the smartphone, there are many design choices to be made by the developer. Baca et al. [5] presents a data flow that extends the communication of the smartphone at both ends. They describe a system that is made for monitoring the activities of athletes, explicitly using external sensors, and using the smartphone to give feedback and communicate with a server. Figure 2.3 illustrates what that might look like. In the proposed system, data packages are transferred from the sensors to the microprocessor which handles the communication with the smartphone over a wireless connection. The smartphone receives the data and can give feedback directly to the athlete, or forward it to a server where the experts can analyze it using more complex analytical tools.

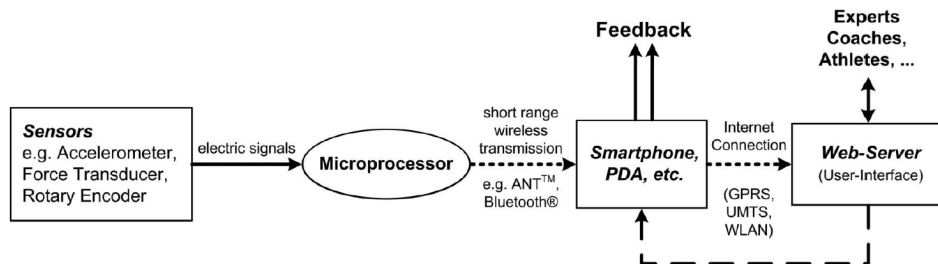


Figure 2.3: Use of external sensor and Web Server [5]

Some challenges need to be discussed when making the choices for the system's design. The selection of the equipment and protocol might be an impediment to whether the communication flows as it should because some hardware might be vendor-specific, as experienced by Schobel et al. [69], where the authors had issues regarding connectivity and sensor data packages on some equipment.

An important question remains whether to store and calculate data locally on the device or upload the data to a server. If all the data is processed and stored on the smartphone with no external communication to a server, the data is safe and only for the owner's eyes. This might be a challenge for smartphones because of the workload might be a strain on the battery, which is still considered a major bottleneck of smartphones [45]. Over time the datasets of activity tracking are more ideally stored on a server where the same restrictions do not apply. Externally storing data might also be an advantage if the user chooses to upgrade their device. In addition to having the data available on the smartphone, other platforms can be used to access the data through the web. Google Fit is an example of a platform on which data can be stored on an Android device with the user's consent. They have an open API on which developers can use when developing fitness apps, and they have clearly written terms of how to use the data responsibly, one of them being that the user can request the data to be deleted [58].

One of my goals was to determine the feasibility of the technology to aid athletes, serving them objective, real-time data, and statistics of their fitness. I also wanted to explore some of the possibilities and challenges regarding the technology. Rowlands and James address four aspects of the system design to capture and analyze data in real time [64, pp.467]:

- Operating System (OS). The OS is an important consideration since it needs to be able to easily communicate with the sensor unit without losing information and be easy to configure. This is especially relevant in real time monitoring since the data is streaming into the OS and it must be able to handle both the data transfer rate and store the data. The OS should be quick enough to running the analysis application or communicate with the data storage devices.
- Analysis Applications. The Analysis applications are an important choice based upon the type of analysis to be performed. If the data is not real time data, then the speed of analysis is not that important. However, if the data is real time from streaming sensors and needs to be displayed in real time then a fast application needs to be used that can update the display windows quickly. Interpreters or single task applications are not good for this type of application.
- Concurrency. It is useful for the system to be able to perform more than one operation at a time. This enables data capture, and data analysis to run simultaneously but separately. This is the structure that is employed by most servers which need to handle streaming data.
- Scalability. The system should be able to scale up to incorporate many sensors of many different types and connections. This will allow for multiple participants as well multiple sensors. This is important because it allows for versatility in the future.

While I agree with the requirements, I believe the focus the previous five years, has moved from a system running on a device, to make a platform suitable to comprehensively say something about an athlete's fitness. So from discussing whether the smartphone itself is capable of tracking health data of athletes, which the literature strongly support, future discussions might be concentrated around the entire platform. This includes what kind of vital data is needed to aid the athlete in getting better, and further ethical discussions about the consequences of using the data as objective data to define our health.

2.2 Young male athletes

Throughout the research project, the participants were male athletes, based on the age group that KULU is researching with, i.e. youth between ages twelve and twenty-five. However, gender is something I have to consider when assessing whom to include in my study. Fox and Duggan [22] present the demographics of the use of health apps in 2012. The authors findings indicate that there has not been a significant difference in either growth or usage by the genders. As for sports science literature, the focus on sex might be difficult to assess according to Stenberg's [78] discourse analysis of sport related research on men and women; the literature tends to lean on the male athlete as the norm for sports science.

This is a single-gender study, and therefore I am to justify my motivation for doing this, as well as my choice of gender to focus on. Even though male athletes have the tendency to be considered the norm in sports science literature, Stenberg's findings indicate that in many single-gender studies on male participants, the gender is excluded from the title, and that in single-gender studies on female participants, the gender is included. This finding is an interesting critique of the transparency related to gender selection in sports science. I want to be clear in the definition of the user group of this study, motivating the inclusion of gender in the title.

With the inclusion of gender in the title and transparency regarding the user group throughout the thesis I hope to reduce gender bias. The findings from this study does not apply to both genders, as the critique of single-gender studies has pointed out [78, 83].

The argument for doing single-gender studies is difficult to find in the research literature. However, PD studies that involve close interaction between researcher and participants might be experienced as intimate because of the personal nature of the questions when trying to understand the health issues of a person's everyday life. To avoid this problem all, the participants in this study are young men like me. It is also worth mentioning that the group of participants is clearly defined in this study and I will not generalize my findings beyond the group.

Chapter 3

Theory and Methodology

In this chapter, I will present a framework of theoretical approaches and concepts that will guide my research. The framework will help me understand the different perspectives of my research. To better understand technology and how it can have an effect on people, I will use Activity Theory (AT), which will be central in my approach to gather valuable data from my participants in the preliminary interviews. Another central concept to the way I review my research is the idea of self-quantification, quantified-self or self-tracking. There are several terms to this concept, but the main aspect is the involvement of the “self”, the way of seeing a person by itself, without considering the outside. Moreover, looking at the self as numbers and data, ready to be interpreted by the self. Lastly, to better understand the perspective of the person behind the data, I will reflect on my data and analysis through the concept of Lifeworld. This will enable me to understand how life is lived with the apps as a part of it, and increase the value of my gathered data.

This chapter is structured as follows. First, I will present the topics in relation to the field of human computer interaction, namely Self-Quantification and Activity Theory. Then introduce the phenomenological concepts of lifeworld and the lived body.

3.1 Human-Computer Interaction

As a research field that has rapidly developed since it emerged in the 1980s, HCI creates the frame that is the field of research for this thesis.

“HCI is taught now in many departments/faculties that address information technology, including psychology, design, communication studies, cognitive science, information science, science and technology studies, geographical sciences, management information systems, and industrial, manufacturing, and systems engineering. HCI research and practice draws upon and integrates all of these perspectives.” [11, pp.28-29]

Being a multi-disciplinary field, including theories and perspectives from, among others, psychology, social sciences and of course, computer

science, it frames my research project in a way that certainly needs its boundaries in which I will operate within [11]. The following concepts fit inside the frame of HCI, which allows for thematic width, looking at the research area from different perspectives. The phenomenological concepts presented later in this chapter is presented outside HCI, but I will use it as an active part of my theoretical framework to explore issues related to the research.

3.1.1 Activity Theory

Rather than being a "strongly predictive theory", AT can be described as a "powerful and clarifying tool" to understand the relation between context, consciousness and activity [52, pp.4]. AT is highly applicable and adaptable to put activity into a system. Having roots in social sciences, AT looks at the human and social aspect and reflects upon how tools can enable the human to create outcome by reaching an objective. It is a way of looking at the structure of activities, through the relationships between subject, object, and tools. The model is further expanded by looking at the roles of rules, community, and the division of labor, to get a richer look at the context in which AT is used [20].

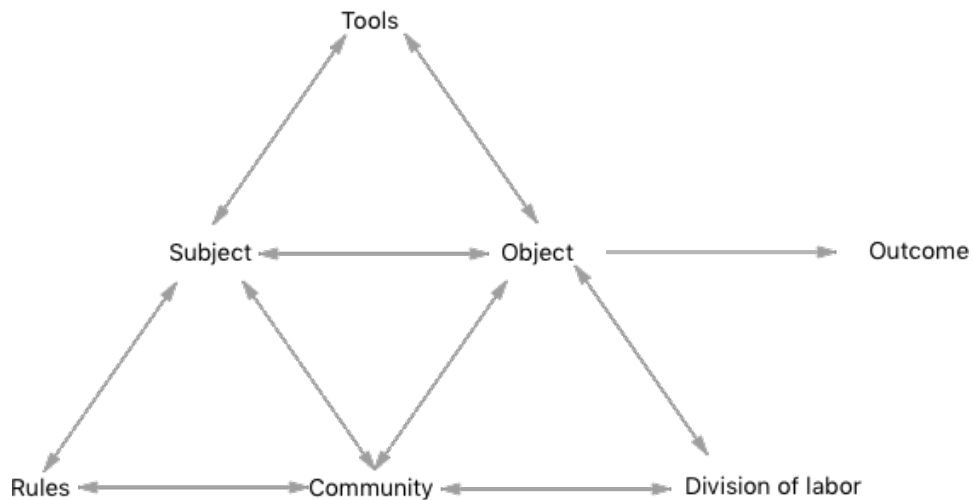


Figure 3.1: Model of Activity Theory based on Engeström [20]

The pervasive model for AT that has been widely used by AT theorists (figure 3.1), shows the different constructs of the figure in relation to each other. The figure is made after Engströms [20] model for AT, but slightly simplified in this overview to give us a clear idea of the structure of activity. The model can be thought of as a set of triangles with their relations, coming together to form an activity, motivating the outcome of the activity. The complexity of the model varies depending on what field AT is applied. The structure can be applied to a single activity in a certain context or a whole system of activities.

The subject is the individual set to do the activity or action which is necessary to reach the object with its consciousness, skills, experiences and

memories. This plays a role in the relation with the other parts of the model. An essential part of AT is that the subject's relation to the object is mediated through the use of tools and artifacts, and not only through the subject itself [20, 21]. The tools or artifacts the subject interact with can be completely tangible, for example when a person uses a hammer to nail down a nail into a piece of wood. The example is a classic subject, tool and object scenario where the outcome is formed in the relation between them. The tool can also be less tangible, in the form of methods, procedures or laws, the last one not to be confused with rules. The intangible tools can be related to the use of tangible tools in the form of technique, such as a way to hold a hammer, or a way to approach an objective with a particular mindset.

A central element in AT is that the relationship between subject and tools are strongly connected and that the use of tools are mediated through the experience and the consciousness of the subject, being dynamically adjustable and historically rooted in the subject. It can be both enabling and disabling depending on the mediation, which can be a strength when discussing the subjectivity and adaptability of the theory. In the same way as a tool can be physical or abstract, the object can have similar traits. The object can often be regarded as the goal, and as the model shows, the outcome is directly related to the object. If the object is material or more abstract depends on the context the activity is in, which will be looked more closely upon in the next paragraph. To summarize, the relation between subject and object is mediated through the use of the tool [53].

So far, half of the model is described, and we have a simplistic model to describe an activity. In order to say something about context, the model is expanded with rules, community, and division of labor [53]. Rules are for the subject to maintain when doing the activity, whether the rules are the law or simply acceptable behavior. The rules are firmly connected to the community which the activity is a part of. The community defines the role of the subject in the activity, which again says something about the division of work, what tasks are the subject expected to do and what is done by others in the community or done by tools or artifact.

An example to concretize the model: A software developer, with his or her consciousness, experiences and memories, have an objective to develop a module to a software product. The developer has tools, tangible and intangible, a computer with an environment for developing software, as well as a method using the tools. As a part of a team, the developer has a community to work with, and with the community, a set of rules. The rules can be related to whether the community demands a particular way of writing code, non-disclosure agreements or law. Also, as a part of the team forming the community, the division of labor can tell us something about what is done by others for the team to reach the object. This structure of activity is meant to help us understand outcome, what thoughts are behind, and why an activity is done in a specific way.

The basis of AT is older than many of the terms used in the application of it in modern research, having roots in Soviet psychology [20, 29]. This is where AT meets HCI, because of the need to put HCI activities into system to analyse them. A point made by Kaptelinin, who argued that these questions

fall outside the scope of traditional HCI research [27]. By looking at the early days of HCI, he points out that it was important to understand tasks, and motivation behind the tasks, and how the need for this perspective has increased over time. The next section will look at how AT is introduced in the research field of HCI.

3.1.2 Activity Theory in Human-Computer Interaction

Depending on the perspective chosen to look at the relation between human and computer, one might argue that AT offers a rich perspective which is critical to understand context, activity and practice [53]. This point of view is realized, not through static procedures for research which are preferred in quantitative studies, but as a more conceptual framework for extracting the notion of the specific field. In this thesis, given its qualitative nature, I consider AT to be useful in HCI and that it offers a rich theoretical insight to real activity and use within my project.

AT was introduced in HCI at a time when there was a theoretical uncertainty regarding the HCI field because of the lack of research related to it [28]. In the mid-nineties, AT was introduced as an alternative framework and was soon widely discussed in HCI literature. Now, empirical studies can use AT as a theoretical framework within HCI, and as will be discussed in the next section, its adaptability as a framework to fit new fields. I will also look at the strengths and weaknesses and reflect upon my theoretical scope according to this. The problem when discussing AT in HCI is how to make sense of all the actions and activities going on. Engeström [20] has been very successful in unveiling the patterns of AT in HCI, and creating a consistent model that breaks an activity into smaller units to be analyzed, which figure 3.1 is based on. When breaking a series of actions down into smaller pieces, the researcher can discover what the author calls disturbances and contradictions. This can then be used to analyze the potential of change in the activity, which as an analytical tool is especially useful in HCI because of the complexity of the interaction and tools, making it possible to analyze and change patterns of use, with a focus on the mediation through tools.

It is important that my application of AT is coherent and thorough because the implementation of the theory itself can be a weakness because the researcher and its skillset are prone to errors in qualitative research. An objection to AT is that it is hard to learn and use, especially in the early days when there was a lack of empirical research to back the use of it. Therefore, I want to look deeper into how AT can be applied to my field of research. The more specific my theoretical framework is the lesser margin for error.

3.1.3 Activity Theory in health apps

Tracking health by using mHealth technology, is a recent activity that in many ways are ideal for applying an AT framework upon. Health apps might help athletes reach a goal, or the desired outcome they have from using the app. On the other hand, the whole process of reaching the goal might be frustrating for the user, causing them to lose motivation and stop

using the app. AT can give us a way to systematically look at how activities regarding SQ are organized, providing a way to understand why athletes succeed or fail to reach their goal or why the outcome is the way it is. Almalki [2] presents a framework for describing SQ-practitioner's activities by using AT. She believes that by using AT, one can better understand the context, goals, and outcome, and a strong argument is that the activity is fully operationalized in AT, i.e. the outcome of the activity is a result of either all or some of the AT constructs. I will apply AT to my data to say something about the SQ activities, more specifically, the activities of the athletes I have as participants in my interviews and workshops. AT will be used as an analytical tool for understanding the SQ activities of my participants. I will use Almalki's proposed framework together with a *thematic analysis*, which will be further explained in chapter 4.

So far I have introduced six constructs of AT which I intend to use in my analytical toolbox, which is subject, object, tools, rules, division of labor and community. Although there are not any studies that account for all of them in depth, according to Almalki [2], it is important to include them as a part of my framework to reduce the risk of missing important data. The way I understand it, the literature tends to focus on three constructs, namely subject, object, and tool. An explanation for this may be in the complexity of the analysis, and whether the constructs is within the scope of the research.

I want to make a theoretical contribution to AT, by looking at how it can be operationalized, or applied, in a PD process. Some studies on the relation between AT and PD has been focused around how to understand the PD process by looking at the activities done through the lens of AT and analyzing it systematically. Iversen et al. [24] introduce an interesting study where they seek to understand the motivation among teenagers to participate in a PD process through AT. Although this might be interesting to have a further look at in my study, my contribution is not to the methodology itself, but rather towards the results from the PD process. The next section will be about SQ, what it is, and how it is relevant to my thesis.

3.1.4 Self-Quantification

The concept of SQ can be regarded as a way of making data from our bodies, gaining insight that is not typically a subject of reflection beyond physical sensations [65]. This includes data like weight, heart rate, sleep, blood sugar, food, fluids, exercise, temperature, and much more [2, 15, 44]. The concept may also refer to self-tracking, life-logging, self-monitoring, and self-optimization, depending on who is writing. [1, 2, 41, 42, 44]. There are nuances to what the action is referring to, whether it being a specific body functions under surveillance which can be an example of self-monitoring, while self-optimization might refer to a goal for the tracking of health data [3]. As Almalki [3, pp.1] also points out, the concept of SQ can be seen as "an emerging paradigm for health care self-management". Looking at it as a paradigm, I can assume the other terms are included in the definition of SQ, which can be fairly broad like in the aspects mentioned above. I will consequently use the term SQ when approaching this subject, not excluding

the other terms as they often mean the same thing. This being said, I will do my best to avoid confusion regarding the concept by looking at the context it is being used to ensure that it is, in fact, the same terminology.

There are different ways to look at the consequences, benefits, and implications of SQ, especially concerning mHealth apps. The following section will discuss literature related to different perspectives and attitudes towards the subject.

3.1.5 mHealth and SQ

In recent years, SQ has been implemented through the use of mHealth applications [33, 34]. The most important feature of an mHealth application is the ability to give the user feedback on relevant data about their bodies, whether it being data about sleep, lactic acid values or heart rate. mHealth applications can be considered as vital tools for SQ activities, since it enables technology to say something about the self, through precise sensors and tracking standards. The apps offer rich data about the user's activities, displayed in the manner the creators intended.

According to Lupton [44], the literature on SQ in mHealth has been overwhelmingly positive, giving her motivation to apply a critical sociological perspective on the field. Lupton does this by shedding light on what authority we assign the numbers and values in the respective mHealth apps, rather than being able to reflect on their bodies without the extensive use of health data. Self-knowledge is, in this case, an appropriate word to use within the concept of SQ to describe this.

SQ will be revisited and more thoroughly discussed up against lifeworld in the discussion. The next section of this chapter will introduce phenomenology and the concept of lifeworld.

3.2 Phenomenology

My motivation for including phenomenology in my theory chapter is that I am interested in a concept originating from phenomenology, namely *lifeworld*. So before going into the specifics of lifeworld and why it is relevant in my research, I will present phenomenology.

Phenomenology is a philosophical branch that is concerned with human experience and subjective truths rather than truths independent of our experience when it comes to answering questions about the study of nature and knowledge [18]. Developed in the late eighteenth hundred by Edmund Husserl, and further developed over the next century, the focus in phenomenological philosophy fits well with some aspects of modern HCI research [17]. Themes like embodiment and affordance can be discussed through a phenomenological lens, giving the researcher the task to look at how people experience the world through acting in it in different contexts. Context is also a central theme discussed, more recently in the literature about context-aware computing which looks to phenomenology for a foundation [50].

By including phenomenology, I seek to understand how health technology can be experienced, not just as a way of quantifying life, but to understand the qualitative sides of life. Through living subjectively and intersubjectively, people give the world meaning by acting in it and gaining experience. Husserl's concept of *lifeworld* is about the daily lives, understanding an action in a specific context. The next section will be about lifeworld, a theoretical concept within phenomenology, which provides width to my overall theoretical lens.

3.2.1 Lifeworld

As a theoretical contrast to the concept of SQ as described above, the idea of *lifeworld* acts as an important part of my thesis. It is a contrast in a way that it enriches my perspective of my research, providing the qualitative view where SQ provides the quantitative view.

Lifeworld seeks to understand how the world is experienced subjectively. Although we as humans might have an implicit understanding of what experience is, lifeworld is a way of making this applicable in research. The relationship between a person and the world is world-to-consciousness when it comes to looking at reality, which focuses on subjective experiences [81].

Van der Velden and Sommervold describe lifeworld as: "the world of lived experience or the beginning pace-flow from which we divide up our experiences into more abstract categories and names" [85, pp.215]. Related is the term lived body, which relates to how the body is experienced by the self and as being-in-the-world. Van der Velden and Sommervold's contributions were in the author's study made through a lifeworld-led design approach, letting the participants express themselves through their lifeworld.

My discussion will be formed around the dimensions of lifeworld, with an emphasis on the lived body as a theoretical counterbalance to SQ. There are five dimensions within lifeworld, which attempts to answer the "what" in the relation between the human and the world, these are: *temporality*, *spatiality*, *intersubjectivity*, *embodiment* and *mood* [81]. These will be presented shortly here, as they are presented by Todres et al. [81], then revisited in the discussion in chapter 6.

- *Temporality* refers to the experience of time or the relation to it. Not in the linear sense, but rather how the future, past and present is experienced and how it makes us feel. This is an important aspect when it comes to, for example, the humanization of healthcare.
- *Spatiality* considers the environment and the circumstances of the subject. The surroundings and how the subject feels about the distance to the environment.
- *Intersubjectivity* refers to how the self relates to others as a reference for its own experiences. The way interaction with others is experienced can be experienced as humanizing or dehumanizing. In this way,

subjects are interconnected, affecting each other and their experiences either consciously or unconsciously.

- *Embodiment* might help us understand how the "here" of our lived bodies, as it is experienced and feels like. It provides a rich description of how the lived body feels like together with the three previous concepts.
- *Mood* is the most abstract concept, and can only be described in a qualitative way. It is also complex in the way that it can be difficult to explain with words. It reflects our "being-in-the-world", and cannot be separated from the lifeworld.

3.2.2 Why include lifeworld?

Todres et al. [81], and, van der Velden and Sommervold [85], use lifeworld in a healthcare setting, pointing to the dehumanization of healthcare, with its focus on numbers, partial goals and diagnosis and not the lived experience of the patient. A crucial assumption for me is that this also relates to athletes and that their lifeworld can be humanized or dehumanized through the experiences of using health apps. The qualitative dimension needs to be understood as SQ mainly focus on quantitative values, that is why the inclusion of lifeworld is necessary.

In my study, I want to explore how young athletes relates to health apps as tools to become better at what they do. To understand the perspective of the athletes concerning health apps, I want to get a better understanding of their lived bodies, and how they experience their health and their bodies through the apps. I want to use this knowledge to design for the whole person, and not the compartmentalisation that SQ can result in. By using the five concepts of lifeworld presented by Todres et al. [81], I seek to explore the nuances of lived experience each concept provides.

3.2.3 Lived body

To supplement the discussion of the tension between lifeworld and SQ, the need to explore a dimension which is encompassed by lifeworld arise, namely the lived body. This has made me include new literature on lifeworld, and the immediate observation is that different terms are used to describe the same dimensions of the lifeworld. First, I need to show the lived body as a part of the lifeworld. As mentioned above, Todres et al. [81] use five dimensions to describe lifeworld, namely temporality, spatiality, intersubjectivity, embodiment, and mood. Additional literature use four dimensions to describe it, seemingly excluding mood as a dimension [57, 80]. The four dimensions to describe lifeworld used in Pettersson et al. [57] are lived body, lived space, lived time, and lived relation to others. I argue that these two sets of dimensions are comparable; spatiality equals lived space, temporality equals lived time, intersubjectivity equals lived relation, and embodiment equals lived body.

Based on this, I see that lived body was introduced previously as the embodiment dimension of the lifeworld. As I look more in-depth, I need to present how lifeworld encompasses lived body. Further explained by Toombs [82], who uses a similar definition as van der Velden and Sommervold [85], which is being-in-the-world:

“As an embodied subject, I find myself always within the world, always in the midst of environing things. I am "embodied" in the sense not that I 'possess' a body but in the sense that I *AM* my body. Rather than being an object *of* the world, my body is my particular point of view *on* the world. Indeed it is by means of my body that I have access to the world in the first place.” [82, pp.202]

Toombs view the lived body as a personal embodiment, in the sense that a change in the body is the same as a change to the being-in-the-world [82]. Furthermore, he uses the example of illness being able to disintegrate the lived body. As my participants are not struggling with illness, I have to look beyond the example and consider other factors having the potential of disrupting the lived body. Having a clearer understanding of the complexities regarding the lived body, the discussion will focus on the challenge of designing for the lived body, but not excluding the other dimensions.

To gain the knowledge that I want from the design process, I need a methodological framework that facilitates the acquisition of data related to the participant's lifeworld, i.e. my reason for choosing the methodological framework that I have is rooted in the lifeworld and the need to explore the lived body.

3.3 Methodology

The knowledge in my thesis is constructed from an epistemological point of view, more accurately an application of interpretive research, which fits well with PD [77]. This section will look into the philosophical questions related to the views of knowledge, and let that permeate the process, from data gathering to analysis, discussion and lastly, conclusion. This chapter will look into what a methodology is and why it is important to have methods in a research process. The next section will look at PD, which is my choice of methodology. There I will discuss how to conduct a PD process and how it can enable me to generate knowledge. In contemporary science, the choice of qualitative research methods is determined by the context and aims for the research. An assumption is that a specific context and aim of the research requires a specific set of methods to generate sufficient knowledge. The research context and aims motivate the choice of a methodological approach, which in epistemological terms does not claim to be objective or reproducible as for example the scientific method, but rather wanting to create knowledge within a particular context, often based on social construction [79].

This claim relates to Carter and Little's [12] definition, and they elaborate by calling it a justification for the choice of methods. The analogies are many, for example calling a methodology a recipe, indicating if you follow a certain set of steps and values that you will get a somewhat desired and consistent result. I think qualitative research is different from this analogy because even if the same procedure is followed, the results might be very different through the eyes of the researcher. Carter and Little [12] refer to the work done by Creswell, comparing different qualitative methodologies, considering them all to be "internally heterogeneous, dynamic, and evolving" [12, pp.1318].

The choice of methods should always be explained and discussed. Methodology gives us a platform for discussing which methods fits a certain research. Participatory Design is the methodology I have chosen to shape my thesis. I will use the rest of this chapter to introduce the key concepts of Participatory Design, and how it will help me to create knowledge in my research.

3.3.1 Participatory Design

Simonsen and Robertson [73] define PD as:

"a process of investigating, understanding, reflecting upon, establishing, developing and supporting mutual learning between multiple participants in collective 'reflections-in-action'. The participants typically undertake the two principal roles of users and designers where the designers strive to learn the realities of the users' situation while the users strive to articulate their desired aims and learn appropriate technological means to obtain them." [73, pp.2]

In addition to being a part of KULU, the motivation behind choosing PD as the methodology is because of its connection to the participant's lifeworld. It facilitates a base for understanding the participants through its values that will be presented in this section.

As a methodology, PD is not as well defined regarding which methods that should be used to gain knowledge from the participants [30, 32, 77]. According to Khaled [32], it is "extraordinarily diverse and this diversity has not lent itself to a single theory or paradigm of study or approach to practices" [32, pp.458]. It is also diverse in the sense that it is about design as well as research. So the methods could be everything from interviews to observation, but the point is iterative *co-creation* and *mutual learning* [77]. Moreover, as the participants have two roles researchers need to consider, the choice of methods needs to be carefully considered, which in my thesis will be presented in chapter 4.

A PD project strives for actual user participation in the design process because it is a given that designers cannot fully understand the needs of users [32, 60], which points to a need for an understanding of the lifeworld. It is not enough for the researcher to merely interpret interviews done at a workplace, as users should be regarded less as informants and more like participants, which are going to be directly affected by the project. Bødker,

Kensing and Simonsen [8] argue that there are pragmatic and political reasons for striving for genuine user participation. The pragmatic argument is regarding the goal that *mutual learning* will be fruitful when done in the right conditions. Simply *having a say* about the practice of your daily work routine, can be a political argument about workplace policies and rights, stemming from the roots of PD [73].

The central concepts of PD are further explained by van der Velden and Sommervold [85], Kensing and Munk-Madsen [31], focusing on circumstances that enable the participants to contribute. To utilize PD within a certain set of frames, I will use the SHARM approach presented by van der Velden and Sommervold [85], which is a coherent presentation that relates to my project, being within the KULU research scope. However, I have to keep in mind that this framework was tailored for a hospital setting which is far from the reality of my participants. So when planning my research within the SHARM framework, some definitions need to be adjusted to fit my scope, which will now be presented.

SHARM is an acronym, consisting of three concepts that can be regarded as central in PD, namely *situation-based action*, *having a say* and *mutual learning* [86]. The other two, *adaptability* and *respect*, have a less direct connection to PD but I will argue that it is important to utilize the other concepts and to be context sensitive. *Situation-based action* urges me to base the design activities in the participant's everyday lives, in their lifeworlds. *Having a say* says something about facilitating a process where the participants have actual decision-making power over how the design should become. I want to be *adaptable* in my choice of methods, in the sense that allows the participants to express themselves freely. I also want to *respect* the participant's entitlement as experts in their lives, not going in with the intention to tell them otherwise. Moreover, lastly, I want to facilitate *mutual learning*, which seeks to enable the participants to learn as much from the process as the researcher [86].

The SHARM framework gives me a base on which I can decide which methods to implement in my study. The choice of methods is made to accommodate the framework and its concepts. The next chapter will give an overview of which methods I have chosen, and the reason behind using them.

Chapter 4

Methods and Ethics

In the field of HCI, there are a large number of qualitative research method to choose from, everything from ethnography to surveys [7]. When considering which methods to implement in the study, one has to look at the purpose of the study. Blandford [7] makes the argument that the choice of methods has to answer the purpose and context of the study, which in my case would be to research how health apps support young athletes in a participatory design process. Further, I agree with Blandford [7] that there is not a single right way to conduct a qualitative study, and as Willig [89] explains it, "Strictly speaking, there are no 'right' or 'wrong' methods. Rather, methods of data collection and analysis can be more or less appropriate to our research question. Having formulated a research question, the researcher needs to make a decision about how to collect the sort of data that can answer that question" [89, pp.28]. If the choice of methods is justified, then a useful understanding can be developed from the gathered data and analysis. As mentioned in the previous this chapter, methodologies give us a frame for which methods are more "appropriate" than others in for that specific purpose and context.

The following sections will present and justify my choice of methods to gather and analyze data, as they were chosen in order to understand participants experience using health related technology. The methods are presented chronologically as they were implemented in my project, and the implementation itself is presented in the next chapter.

4.1 Scoping the field

As a subset of scoping studies, scoping interviews are an effective way of exploring assumptions about a user group. Befring [6] argues that its relevance is highest at an early phase of a study. As the name indicates, the motivation behind doing it could be based on an interest in exploring a field of research that has not been extensively studied. Though it lacks a formal framework, scoping studies occur in qualitative research as a way of uncovering and mapping broad concepts [37], often in the form of an interview [25], which is what I will focus this section on.

"Scoping interviews refer to a small, loosely-constrained, loosely-focused and loosely-structured series of interviews. These are designed to evaluate, ground and refine the initial understandings, assumptions and concepts of a research." [62, pp.517]

The definition presented above by Robertson et al. [62] fits well with my perception of what a scoping interview is. It is in every sense of the word an interview, but with a very specific purpose that might serve well during a qualitative research project. Instead of giving an in-depth understanding of the topic of the interview [36], the scoping interview will seek to map key concepts [4], or to get an overview of the HCI problems. As it is referred to as a loosely constrained, loosely focused and loosely structured method, I make the assumption that it is similar to an unstructured interview, which I will cover in the next section.

The sense of scoping refers to the field. The method will be implemented at the beginning of my exploration of the themes and user group. It is fairly easy to design and conduct, letting me focus on how to facilitate initial understanding of the topics. These understandings will hopefully permeate the thesis by setting the direction or adjusting the scope to what is interesting in the field, giving me a base to drive the project further.

4.2 Interviews

The purpose and context of my research, i.e. a qualitative study within a context of HCI with PD as my methodology, leads me to believe that interviews will be useful to gather data to answer the research question. Interviews are a good way to involve interested individuals to get answers that go in-depth as opposed to research methods that tend to lean towards a more quantitative tradition, for example, surveys [36]. Rogers et al. [63] describe interviews as a "conversation with a purpose", which I will argue are an oversimplification of what a conversation is and the potential of it. I believe the nature of a conversation is more on equal terms in the form of the exchange of thoughts and ideas than an interview, which has a clearly one-sided agenda, which might be the "purpose" they describe. Befring has a more clinical approach where he describes it simply as the contact between an informant and a researcher, where the interaction is that the researcher asks questions and the informant answers them, facilitating the collection of data based on the topics the researcher asks the informant. He further describes interviews as challenging, flexible and academically valid [6, 36].

Rogers et al. [63] presents a threefold spectrum of approaches on how to design an interview, namely unstructured, semi-structured and structured interviews, where the spectrum represents the control the interviewer has. The choice of method is reliant on how the researcher approaches the task of conducting interviews to answer the research question, which in qualitative research will always vary based on the researcher [36]. It is the researcher's task to determine the user group and collect participants to fit

that group, and to design an interview guide that brings the answers close to the area of research by formulating questions and potential follow-up questions. The selection of participants is explained in chapter 5, as well as the implementation and results. The rest of this section will focus on how an interview can be designed, and explain the reasons for my choice of design.

4.2.1 Structured interviews

A structured interview is on the border line of a quantitative research method because of its similarities to questionnaires and surveys [6, 36, 63]. Questions asked bear the resemblance of a survey regarding the closed, alternative based questions, leading to broad insight. If this is the case, then the strongest argument for conducting an interview, which is the ability to gain in-depth knowledge, is not as apparent as it otherwise would be in the other disciplines.

In the context of a study that is reliant on interpreting participants' experiences with mHealth technology, the need to go in depth is a feature that is not within a structured interview and is, therefore, not relevant for my study. However, having a structured approach to the process of designing an interview would mean to not rely fully the researchers on own skills in the interview process, which could deal with some of the challenges related to the process due to lack of experience.

4.2.2 Unstructured interviews

At the other end of the interviewer control spectrum, there are unstructured interviews. These are the opposite of structured interviews regarding openness, and are often interested in opinions and feedback that goes deeper than a question with predefined options. A phrasing would typically be: "what do you think about...?" followed by a theme, which allows the researcher to pursue the trail of the answer to seek out interesting content, so the depth is determined by how many follow up questions the researcher asks [36, pp.194]. The pro for this approach in qualitative research is the ability to go in depth into the participant's experiences and get rich data. Ideally, the method is conducted where the goal for the study is not yet fully established to make full use of its flexibility [63], for example, the scoping interview as presented in section 4.1.

4.2.3 Semi-structured interviews

As a compromise between the two abovementioned approaches to design an interview, semi-structured interviews gives researchers the best from both control and flexibility in interviews [63, 76]. The method ensures that the researcher follows a list of topics to be covered, and at the same time have a clearly defined goal for each topic, so the conversation does not go completely in a different direction than intended. It also allows the participants to answer freely within a frame set by the researcher, which means that the preparations and execution of the interview demands focus

and skill to facilitate rich data. I will conduct semi-structured interviews in my study, based on the proposed six stages from Legard et al. [61, pp.145]:

1. Make the interviewee comfortable by creating a stable atmosphere in case there is uncertainty or anxiousness before the interview begins.
2. Introduce the research to set direction. Explain the different topics related to the research that the interviewee needs to be introduced to before talking about them. Explain how the data will be handled.
3. Begin the interview. Start voice recorder and begin with slightly open, easy questions to get the interviewee into the right mode.
4. The main body of the interview is where the topics are discussed by asking questions and follow up questions to go deep into the topic.
5. Letting the interviewee know that the interview is coming to an end allows him or her to gather their thoughts and reflect upon their answers before the time is up, in case there should be any last minute thoughts that might be interesting to the research.
6. End the interview by thanking for participation, explain again what will happen to the data they contributed, and what is the next step in the research.

4.2.4 Why interviews are relevant

The results of the interviews will be determined by what I ask, how I ask it and whom I ask [36]. As already mentioned, this can be a challenging process because of what it demands from the researcher concerning conversational and observational skills. Making sure the right measures are taken before, and after each interview, it can contribute hugely to my thesis as a whole, giving me data that will be a base for the rest of the research process. I have had previous experience conducting semi-structured interviews as part of gathering data from users in other design processes, which will help me handle some of the challenging aspects of planning and conducting the interviews.

4.3 Thematic analysis

As a method for organizing and exploring patterns, thematic analysis can be used to describe data sets in rich detail. It is useful when it comes to qualitative research, and is therefore widely used as it supports qualitative descriptions, i.e. reporting user experiences and realities [84]. According to Braun and Clarke [10], there is no agreed way of how to do a thematic analysis, or even what it is. So maybe it fits in the context of a qualitative research because of its flexible characteristics, and maybe we can argue whether every thematic analysis is unique as well. This section will present the suggested approach to it as presented by Braun and Clarke [10].

Even though there are not many clear lines on how to do a thematic analysis, there are two distinctions that I will make to what perspective to view the data from, and that is whether my analysis is deductive or inductive and whether it has a semantic or latent level of analysis [10].

The process of identifying patterns and themes are essentially twofold, inductive and deductive [10]. An inductive thematic analysis is a bottom-up, data-driven approach that has similarities of a method where theoretical preconceptions are not as important as the data itself. Deductive, also named theoretical, thematic analysis is at the other end of the scale. Highly driven and motivated by theoretical conceptions, looking for aspects of the data that fits into a theoretical framework, and analyzing that data extensively, gives a rich description of some of the data [10].

A choice has to be made whether the analysis should be at a semantic or latent level. As presented by Braun and Clarke, the decision is whether to look at the surface of the data, i.e. take what the participants say directly as findings, or add a layer of interpretation between the data and the analysis, which is the latent level. If I want the analysis to transcend the sets of data in my research, from different participants during the interviews onto the first workshop, I want to look at the underlying factors and meaning in what the participants are saying.

With the approach set, the actual execution remains. This is where there is no agreed way, but the notion of it consists of getting familiar with the sets of data through an iterative process of coding and analyzing data. When the data has been coded and reviewed against each other and the original data set, the themes can be seen as a summary of the coding process, a comprehensive mapping of the data, organized in themes [10].

Based on the presentation of thematic analysis, and in the context of my thesis, which is a PD design process where I conduct, among other methods, a semi-structured interview, I want my thematic analysis to have a deductive approach with a latent level of interpretation. This means that when analyzing my data, I focus my understanding of the theoretical framework which I am operating within. It also means that the analysis is highly data driven. This will prove useful to uncover themes across the data sets in the interview process, which with its semi-structured approach might address many different experiences, but cover the same thematic ground which the analysis can organize.

4.4 Future workshop

A future workshop is a tool in common in PD that is intended to give rich, detailed data about user experience. It is well within the methodological bounds of PD because it evokes empowerment of users, mutual learning, teamwork and democracy [87]. This section will further look at what a future workshop is and why it is relevant to my thesis.

Workshops typically have an agenda to gather users to do activities meant to facilitate understanding of a topic. The agenda of this type of workshop is to criticize the current situation, dream about the perfect

solution, then propose a realistic solution to the critique.

Vidal proposes a comprehensive description of a future workshop containing five phases, where the first and last are phases, namely preparation and follow up, is common for most types of workshops, so it will not be covered here. Instead, I will focus on the three central parts, which are: *critique*, *dream*, and *implementation* [87].

- Critique: Raising issues and problems concerned with the participant's experience of use. Brainstorming is a technique common to the phase, seeking quantity of content to drive the workshop further [87].
- Dream: Exaggerate the potential of future technology to fit a solution to the problems experienced, without thinking uncritically on the restrictions of reality. "Any useful statement about the future should at first appear to be ridiculous" [16, pp.4].
- Implementation: Also called the reality check. At this stage, the participants look at what they have contributed in the dream phase and try to think of possibilities that are realizable using current technology. Make concrete ideas to solve issue and prioritise them [87].

As a method, the framework of a future workshop acts more like a guideline than a recipe, given the analogy that a recipe is something to follow strictly as a way to approach it. Because it can be regarded as a guideline, it fits well into my frame of research, where I need to implement flexible methods to fit my qualitative approach. The method will be used during the first workshop in the next chapter.

4.5 Prototyping

Prototyping is a method used to explore alternatives for design before the product is finished, and is one of the core activities of interaction design [63]. Prototyping can be motivated by the possibility to explore different solutions in order to find the right one. As a method it can be quite powerful as a way of intertwining analysis and design, engaging the participants in the process of exploring new design solutions. "In this way, users who 'do not know what they want before they see it' can see various possibilities open up and hence develop a sense and an opinion of what they really want" [9, pp.134]. PD emphasize on the relation between analysis and design in prototyping as a way of understanding context through analysis and explore opportunities through design.

There are many different ways of prototyping, ranging from low- to high-fidelity, as well as motivations for prototyping, from clarifying requirements to exploring alternatives. Hence, the process depends on what stage the project is in, and who the participants are and what they are requiring. This section will present the different approaches to prototyping and why it is relevant to implement an interactive prototype in my project.

The distinction between a low- and high-fidelity prototype, according to Houde and Hill [23], is found in how close to the finished prototype it is. Low-fidelity prototypes are an easy way of exploring design, including elements that are not necessarily in the final product or design. It is a quick and cheap way of making the design, regarding it as useful in the early stages of a design process [36, 40, 63, 66]. On the other side, prototypes made with high fidelity are regarded more close to the final product, for example sharing the same platform of use.

I find both approaches to be important in my project for different reasons. In PD, low-fidelity prototyping can be seen as a tool for dealing with communicative issues that might arise during the project [9]. In this way, I can help the participants express themselves and their ideas through making prototypes, and at the same time facilitate mutual learning. This can be done by creating design alternatives for the participants to decide which content goes into the prototype, i.e. create a paper prototype, which I will do in my project.

Liu found that a paper prototype was insufficient because of its low fidelity and that an interactive prototype is a good supplement to explore its usability [40]. Prototyping is a technique to show the participants technically possible solutions, letting them apply their knowledge and experience to evaluate the adequacy for their usage. Bratteteig [9] describes tangible artifacts as a prototype when making the point, but I believe it also can relate to an interactive screen based prototype as well. By letting the users evaluate an interactive prototype, the point is to get a richer evaluation, as done by Liu [40].

To summarize, the prototyping process, presented in section 5.4, will consist of two parts in my project. The first part will be a low-fidelity, paper-based prototype with high-fidelity graphical content for the users to participate in the making of it. This solves the communicative issues, and even more importantly in a PD context, contributes to co-realisation [9]. The second part will consist of an interactive prototype, which has a higher level of fidelity. I chose to make an interactive prototype to, not only follow the methodological narrative and flow of my project, but to facilitate PD by including them in a higher level of the decision making.

Prototyping will happen between the workshops, ensuring the flow of the design process.

4.6 Design evaluation

Evaluation is essential to verify the results of the design process so far. In PD, the evaluation would consist of feedback from the participants and is one of the concluding steps of the design process before another iteration can begin [9]. Integral to the evaluation is the inclusion of participants who, in the context, has been a part of the whole process. By evaluating, an assessment can be made whether the results was a success, and the contributions are results themselves, or if the goals were not met. In the latter case, the contribution of the project might point back to itself, leading

into the preparations for a second iteration [8, 9].

In this project, the participants are going to evaluate a high-fidelity prototype. As proposed by Bratteteig [9], the evaluation that happens while pretending to be in a work-like context is desirable when evaluating with users. While this might be difficult to accomplish, I will strive to bring out the personal experiences and competence from the participants by asking them to reflect on their needs and previous experiences.

The purpose of the evaluation is, as mentioned above, to gain insight to whether the goals of the project was met. After the evaluation and the required changes to the prototype is implemented, the first iteration could be considered completed, concluding the use-oriented design cycle presented by Bratteteig [9]. This also concludes the design process.

4.7 Ethics

The choice of methods is an ethical assessment, which influences aspects that dictate how I proceed in the different methods, how I handled the gathered data, and how I position myself as a researcher. As mentioned in the previous chapter in section 3.3.1, the SHARM approach was the framework for which I conduct a PD study. This gives me a foothold to make ethical considerations based on the context of the study. The SHARM approach consists of *situation-based action*, *having a say*, *adaptability*, *respect*, and *mutual learning*. Viewing these as ethical guidelines, keeping them in mind as I make interview guides and plan the workshops, ensures that the participants' interest and integrity are considered, as well as the goal of the research. I want to develop questions throughout the different parts of the process that respects the participants as experts of their domain, not degrading or making them unsure about their experiences. I also want the research to happen within a comfortable time frame for the participants, not making them have to reschedule workouts by being adaptive to their lives. To summarize, the SHARM framework helps me relate to the participants by choosing methods that ensure their experience and opinion. The rest of the section relates to concrete measures for handling participants and their data.

4.7.1 Handling participants and their data

I made three considerations regarding the formal ethics in my project, which all affected how I handled my research data.

1. **Informed consent form:** Informing the participants of their rights as they contribute to my study. Terms to which they gave oral consent. The form can be found in the appendix A.
2. **Audio recordings:** An audio recorder was used during ever data gathering session. After the session had been completed, the recordings were transcribed and deleted.

3. **Photos taken during workshops:** A camera was used during the workshops. The participants will not be identified in the photos taken, only their hands or back were included.

To summarize, throughout my data gathering process I want to have a *privacy by default* approach. This means that the participants cannot be identified in the data, and the names of the participants are never written down in the same place or connected to the research.

Chapter 5

Implementation and Results

The previous chapter described the choice of methods and justification for those choices; this chapter will present the implementation of those methods and the results. My project has had a flow of data, a direction of where my research was going. To get an understanding of the direction, and how each step in the process have influenced the next one, the chapter is structured chronologically from the first scoping interviews, ending with the second prototype. Each section of the chapter is organized more or less in the same way. First, I present the planning of the methods, explaining what measures were taken to prepare for the collection of data, ensuring that the process generated data that was within my scope. Then the actual execution is presented, explaining how, when and where the data was gathered. Lastly, the results are presented. My goal is to see a consistent flow of data, themes and findings from the first exploration to the last implementation. If I succeed in doing this, I can say that my data basis remained within the scope of my research.

5.1 Scoping study

5.1.1 Planning

In the late second quarter of 2016, my initial plan for the thesis leads me to conduct an early scoping interview to gain better insight about the users and their relation to mHealth. I wanted to seek out participants for the interview that were within the user group of my research, and to some extent, educated on the topics of sport and health. Through my personal network, I contacted an acquaintance who at the time studied at the Norwegian School of Sports Science. He put me in touch with two students who gladly wanted to help me in the early stages of my research. Two males, ages twenty-one and twenty-two, one had a background in cross-country skiing and the other a football player.

I chose that channel to get participants because I made an assumption that many of the students at the school in addition to being academically interested in sports, were athletes themselves. With theoretical and practical insight, the participants could give me data that I could base further research

on.

5.1.2 Execution

With the participants in mind, the interview was designed to explore their experience with health apps and their thoughts on the importance of tracking health data. The interview guide can be found in the appendix B. It took place at the Norwegian School of Sports Science and included both students due to practical arrangements and time constraints, and it lasted approximately thirty-five minutes. Before the recording started, the participants were introduced to the project, KULU, and the oral consent form. The conversation was recorded, transcribed and analyzed upon completion.

5.1.3 Results

On the experience with health applications

Both participants had previous experience with health apps and tracking their activity using technology, but only one of them used an app daily to log activity. An area where they both had experience, was during a test of an in-house app made by the school, called "Skadefri"; an app that supports athletes by listing exercises that help reduce the risk of injury based on the sport practiced. The skier used RunKeeper to track his runs and has been using it for a while to get an overview of his performance as long as he remembers to bring his phone with him. He explained that it was sufficient to track simple runs, but for more complicated forms of running, like intervals, he just used a stopwatch and left the phone at home.

On the usefulness of tracking health data

While both participants' experience with health apps was limited, they used manual ways of tracking their performance and training as a diary. The tracking took the form of written notes during and after workouts and organized in binders, for example, while lifting weights, the repetitions and weight were written down to keep track. At the end of each diary, a short comment about the performance was written down. One of the participants said: "I tend to be a bit harsh on myself. If I feel that I could have done better, the comments can be everything but constructive. However, it drives me forward."

They typically wrote down all the data they had access to from their workout. If they went for a run, they recorded when, where and how long it took, and additional data like heart rate if they had a monitor. The method of recording was considered more useful to record progression when lifting weights, because of they both saw the process as a manual one.

When asked whether they would find it useful to be able to track all data from all activities, one of them said: "It depends on what my goals are, and if the gathered data could help me get to that goal. If I just track health data just for tracking itself, then I am not doing myself a service by investing my

time into it". The other agreed that a goal was a must when tracking data, and expressed the concern for tracking general activity as a "data overload".

On the ideal health app

When asked what the ideal health and training app would look like, the answers were somewhat underwhelming, but at the same time reflecting the participants' personal needs from that type of app. The football player explained that he would like an app that specifically developed footballing abilities by, for example, make a list of exercises to perform with an explanation on how to do them. The skier wanted an app that did the same as the manual diary he already is familiar and use in his daily activities, and underlined the importance of simplicity. He also wanted a feature that allowed him to set up custom time intervals for running.

What did I learn?

From the scoping interviews, I learned that I have to be more clear when formulating my interview questions. This was a time when I did not have a clear framework to base my thesis on, so I saw the need to define the concepts I am working with, as well as having a theoretical framework for the data. Since this was an early scoping interview, with its loosely-constrained and loosely-focused nature, I expected the outcome to contribute to the direction of the thesis. I learned that a scoping interview is a good way to explore topics to get a broad understanding in a short amount of time. It was also useful to get an understanding of how the participants perceives the questions asked, taking this with me when designing future interviews.

What I learned about the usage of health apps is that usage might be directly motivated by goals, if I am to interpret what the participants expressed when talking about usage. Therefore, in the process ahead, I might seek participants that compete at a certain level in their respective sports to explore a more relevant user group to my thesis.

5.2 Interviews

As a necessary mean to get in depth to a user's views about a research topic, semi-structured interviews are commonly used in qualitative research. My motivation for choosing this method lies in personal experience with conducting that kind of interview, and the flexibility to explore the content of what the users are saying, while at the same time controlling the direction of the interview. To analyze my data after the interviews have been conducted, I will use thematic analysis, which is explained later in section 5.2.4.

5.2.1 Planning

Determining the sample size of this qualitative study was based on Sandelowski's [68] research on sample size in qualitative research. She

deems it as a matter of judgement regarding the quality of the information that is collected. Given the complexity of the topics studied, the methods, and analytical tools used in the process, I did not want too many participants, i.e. I deemed ten participants to be too many. A too small sample would be less than three, but would be easier to organise. I wanted to have between three and eight participants, which would be adequate given the methodological framework and the timeframe for the whole project.

During the fourth quarter of 2016, I conducted five interviews with participants that I had sought out, again using my personal network. When sampling users, what I had learned from the scoping interview was that I needed participants that were above a certain level of activity, to meet the assumption that goals might motivate usage of health-related apps, to reach the wanted level of competitiveness. The participants from the scoping interviews were contacted, but could not commit to participating in further studies. Through my network, I sought out athletes that were ambitious in their practice of sports, who prioritized it in their daily lives. I contacted a total of fifteen potential participants, and five of them were interested in participating in the interviews. They were also informed about further stages in the research process that would involve workshops, which they were also positive to take part in. Three of them were football players, one runner, and one cross-country skier, between the ages twenty and twenty-three.

To reduce the risk of having to change the interview questions after each interview with the participants, I ran two pilot interviews with fellow students to get a second opinion on the flow of the questions and what thought that was behind each of them. It was useful to get feedback on the structure and formulation to reflect the expectations.

The interview was designed to uncover how the participants viewed the potential of health apps to say something about their bodies and their performance. Asking about experiences they have had with health apps or tracking their health in different ways, and what ways that data can be used, I wanted the participants to start a reflection on their health data and what the potential of it is. The interview guide can be found in appendix B.

5.2.2 Execution

Scheduling the time and place to meet the participants individually was surprisingly easy, considering the schedule that many of them had. When contacting to them, I briefly explained what my study was about. By probing information about the topics of my research, the reflection could start even before the interview. I met all of them within a period of three weeks, in their environments. The participants were informed about the consent form, informing them about the research, audio recording and the measures to ensure their anonymity throughout the process (see appendix A). The interviews were recorded and transcribed upon completion, each of them lasting between twenty and thirty minutes. After the transcription, an initial coding of the content was made to begin the process of a thematic analysis as described by Braun and Clarke [10]. The coding was done before the

completion of all the interviews to reduce the workload upon continuing the analysis.

The analysis was driven by the exploration of what design the users in my participants need. If I could uncover reasons for using health apps, as well as reasons not to, then I could further develop a participatory design process where I aim to enable the participants to express their needs in design terms and facilitate democracy and mutual learning.

5.2.3 Results

When presenting the results, I will briefly cover how the participants replied to the questions about the main topics of the interview. The three most important topics were; tracking health data, experience with using apps, and the ideal health app. Each topic had follow-up questions to elaborate on the different topics. From this, I will present the steps of a thematic analysis, which is what I base my future work on.

On tracking health data

All the participants had experience tracking data from their workouts, either manually through diaries or by using a broad range of different health apps. In fact, all of them had experience using diaries to write down the type of workout manually, with a comment on how they felt after the workout, and four out of five have made an effort to explore the use of technology to track their performance. When asked why they chose to track data about their bodies, they answered in the line of having the potential to improve results over time, and that by organizing the data in some way was an important tool to determine that. The goals were unspecific and varied among the participants, but they all expressed a need to be better than the opposition, and the health data could play a role in that. On the other hand, if there is a downturn in results, tracking health data could be a useful tool to analyze why that is. The ability to share data with personnel that can help with the analysis and suggests improvements, was incredibly important for one of the participants, explaining how it has helped him many times from working out incorrectly.

When it came to sharing health-related data with others, the rest of the participants had varying experience. Two of them found it relevant to share with personnel for analysis, while two others actively used it as a social feature in the apps they used. The two who shared with personnel were required to do so and did not give much thought into what it meant by doing so, as the two who shared willingly felt a sense of motivation by investing time into maintaining what one of them described as a “social diary”. The last participant had never shared his data with anyone. Neither did he currently track anything specific about his activity that could be shared. He was skeptical and argued about the importance of shifting the perspective from numbers to how the activity was experienced, to reflect on the feeling of it rather than reflecting on the numbers. So in the cases where

numbers were unavoidable, for example, fitness tests, he spoke passionately about taking control of the numbers, instead of them taking control of you.

When asked when and what data that was collected, it depended on the method of data tracking. Three of the participants used a wearable heart rate and activity monitor, i.e. a watch, to track general activity as well as workouts. The monitors could track most aspects of their daily activities, including steps, location, altitude, heart rate and distance, but during workouts, different sets of data were important. One of the participants elaborated: "When I go for a run, the watch gives me more data. Most useful for me is distance, current pace and heart rate." None of the participants tracked restitution or sleep. Though one of them pointed out the importance of restitution as a crucial part of an athlete's lifestyle, referencing one of his former coaches, who had a theory that, "there is no such thing as too much exercise, just too little rest". He concluded that he would like to track his health data more generally, not just during exercise.

On the use of apps

The same participants that used wearables, use health apps as part of their training regime and are predominately interested in getting better by looking at improvements in quantitative sets of data. Between them, they have used a vast number of health apps and methods of organizing their days, some of them being Adidas miCoach, RunKeeper, Garmin Connect, Strava, Endomundo, Google Calendar and Apple Health. All of them expressed that it was a useful tool, in an overall sense, to help them structure their life according to their level of activity. Specifically, one of the participants explained that; "When I feel that I have a bad day when working out, the app can tell me that my heart rate is not as high as I feel it is, and therefore I can safely push myself further even though I do not feel like it".

All of the participants who have had experience using any health app pointed out that there have been many shortcomings which have made them switch, or stop using health apps at all. From incorrect tracking to too many advertisements, the reasons are many, but the three who are still using them as a part of their life feel like pioneers, and they get excited when thinking about the possibilities of the personal health technology.

On the other side, the two remaining participants regard themselves as skeptical to the exposition of too much health data through apps because of the focus that might influence how we look at ourselves. Pointing out that it has become too available, and the focus being on short term improvements, both remain skeptical, which also reflects their usage of it.

On the ideal health app

I asked the participants to explain how the ideal health app for them would look like. The answers reflected mostly the answers given to the previous questions, regarding their attitude and fondness towards the concept of health apps. Those who used apps daily to track their health, wanted as much data as possible, preferably automatic gathered data, i.e. quantitative.

They also wanted it to have a simple design, and that they could have everything in one app, instead of one app to sync the wearable and another to track other activities. Those who did not track their health saw little use for a general tracking of health and saw their chance to think of something very specific, almost niche. The one with least experience and willingness to track health wanted to know how many sprints he had during a football match, and how his ability to sprint was affected during the game. The last participants wanted a way to measure restitution, in addition to measuring, he wanted to know how to improve it. "Instead of just telling me that the quality of sleep was a certain value, I would like to know how I can improve it."

5.2.4 Thematic analysis

I conducted a thematic analysis of the interviews to organize and make sense of my data. The level of analysis was at an interpretive level, which means that the results are based on my interpretation of what the participants said during the interviews. I organized my analysis through the steps proposed by Braun and Clarke to get rich detail from qualitative sets of data. After doing the initial familiarization by transcribing while noting interesting results, the coding of the data could begin. The coding happened after all the interviews were done. My goal was to look at the data sets and uncover the underlying concepts that affected the participants. By this, I mean that I was leaning towards the theoretical concept of *lifeworld*, exploring in what way the participants experience the activity of tracking health data. This is related to the way of doing a theoretical thematic analysis, where the data is coded to answer the research question. The patterns sought out in the initial coding was the when-, what-, why-, and how-questions surrounding tracking health from the perspective of the participants. From the patterns, I quickly saw that the participants were talking differently about the same things. Sometimes in a very broad sense, for example about the technology in use, but also in a specific way, for instance, different reasons for measuring heart rate. I organized my findings in this way to discover potential themes. After reviewing the possible themes against the sets of data, I wanted to define each theme to fit my findings clearly.

Figure 5.1 shows the result of the thematic analysis. The themes are technology, context, authority, and motivation. My aim was that the themes would comprehensively cover what the participants expressed when asked about tracking health data, use of health apps and what an ideal health app would look like, and keep the integrity of the perspective of the participants and their experience. *Technology* covers what the currently used technology can and can not do for the participants, what was inadequate and what would they want to have in the future. *Context* related to when and where health was tracked, to look at what is needed in different types of situation. The participants spoke differently about what they needed at various times, and therefore is important to bring further in a design process. *Authority* describes many of the interactive and experienced aspects of tracking health. The theme can give insight to how much authority the participants give the

data they are presented, and if they are in control of their data, also when sharing with others. *Motivation* covers the why-questions related to the concept. Within the theme, I can explore the driving force behind tracking health data, which later can be useful to look at in the light of AT.

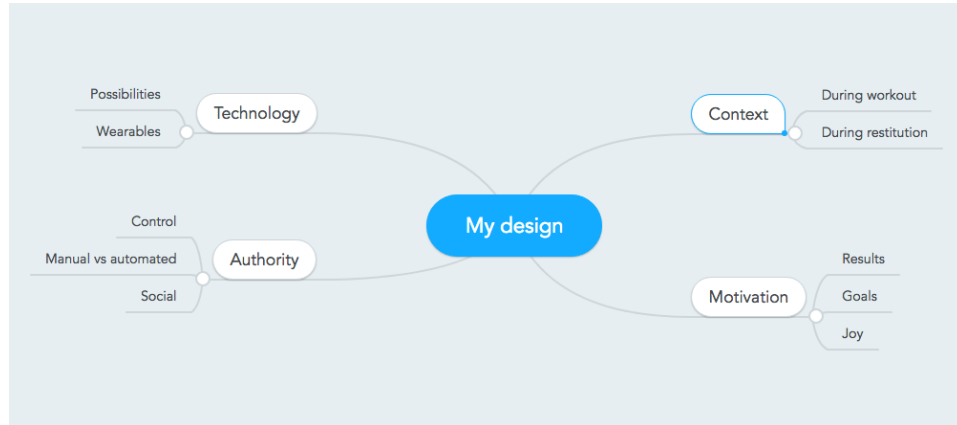


Figure 5.1: Thematic analysis

The point of my analysis was not to find contrasting themes, but rather have distinctive themes that are interconnected and internally nuanced and could give a fruitful discussion on how the facets relate to each other, describing the experiences of the participants. The future work of the project will be based on the results from the interviews, to ensure the flow of data throughout my thesis. The next section will be about the first workshop I conducted, whereas a part of the workshop, I used the results from the thematic analysis to further develop the thematic analysis.

5.3 Workshop 1

The first workshop was structured as a future workshop. One of my goals for the workshop was to continue the development of data from the interviews, ideally with the same participants, to pursue what was interesting and maybe gain more in-depth knowledge of it. In this section I will present how I planned the first workshop through several iterations, how I started out with a framework for arranging a future workshop and the thematic analysis from the interviews and ended up with a workshop containing two parts, leading to the results at the end of this section.

AT will be used at one stage during the project as a continuation of the thematic analysis from the first workshop. This will be the basis for making the design decisions based on my analysis of what the participants wanted from a health app. When organizing the findings from the thematic analysis with the proposed framework for health self-quantification from Almalki [2], I obtain a way of describing the features in the design of the health app systematically.

5.3.1 Planning

First iteration

When planning the workshop, the first part of it was based on Jungk and Mullert [26] and Vidal's [87] outline for a future workshop. I carefully thought through the different phases, and how it would look like in the short period I had scheduled with the athletes. I also planned to elaborate on the data from the first part in the second part, through a mapping of the data based on the topics that developed in the interviews. Having roughly an hour to conduct the workshop, I gave each part the same amount of time of fifteen minutes. The initial outline was as follows with respective goals for each phase:

- Critique phase
 - Open critique of the topics
 - Negative experiences
 - Problems
- Dream phase
 - Response to the problems and negative experiences
 - New ideas
 - Pragmatic approach
- Implementation phase
 - Look at how to realistically implement the ideas from the dream phase
- Part 2: Mapping phase
 - Prioritize functionality based on topics

My aim was that this outline would provide the data I needed to drive the design process further. As the planning continued, I had time for more iterations to design the workshop, preceded by a test.

Second iteration

An initial test of the workshop was conducted, just running through the different parts with a fellow student. This gave me feedback that formed how the actual workshop was conducted. Feedback regarding the flow and the presentation slides introducing the topics and the different phases of the workshop, lead me to a plan that I was more satisfied with. An example was used during the discussion of the workshop based on the themes from the thematic analysis, namely authority, context, motivation and technology. When mapping functionality in the last part of my workshop, an idea or concept they come up with can, for example, be a "sleep app", and app

that tracks sleeping activity. Then we code the different functionality within the sleep app to the various topics. Sensors can be mapped to technology, “how to sleep better” can be a functionality that inspires motivation and “not sharing” the sleep data with anyone can cover the topic of authority. For context, the feature can be to detect that the user is not in bed.

Third iteration

After going through the workshop again with my supervisors, we discovered the additional potential for improvements that would increase the value of the data from the workshop. It is crucial that the data represent my users as well as possible, without too much influence from me in the initial phases. My co-supervisor pointed out that I should not introduce the themes before going into the mapping phase of the workshop. Then I would just get the same data as in my interviews without any supplement, and I might miss important aspects of their view. Also, as my supervisor pointed out about this, the themes are merely interpretations of my analysis of the interviews.

This tells me that rather than using the themes or topics to guide the workshop, I should do the workshop according to traditional future workshop design as according to Junk and Mullert, and Vidal [26, 87]. After the first part of the workshop, which is the future workshop, I introduce what I call “mapping of functionality within the themes”.

I got the advice to color-code my participants. This might be useful if there is a relation between the phases based on the color - A certain way of thinking about the problem and a solution that might be helpful to me in the analysis. It might also be not so useful, if the participants decide that one of them will take the task of writing, for example, if they see this as a team effort. However, it opens the possibility to do this if I need it. The workshop was tested with my supervisors as shown in figure 5.2.

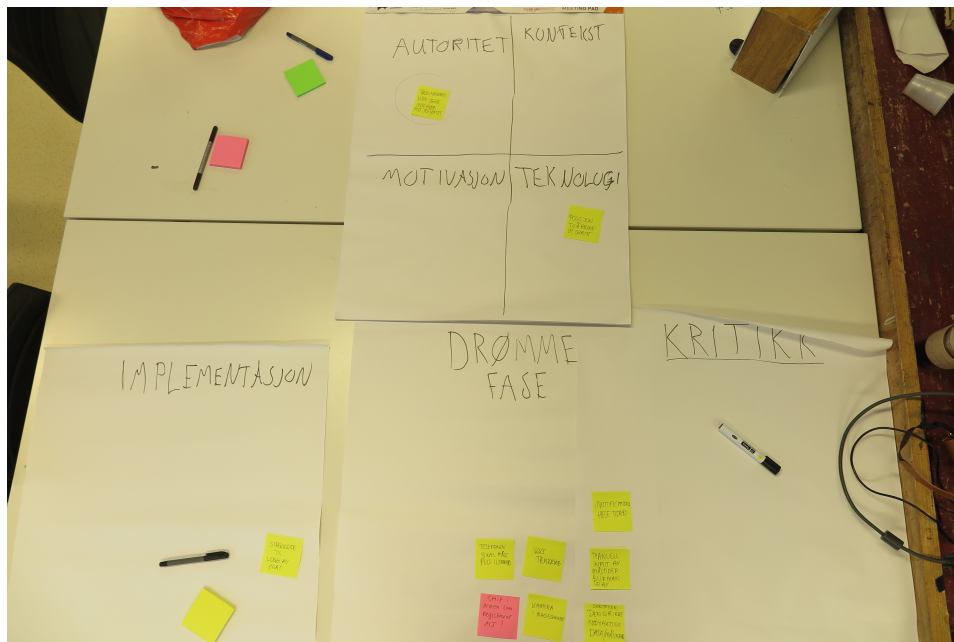


Figure 5.2: Pilot workshop conducted with my supervisors.

The last adjustment from the original plan was to change the time range for each phase. Having never done a workshop before, I thought that it would be useful to give each phase equal amount of time to execute, but as it was pointed out, the most interesting parts of the workshop are the implementation phase and the mapping phase, so I could easily adjust my schedule. I think in hindsight that this was a wise decision, giving me more interesting data to work with.

5.3.2 Execution

Now I will present each phase, with my initial goal for each phase. These goals were written before the workshop, to see if I could get richer data on the themes from the interviews. The goals were for my eyes only and never revealed to the participants. The presentation I used during the workshop can be found in appendix C.

The workshop was conducted with three participants who had attended the interview. We met at a lab in Ole Johan Dahls hus.

The critique phase aimed at exploring issues and shortcomings in the field of health apps. I explained to the participants that this phase was for them to comment on what they dislike with the current health apps and technology according to their needs and wishes. I urged them to use concrete examples from their experience. This phase was to last ten minutes, with a chance to revisit if needed.

The next phase was the dream phase. I introduced this phase as an opportunity to dream about the perfect health app. I explained that technology should not be a hindrance to their dream. The only restriction I gave them, was time. As the two first phases were intended to get the

participants to think about their experiences, needs, and wishes, I gave them ten minutes to complete the dream phase before going into what I regarded to be the most valuable and therefore wanted to spend the most time doing. Not only valuable to me, but valuable in the sense of mutual learning, letting the participants use more time reflecting upon the use of health apps and technology.

In the implementation phase, we looked at out we could solve the problems raised in the critique phase by taking a realistic approach to what was discussed in the dream phase. This is according to how to do a traditional future workshop [26, 87]. After twenty minutes, we moved from the implementation phase and into what I regard as a continuation from the interviews, where I applied findings from the thematic analysis to go deeper into a set of themes that came to light in the process.

The mapping phase was where we took the work done so far in the workshop and put it to use within a set of themes. The themes are motivation, authority, technology and context, and were the themes I interpreted to be central from the interviews. We used a total of thirty minutes to discuss how different functionality fit into the themes. The goal of this phase was to prioritize functionality, and most of all get enough data to make a design decision based on the participants' needs and wishes. This goal was also an overall goal, which affected the other phases as well.

5.3.3 Results

The future workshop

In the first part, I followed a traditional future workshop structure with three phases; the critique phase, dream phase, and implementation phase. Chronologically going through the phases, the narrative presented itself in what the participants discussed and wrote down, with one exception, which is described in the section "Unexpected findings" later in this section. I experienced that the participants were eager to get going with the critique, but in the process, they also made many feature requests that ideally could have been spared for the implementation phase. For the sake of the narrative, I will postpone the ideas and features that were mentioned in the critique phase to a part where it fits better thematically. I will shortly present the topics of what they discussed in the phases before going into the second part which was the mapping.

As mentioned in the planning, I distributed the time with two things in mind. Firstly, I had a very constrained schedule, i.e. the workshop was held in the afternoon, and all the participants had workouts to attend. Secondly, I had to prioritize which part should get the most time due to what I expected from the data collected in each phase.

Critique phase

The participants raised questions to the design of the apps they used or had heard of. They described some of the design as "cheesy", which meant two

things. The first was that there were too many apps that made a promise to get results within a specific amount of time. For example, a “get a six pack in ten weeks” kind of apps. Secondly, it made them critical to the focus of the apps. By focus, one of the participants explained that he did not want to be interrupted by the app in the middle of a workout, “... the focus during the workout should be on the workout itself, without being constantly reminded that you have the phone with you and that it is monitoring what you are doing”. They criticized that the app did not in any way measure how the workout “feels”, i.e. whether it was a good or bad session, and that this is a focus they miss in the apps they use.

Concerning “cheesy” design, they further criticized the focus of the app for giving feedback during a workout, which they found intrusive, and pointed out that the focus of the app should be to exercise correctly. They were also skeptical to whether all the calculations made by just measuring activity levels, i.e. counting calories based on a number of steps during a day without taking account for the intensity of the activity. One of the participants said, “I do not trust the calculation of calories based on steps alone, without even measuring heart rate”. When asked whether accuracy was important, they all agreed that if some of the measurements were not accurate, they were not interested in knowing about it.

As opposed to existing features they deem unnecessary due to inaccuracy, there was some critique towards features they missed. The core of the critique can be interpreted to be about having the features readily in the apps they are using, without having to install several apps to get what they need. One of the participants explained why he had to use several apps:

“To a certain extent, the apps are good, until you need more from the app, then you have to get another. I feel that I do not get everything I need from one app, so I have to use two or three. For example, one for running and another for weight lifting. Also, even if the apps interconnect, it does not feel optimized, and you need a pro user which costs a lot of money, which is certainly not what I want. And it is cumbersome when I finally have found an app that I like.”

This summarizes the critique towards functionality in a neat manner, coming back to the specific functionality later.

Also mentionable is the fact that one of the participants did not have adequate storage on his phone to use several apps for tracking health data. Trying to blame the phone and not the developers, we discussed the importance of designing apps that are not too heavy on the device. This needs to be considered in the actual development of the app, so it falls outside of my scope, but either way, it is important to consider what workload features means to the device in every part of the process.

To sum up the critique phase; the participants were predominately skeptical to apps that intended change instead of assistance to the participant’s life. They also pointed out the credibility they held towards

the technology to be faint, i.e. the accuracy and presentation of data based on simple calculations.

Dream phase

After closing the critique phase, we immediately went over to the dream phase. The participants had already begun to dream during the first phase, so bringing up what they had already talked about was an appropriate start to it.

A theme that came up at the beginning of the dream phase was simplicity. The participants dreamt of having one device with one app to do everything. One of them wanted a fully automatic system that could track activity with no interaction, and present it to the user in a coherent and useful manner. Following, they discussed wearable technology that could track specific aspects of performance, for example sprints. They compared the idea to an existing solution, called “adidas miCoach”¹, which uses wearable technology in, for example shoes, to give real time coaching. They dreamt of this kind of technology, without the connection to a specific manufacturer of sporting equipment, “for example a band or tape around your ankles, that does not disturb you or feels like it is there”.

After talking about technology, I went back and asked about the app that could do everything, because I expected that we had different ideas of what everything meant. They elaborated and said that for their usage, the app need to account for running, lifting weights, food intake, amount of sleep and professional coaching. When asking what values that specifically should be tracked, the answer was again, “everything”.

Not having time to elaborate further in the dream due to the tight schedule, I hoped to bring the specifics back in the implementation phase. There we had a bit more time to discuss and elaborate what had already been brought up so far in the future workshop.

Implementation phase

In the last phase before going into the second part of the workshop, we talked about how we can think realistically about the dreams we had in the previous phase. The participants immediately came to realize the economic and technological constraints regarding the wearables they wanted, but they liked the idea of having one device and app to interact with during exercise, and this device synchronizing afterward making the data available other places as well, for example, a desktop client.

We discussed how much or how little interaction should be possible and necessary during and after a workout. There was an agreement that as little interaction as possible should be required during a workout, preferably none. This meant featurewise that passive tracking was preferred, just gathering the necessary data during the workout. I interpret this as a wish for non-intrusive design. On the other side, the need for features after a

¹<http://www.adidas.com/us/micoach>

workout was a bit more specific. Two of the participants repeatedly talked about having a more comprehensive social feature that is more similar to news feeds in huge social media platforms, for example, Instagram. Further discussion about the social aspect of a health app leads to a wish to create events that one could invite people, for instance, teammates, to join the workout. This was regarded of to be very useful.

We talked about how an app could help them plan the workout sessions, and two things came up. The first was that the workout was organized through the calendar, ensuring a distribution of workout throughout available times in their schedule. The second was the focus on content for each workout that it was somewhat professional and ensured the correct type of exercise. All three agreed that professional content regarding how to exercise correctly to develop an ability should be in focus. One of them expressed the flow of this type of feature well; “set exercise goal, have professional tutorials that set up a program, for example, three sessions a week, and it helps you get there. Also, you can easily view it in the calendar”. This combined with a social feature, with the ability to plan workouts and exercises with, for example, coaches and teammates were in the participants’ eyes a pretty powerful set of features that would be useful at their level of activity.

Overall, the participants expressed a need for a simple design, with a focus on correct exercise and non-intrusive planning and social integration. This concluded the future workshop, and we went on to the second part, which was to conduct a mapping of what we had discussed. The mapping was based on the themes that emerged from the thematic analysis of the interviews.

Second part of the workshop

To apply the data gathered from the interviews, a mapping was conducted based on the ideas and concepts discussed during the workshop up against themes from the interviews. The themes were developed through a thematic analysis of the interviews as explained in section 5.2.4. I presented the themes, namely motivation, authority, technology, and context and presented them all at once. At this stage, there was uncertainty whether what we discussed in the future workshop was translatable to be mapped, so I started writing up some of the points that applied to what we discussed in the implementation phase. This got the discussion going, and the mapping ended up as shown in figure 5.4. Not everything we discussed got written down, because of the tempo of the discussion, and it lasted ten minutes longer than I had promised the participants, but they did not seem to mind. Figure 5.3 shows how we did the mapping.



Figure 5.3: During the mapping

I organize my findings into more coherent sets of data that will lead into the next section where I go into specific features. Initially, I wanted the participants to write down every aspect of the themes regarding their ideas, but this would take too much time, and was somewhat unnecessary, given that the data seemed to have a lot of preconceptions on, for example, what kind of tracking capabilities a smartphone or watch has.

Context	Motivation	Technology	Authority
Simple design: Easy to adjust use based on context. For example, during or after workout.	Simple design: Less errors. Prolong the use.	Simple design: Easy to use.	Simple design: Easily choose what you share.
Subjective evaluation: Says something about external factors having an influence on the performance.	Plan workouts: Structure. Plan ahead. Easier to prioritise.	Precise sensors: Giving the right data as output.	Control: Know what is shared.
Plan workouts: Able to plan workouts based on schedule.	Subjective evaluation: (would this be sharable? Yes, thinks one)	One unit: Smartphone or watch that tracks activity through one app.	Filtered sharing: Choose what is shared.
Sturdy components: Handles a "rainy day in Stoke".	Inner motivation: Related to subjective evaluation. Focus on how the workout feels, rather than the results.	Sturdy components: Handles a "rainy day in Stoke".	
	Detail vs. gain: Have a consious relation between focus on detail and gain.		
	Music: To be able to play music in the app.		

Figure 5.4: Mapping

In the next part of this chapter, I will use AT to derive design requests based on what I interpret what the participants talked about. However, first, I will present unexpected findings that will have a significant influence on my design.

Unexpected findings

One of the participants who had the least experience with health apps, and had little interest in using them, made an interesting point during the workshop. As an aficionado of exercising for health benefits, rather

than results, he brought a perspective that the others did not have, which became apparent during the mapping. Before the mapping, his contributions seemed mostly critical and hard to interpret in concrete design terms, but when we talked about motivation, he made the an important contributions I want to take into consideration when making the design.

The point was what he called “inner motivation”, and he referenced a paper about Self-Determination Theory (see Ryan and Deci, 2000). I asked how to measure or reflect on inner motivation when using a health app, and we discussed why inner motivation was important, by itself and related to the other themes. We found two ways of looking at it, in short- and long-term. In short-term, inner motivation could be shown through a subjective evaluation of every workout, for example by giving the workout a rating and an optional comment. In a long-term perspective, this might become a useful dataset to reflect on the results, as one of the participants said: “Over time, I want to have more good workouts than bad ones”. All of the participants wanted this as a feature so that they could get a more comprehensive overview of their workouts, not just regarding numbers and stats, but a subjective evaluative perspective.

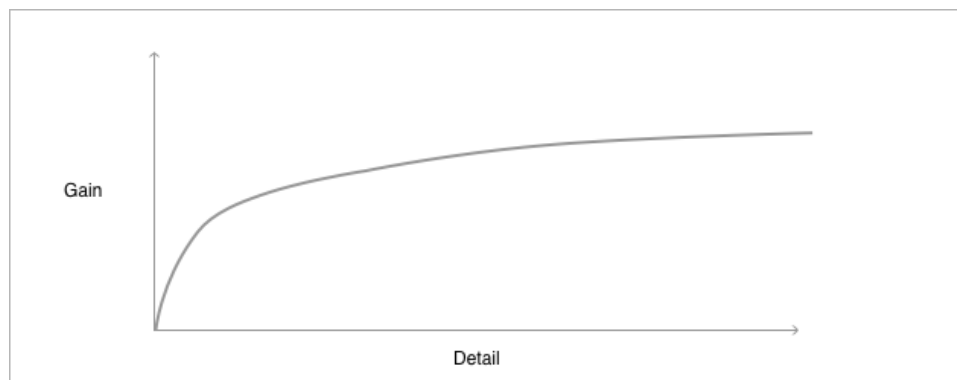


Figure 5.5: Detail versus gain

To illustrate his point, he drew a simple x-y-axis graph, explaining how he thought of the relation between detail focus and gain, as shown in figure 5.5. By detail focus, we discussed how specific the generated data should be, and how useful the data was to the athlete. The participant explained that if the focus on detail was very high, then the gain was not that high, as the curve flattens out along the detail axis. So at a certain point, the increase of gain slows down as the focus on detail increases, which makes it desirable to find the area where the gain is high, and the detail focus is not, as one of the participants put it “discouraging”. Not being able to articulate the specifics about detail focus, we agreed that this was something to be brought up in the next workshop, where we could evaluate whether the design is in the desired place in the graph when it comes to detail.

5.3.4 Applying AT - Deriving objectives from a future workshop

In this part I will use the six constructs of AT, which were presented in section 3.1.1, to look at how design features can be realized from the results of the workshop. The constructs are object, subject, tool, community, division of work and rules. The results of the mapping allow me to formulate features that the participants want. To apply AT, the object was formulated as a sentence, for example, “as a user I want to track my heart rate during workout”, then deriving the rest of the AT framework based on data from the workshop. Not all constructs will be defined for each object, as AT seldom is fully operationalized or applied in a single action, but in my design as a whole, I will aim to make the account for all the constructs. In the design, the subject is always the athlete who use the app, and the tools are the technology in use, i.e. smartphones or wearables. At this stage, some of the constructs remain open sentences or questions.

When I extract the features, both parts of the workshop are included. This is because the second part of the workshop is not enough by itself to determine the features. It is rather a more in depth discussion about themes brought up in the interviews. When the mapping session started, my hopes were that the interview data could be usefully connected to the workshop data. The objectives are as follows, with the prefix:

- As a user I want to...
 - Plan my workout schedule.
 - Invite others to my workouts.
 - Track workouts and get data presented in a format that I understand and find useful.
 - Give subjective feedback on my performance.
 - Use one app/device to track my activity (Running, lifting, planning, socialising, synchronizing).
 - Share my activity.
 - Listen to music during workout.

Figure 5.6 gives an overview of the constructs, and how each feature can be operationalized within it. This is a useful way to systematize activities and get a summary of what was discussed in the workshop.

Object: As a user I want to...	Subject	Tool	Community	Rules	Division of work
Plan my workout schedule w/professional content	Athlete	App. Calendar.	Team, coaching staff.	How many workouts a week? How long should restitution be?	Automatic calendar input based on the schedule. With possibilty to edit manually.
Invite others to join my workouts	Athlete	App. Calendar.	Friends, coaches, team mates	Who to invite? How to respond?	Collaborative schedule for workout between two actors.
Track workouts and get data presented in a format I understand and find useful	Athlete	App, sensors in smartphone /wearables	Those who descide what format and measurements to matter.	What formats are used? Which technology? What happens to the data?	Minimal manual input.
Give subjective feedback on my performance	Athlete	App	Is the feedback useful to anyone other than the athlete? Coach, medical staff?	Method for feedback. How it should be measured.	Mostly manual. Have a way of rate the workout.
Use one app/device to track my activity (Running, lifting, planning, socialising, synchronizing)	Athlete	App and smartphone /watch	Online community, friends, coaches, team mates.	Which laws and ethics that apply.	Manual input when sharing, evaluating workout. Automatic input and output when tracking and viewing data.
Share my workout	Athlete	App	Online community/friends	Rules for sharing data. Which data should be shared?	Manually choose what workout to be shared.
Listen to music from the app during a workout	Athlete	App, Music service	Music community, online playlists etc	Has to be connected to a music streaming service?	Use existing playlists vs making your own. Externalized interaction

Figure 5.6: Systematized objectives through AT

To summarize even further to make a foundation for the prototype, I want to organize the findings in shorter, more concise terms. The summary can be seen as a list of features, based on figure 5.6. The selection is also closely related to the themes from the thematic analysis to ensure a flow of my project.

The features are:

- Track activity
- Plan workouts
- Subjective feedback
- Social feed
- Share workout

The next section will explain the process behind making the design based on the findings from the first workshop.

5.4 Prototype

The first prototype was made as a result of the first workshop. The goal of the prototype is to resemble what a final product would look like, so when the participants test it in the second workshop, they get a feel for how it presents information about their bodies. The following section will provide an insight into the process from idea to prototype to making it ready to be tested on the users.

5.4.1 Planning

Derived from the results of the first workshop, the prototype was made to fulfill the requests analyzed and organized using AT as explained in section 5.3. When planning the design of the prototype, I had to consider factors relating to what I wanted to get out of the process. Overall, I wanted to make the most complete and interactive prototype possible in the time I had and what the tools available to me allowed me to make. Also, at the same time, the need for useful data as a result of testing the prototype was crucial. Keeping in mind that a PD process demands a certain involvement from the participants, my plan was to make alternatives to the design of the health app.

Design tools

After making a quick paper sketch as shown in appendix D.1, I decided to use digital tools to help me in the initial phases because this could be reused and modified through the whole prototyping process. To easily keep track of the features and the progress, I organized it in Google Keep² notes, which gave me a base to work from as shown in appendix D.2.

Defining factors in the choice of software to develop the prototype were based on personal preference, workflow, and ease of mastery, which was important due to little previous experience using that type of software. I also wanted to use a work method that is utilized in the interaction design community. The workflow consisted of two applications used for different purposes in a design process. For graphical interface design and artboard management, i.e. the various screens of the prototype, I used Sketch³. As a platform to create a clickable, interactive prototype based on the design made in Sketch, I used a web service called InVision⁴.

This workflow was rather seamless thanks to the ability to upload my entire workspace from Sketch onto InVision.

5.4.2 Design workflow

There were broadly three steps that reoccurred many times in the process of making the prototype. The first step was to determine the features that

²<https://keep.google.com>

³<https://www.sketchapp.com/>

⁴<https://invisionapp.com>

would be included in the prototype. This was a crucial step to determine which areas that would be my focus in the design. Because of the time limit and the scope of this thesis, I could not give equal attention to every aspect of the prototype. I wanted to focus my design on the following five features:

- Track activity
- Plan workouts
- Subjective feedback
- Social feed
- Share workout

These features can be regarded as a compromise between what the participants wanted and my capacity to meet their needs. The relation between the features and the themes derived from the interviews are necessary to maintain my focus and continuity in the sets of data, so I do not move my scope away from what is important in the eyes of the participants.

The next step was to realize the design of each feature using Sketch. I did this by making each screen as shown in figure 5.7. In Sketch, these are known as *artboards*, and elements in the design can be made globally, i.e. making symbols that are reusable and modifiable for the entire layout. This saves much time when making interactive screens that are supposed to show a minor change in the user interface. The artboards could be organized in a way to get a preview of the flow of the prototype before exporting the project to InVision(Figure 5.8b). This step was the most time-consuming because I had to design every aspect of the prototype, and I was prone to focus too much on small graphical details and aesthetics rather than an emphasis on the features I was designing. When it came to user involvement in what would be the final design, I made alternatives for them to choose from in the upcoming second workshop, for example, by designing different ways of evaluating subjectively.

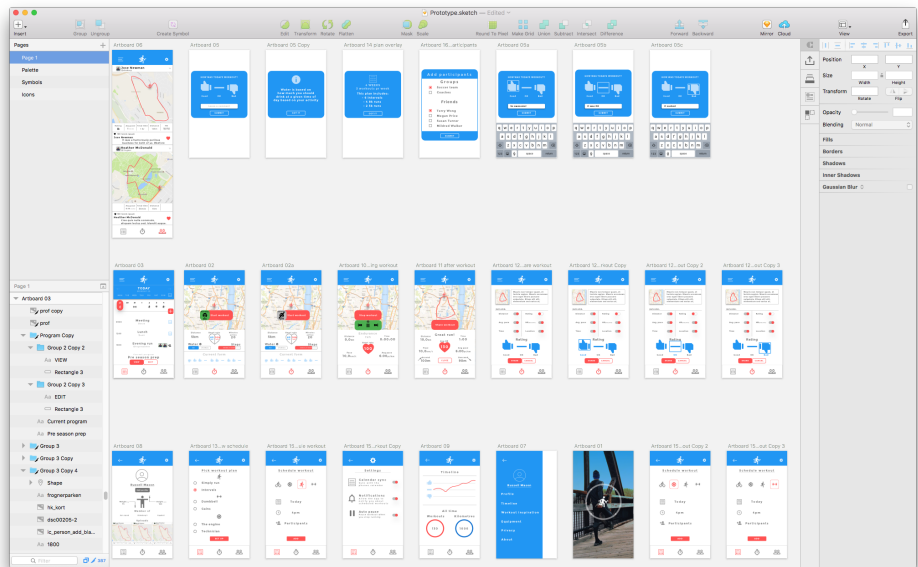
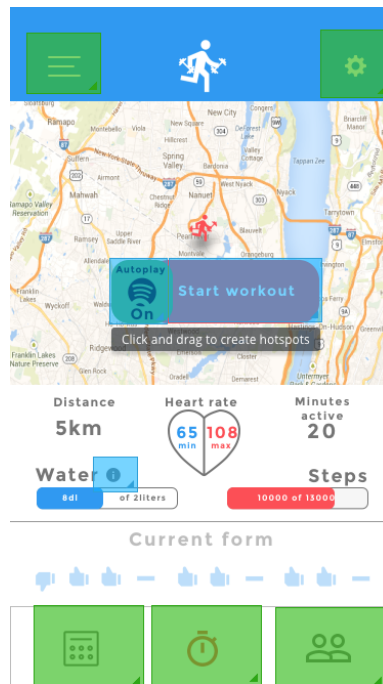
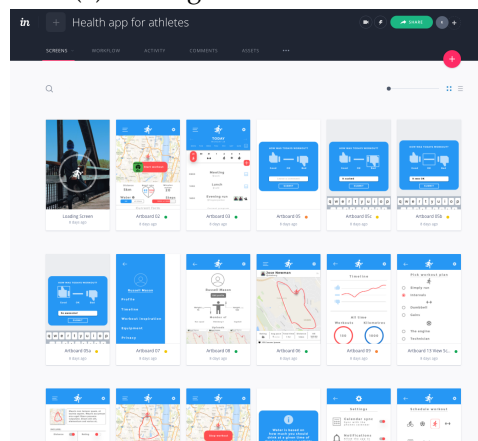


Figure 5.7: Artboard management in Sketch



(a) Making screens interactive



(b) Overview of artboards in InVision

Figure 5.8: Workflow in InVision

The last step was to export the prototype to InVision to make it interactive. Each screen was made interactive by adding hotspots that linked to another screen from the project (Figure 5.8a). In that way, a task flow could be developed to later test with the users. This step was necessary to discover if the work done in the previous step were adequate to solve what the participants wanted and be the base for questions in the next workshop to discuss if their voices have been heard.

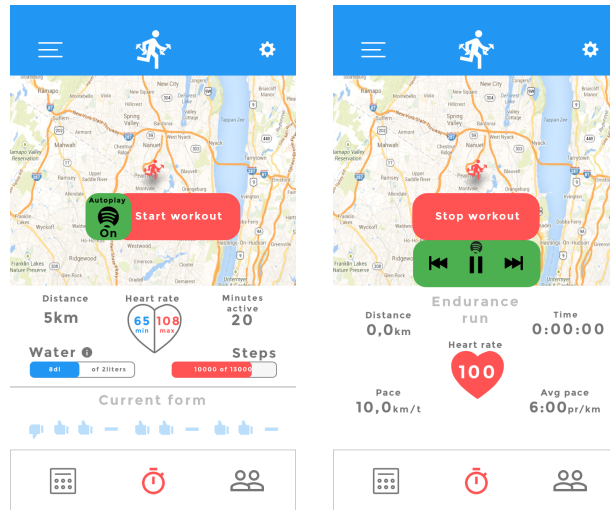
5.4.3 Results

The prototype and the process of design were, as previously mentioned, the result of the analysis made after the first workshop. The participants expressed their experiences and needs in the frame of a future workshop, which leads into a mapping based on what they had discussed, and later applying an AT perspective to concretize features that I will present as part of a prototype in this section. This lead me to create design alternatives for how the prototype would look based on some of the features. What is presented in this section is merely my solution to the design. There was also need to go beyond just choosing from alternatives in the design, so to supplement the upcoming workshop, a more comprehensive set of screens were added to give a "look and feel" to the prototype [23]. My choices on how to design the prototype were based on my interpretation of what the participants expressed as their daily activities and needs, i.e. based on what we discussed in the interviews and workshop. The design was also influenced by my experiences and needs while using health apps. The participants would have their own say about the actual design in the next workshop, where we discussed how they would design it, as well as how I designed it.

The prototype consisted of a total of twenty-seven screens, some of them are overlaying, while other are navigational and contain specific features that the participants wanted. I will present my results as the five features I based my prototype on.

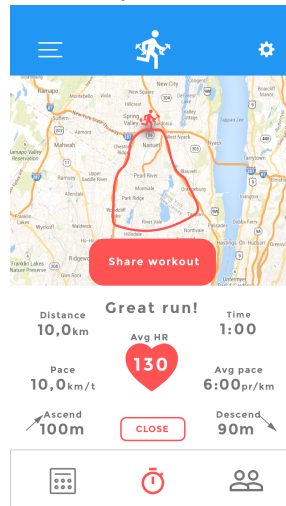
Track activity

To say something about their daily activities, the participants wanted to be able to track different aspects of their bodies based on different contexts. To just say "track activity" is rather vague, and does not restrict the type of data collected, because activity could refer to everything from sleep to competition. A restriction was made to only track daytime activities as well as contextual data, i.e. weather and location. I considered including all the types of data, but that might be experienced as cluttering, and conflicting the wish for a simple design. So I considered three user states to be able to explore different sets of data for different contexts. One where the user will get general activity and information about their body (Figure 5.9a), and the others during and after a workout (Figure 5.9b and 5.9c).



(a) Track general activity

(b) Track workout



(c) After workout

Figure 5.9: Tracking activity

For general activity, the inclusion of data that is relevant for the progression of a day, for example how much water that should have been consumed at any time a day based on activity levels, was prioritized together with overall activity. Overall activity includes minutes active, distance, highest and lowest measured heart rate, steps and, as mentioned, calculated water intake.

During and after workout measure and display much of the same data. The priority is to give the user data that is relevant during a workout. The need will vary based on what type of activity that is in progress, so figure 5.9b illustrates an endurance run. I regard live data such as time, pace, average pace and distance as useful, including current heart rate. These are also typical to have in a running app. After the workout, the data saying something about the performance is presented to the user. In addition to the data that was presented live, ascent and descent are included as well

to say something about whether there was a climb involved (figure 5.9c). The figures above illustrate what flow of tracking activity could look like in a health app, which was one of the features the participants wanted. Also presented here is the navigational structure and graphics of the design, which are there for interactivity when the participants are testing the app. Whether it is unique is only relevant if I was to compare the results to other health apps, which is not relevant for this prototype, because it is my design. An aim of my research is to let the participants have a say in the design, implementing what they want and need from a health app.

Plan workouts

The participants thought it would be useful to be able to schedule their workouts according to the calendar on their smartphones. A feature where they can pick workout plans or workout goals and get the workouts automatically in the calendar based on when they have time available. The idea was inspired by Google Goals⁵, which is a feature in the Google Calendar app that allows the user to set a goal and manage how often and when it should appear in the calendar. In addition to letting the user manage when and how often workouts occur, it gives a possibility to log a workout and the performance as part of a diary, which is a practice known to the participants as a highly manual task.

Figure 5.10 gives a weekly calendar view, indicating what kind of exercise is scheduled, and gives the day's agenda. The participants wanted the calendar to be flexible, i.e. making it easy to defer from the schedule if a workout is preponed or postponed. Three additional screens for the feature were made, one to schedule a workout, one to pick a workout plan that schedules many workouts and the last one to view the overall plan.

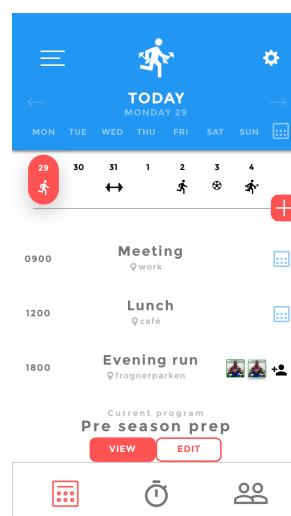


Figure 5.10: Schedule

⁵<https://blog.google/products/calendar/find-time-goals-google-calendar/>

Subjective feedback

Subjective feedback was valuable for the participants to estimate whether they have good or bad workouts based on how they felt after a workout. This is a way to "estimate current form" as they said during the workshop. By that they meant that to some extent, the form is always varying, going either up or down, but as athletes having between seven to fifteen hours of workout every week, they want to have an overall larger amount of workouts they would consider to be good. So to be able to give subjective feedback enables the participants to track their form. The task is to consider what size and form the scale for grading the workout should have. As mentioned earlier, the list of alternatives is far from comprehensive, but I chose a simple scale in order to comply with a simple design, a "thumbs up, thumbs down"-scale with a middle alternative for the times neither fit. Figure 5.11 is an overlaying screen that shows up after a workout is done, asking the user "How was today's workout?", with the three alternatives, captioned "Good", "OK" or "Bad". Independent of any scale, the participants wanted to supplement the grading with a comment - a written feedback to elaborate the choice of grade.

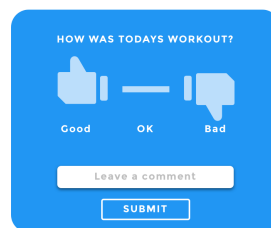


Figure 5.11: Subjective feedback

Social feed

For some of the participants, a sense of community and ability to share their performance with other users was an important factor when using a health app. As well as sharing their data motivated the participants, getting data from other users might inspire them and increase activity, for example by being in the same online community as an athlete which the user looks up to. The role of community when analyzing an activity is highly applicable in AT when analyzing how to reach the goal of the activity. When designing the social feed, I based the content of the feed on the content of the tracked activity mentioned earlier, and the looks of it are inspired by

apps the participants already are used to and regard as simple, for example, Instagram⁶.

Figure 5.12 shows how I chose to design it. I made it with the focus on simplicity and content, letting the user choose what data is shared for each workout they share. This will again be affected by how the sharing functionality is designed, which will be covered in the next section.

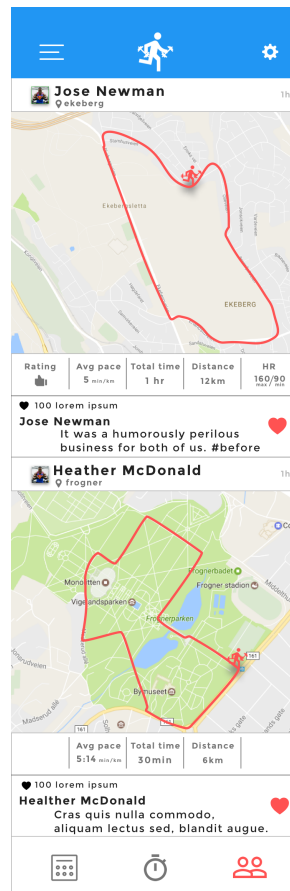


Figure 5.12: Social feed

An interesting discussion arose during the workshop, surrounding the topic of social feeds and the potential for it being a bad influence on the development of the athlete. The discussion ended when one of the participants said: “It is the same as any other aspect of life, surround yourself with people that bring out the best in you. If I follow people that have a healthy relation to their health and community, it is easier for me to do the same”. For me, this speaks of the value of community if it is done in circumstances that are suitable for the users, which I, as a designer, want to facilitate. Even though this is interesting to look in depth at communities of practice and how they form, it falls outside the scope of this thesis.

⁶<https://instagram.com>

Share workout

The feature that allows the users to share workouts is closely connected to the social feed. What makes the feature interesting in this project is its connection to the theme authority. When exploring whether or not the participants find it useful to share their workout data, and in this case some of them do, it is even more interesting to look at how this can be done, and discuss with them the implications of sharing workout data, enabling mutual learning.

I had two ideas for how to design the feature, both representing different ways of controlling data. I chose for my solution to go with the manual control of data, where the users have to select all the sets of data from the workout they want to share, as shown in figure 5.13. The reason for this is the sense of authority over their data the user gets from having this option.

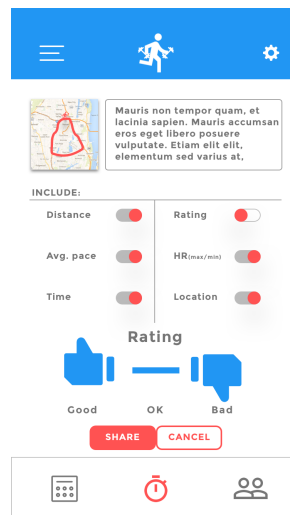


Figure 5.13: Manual control of shared data

Design alternatives

A difficult assessment was how to spend my time most effectively ahead of the second workshop that I had scheduled with the participants. To follow PD guidelines, I wanted to use the workshop to present design alternatives to my participants to get their input and direct involvement in the design, and at the same time, present a prototype as my solution to the design. By doing this, I could get input on what design they prefer and feedback on the prototype by discussing a solution in its interactive form. So I had to determine design alternatives based on the features, and which features I regarded to be the most interesting and relevant to go in depth in making alternatives.

For the purpose of the prototype, not all features would have design alternatives, because of the time constraint and the features relation to the themes. For this project, it is more interesting to for example get the participants' thoughts on how to represent the subjective evaluation than

how precisely a news feed should look. Although it could be equally important for the participants to motivate usage, the flow of the thesis leads me to prioritize the four sets of design alternatives shown in figures 5.15 and 5.14. Figure 5.14a shows elements that represent the user's activity data, from sensory to contextual data, as well as different graphical representations of it. The graphical representations included text and numbers, as well as progress bars and cake diagrams. Figure 5.14b gives alternatives for sharing tracked data. The alternatives differ in the control of what is shared, the above letting the user manually control each data set, and the other giving alternatives that automatically filters data as the user wants, from "share everything" to "share nothing".

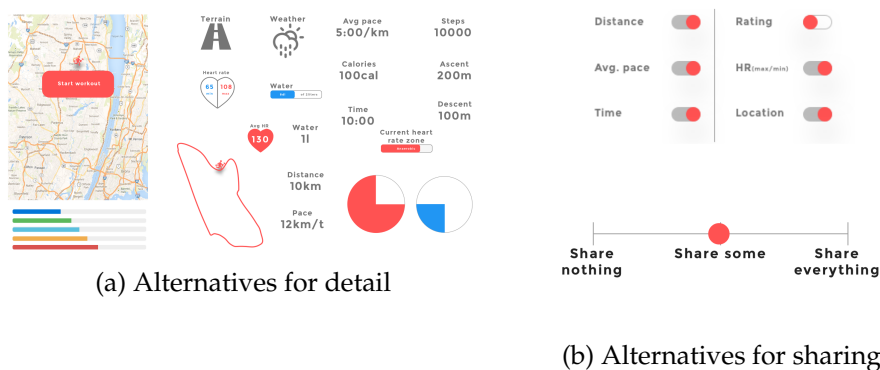


Figure 5.14: Detail focus and sharing. For large versions see appendix F

Alternatives for evaluating subjectively demands several ways of grading emotion as shown in figure 5.15a. The scales for grading are of varying size and form, giving either three or five options, inspired by common ways to rate or scale, and different metaphors and colors associating to feelings. Two alternatives consist of symbols and emoticons expressing a gesture or facial expression telling the prototype the emotion felt. Red symbols indicating negative emotions, and green associating a good feeling after the workout.

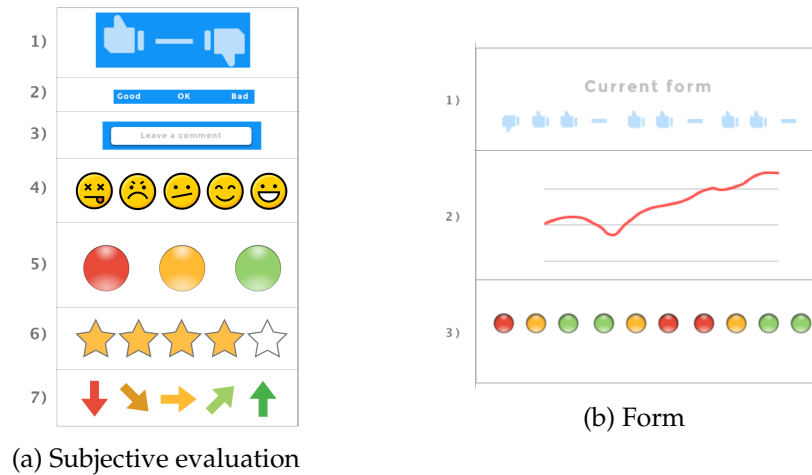


Figure 5.15: Subjective evaluation

Closely related to the subjective evaluation is how it is represented over time to say something about the experienced fitness. Figure 5.15b presents two different ways of displaying it, and even though the looks of it is affected by the choice from how to evaluate subjectively, the representation is what is in focus. By this, I want to explore which is a better representation, if any of them, are what the participants can relate to.

Applicable for all the design alternatives is the fact that they are far from comprehensive. The number of alternatives was limited by my imagination and skill to gather inspiration from other sources. I could have given more thought about psychological and pedagogical factors related to design, but the point of the alternatives being a catalyst for a design reflection, having alternatives that are somewhat opposite or thinking in different directions are enough for this prototype.

The next section will present the implementation and results of the second workshop, which is partly based on the solution I prototyped, and even more importantly, how the participants themselves would design it.

5.5 Workshop 2

The date of the second workshop was set at the end of the first one, which gave a decent time frame and the right amount of pressure to structure the work ahead of the workshop. This also allowed for a reflection on how to gain useful data which could drive the design further. This section will present the planning, execution, and results of the second and last workshop.

5.5.1 Planning

As with the first workshop, the second one ended up having two parts that had their characteristics, but equally important as the data from the first part transcended and influenced the results in the second part. The parts

demanded differently regarding preparation to get the answers I wanted from the participants.

Before the second workshop, I did a pilot study to make sure the tasks presented and the questions asked were in line with my research, reducing the risk of having insufficient data, especially since this was the last time I had the participants gathered. Once again, the pilot proved to be useful to get an overview and make adjustments to the way the workshop was organized. Making sure the participants did not know about the prototype before they had made their solution to the design was one of the things that came out of it. Also making sure the structure was good and the questions asked about the prototype gave insight about what the users thought about it was a result. I also ensured that the workshop did not last more than one hour, which should be a sufficient duration since the participants now know what the project is about.

Part one

When preparing the first part, the design alternatives were a base for exploring what elements the participants were to take part in designing, i.e. which features they were going to co-design. This also related back to the themes from the thematic analysis, i.e. context, motivation, technology, and authority. Two considerations were made. First, the relevance of the topic to the specific functionality and fidelity of the prototype. For example, the theme; technology, is less relevant in the design of a feature for subjective evaluation than motivation. Secondly, design exercises given to the participants would affect the second part of the workshop, which was meant to supplement the findings. It was planned so that the participants would use approximately half an hour to finish the exercises in part one. I chose to include them in the design of three features, which I regard to be most related to the themes; track activity, subjective evaluation, and sharing.

Printing out and making cut-outs of design alternatives and graphic elements allowed the participants to take part in deciding the content of the interfaces we were going to make. The participants would be given four tasks to discuss and complete by placing elements of the user interface on a screen. My focus during the task would be to discuss what content they decide to include in their design, and what content they chose to exclude.

The first task was to discuss the level of detail that would be given by the prototype. Figure 5.14a shows the elements they were presented with. It was to illustrate data that the prototype had about their bodies, both contextual and quantitative sets of data.

The second task was to consider different ways of evaluating the workout subjectively, which was a feature the participants regarded highly in the theme of motivation. The subjective evaluation is a feature that lets the user grade their workout based on the scale presented them. There are many ways of grading a workout, and a goal was to find a scale that the participants liked, and thought made sense to reflect how they felt after a workout. Figure 5.15a shows the different scales presented to them.

Related to the second task, task number three was to discuss how the

form could be displayed. Displaying form meant that the user could look at their progression based on the subjective evaluation. Figure 5.15b shows the mock-ups of different alternatives I had made for that task, and the users would be asked to reflect on how their development and progression of form can be represented in a coherent way.

The final part of the first part of the workshop was to consider how sharing of personal health data should be done. Figure 5.14b gives the alternatives between fully manual control of what is being shared, versus having some control, i.e. choosing from a preset of sharable settings.

Part two

This part of the workshop is where the prototype from section 5.4 is presented to the participants. The prototype would be shown on a mobile device, preferably their own, if they can install the InVision app which allows them to test the prototype extensively. They would have approximately ten minutes to get an impression of what they think about the solution to the design and asked to navigate through the prototype, specifically considering the flow and content of the application. They were encouraged to ask questions about the prototype during the testing. After testing the prototype, thoughts related to the solution of the tasks they completed in part one would be called upon to get the discussion and reflection going. They would be asked what they think of the level of detail compared to what they focused on in the first part, what they think about how I solved the sharing, social feed, subjective feedback, and form over a period. I am also interested in the general impression of the prototype, and whether they would add or remove something from it. The questions can be found in appendix E, as well as the plan for the entire workshop.

5.5.2 Execution

The workshop had to be conducted two times to include the same three participants from the first workshop. The first one was conducted in the afternoon at a meeting room in "Ole Johan Dahls hus", and lasted a total of 65 minutes from the two participants arrived. The second was held in the same place the following morning and lasted 50 minutes with one participant. The structure of the workshop was identical in both runs, so I suspect the difference in time had to do with the number of participants, and my ability as a researcher to drive the workshop forward.

Before the workshop started, the participants were informed about their rights and that audio would be recorded and pictures were taken during the workshop, same as last time. The consent form was updated to apply the workshop, so when given the oral consent again, the audio recording could commence.

The first part needed a surprisingly little introduction on both occasions as if they knew exactly what they were looking at. I had prepared a desk for them to work at, with the sheets of paper as shown in figure 5.16. They got one piece of paper for each task. In case the design alternatives I had

prepared were not sufficient, paper and pens were available to supplement the interface if needed.



Figure 5.16: Prepared desk for the participants

I introduced the first task, which was to decide which sets of data to be tracked by the app. I explained the categories of data sets (quantitative or contextual), and how the participants could consider representation as well as content, i.e. whether a data set should be represented as a progress bar or just text. After introducing the task, I tried not to interfere unless they had questions about the cut outs or the task itself. After the task was completed, we discussed the choices made by each participant, and made a comparison in the workshop with two participants. The same structure was repeated for the three remaining tasks. By not interfering with their work by constantly hanging over their shoulders, I could vary my roles as facilitator, researcher, and co-designer. While they designed, I could take pictures, look at the time, and make sure the task was understood. So when they finished, I could focus on asking questions. This was a workflow that made it easier for me and created a nice atmosphere during the workshop.

After the first part, which in both workshops lasted approximately 30 minutes, we took a break for five minutes, while I prepared the prototype for testing. After the break, I gave them ten minutes to look through the app, as shown in figure 5.17, and I asked them to keep in mind the tasks they just completed themselves. After the ten minutes, we talked through the different screens of the prototype, discussing the content as we navigated through it together. I let the discussion go on for as long as it had to, having prepared some questions if the discussion stopped. My goal was for this part to give me rich data on what the participants thought about my solution and reflections on their choices of design. By not showing them my solution in advance, I got honest, to some degree unbiased data because I could look

at what they made.



Figure 5.17: Participant interacting with prototype

5.5.3 Results

The tangible data from the second workshop would mostly consist of interface prototypes made by the participants during the first part. Secondly, the conversation during the process was recorded and transcribed upon completion to give a reference of what they were discussing when the interfaces were made to give depth and context to the data. The analysis will consist of a comparison between the interfaces made by the participants, and the interfaces I presented to them, along with the discussions and reflections that took place during the workshop. First, the results of the first part are presented, then part two, focusing on the relation between both parts regarding what they preferred and what I presented in the prototype and how they reacted to it.

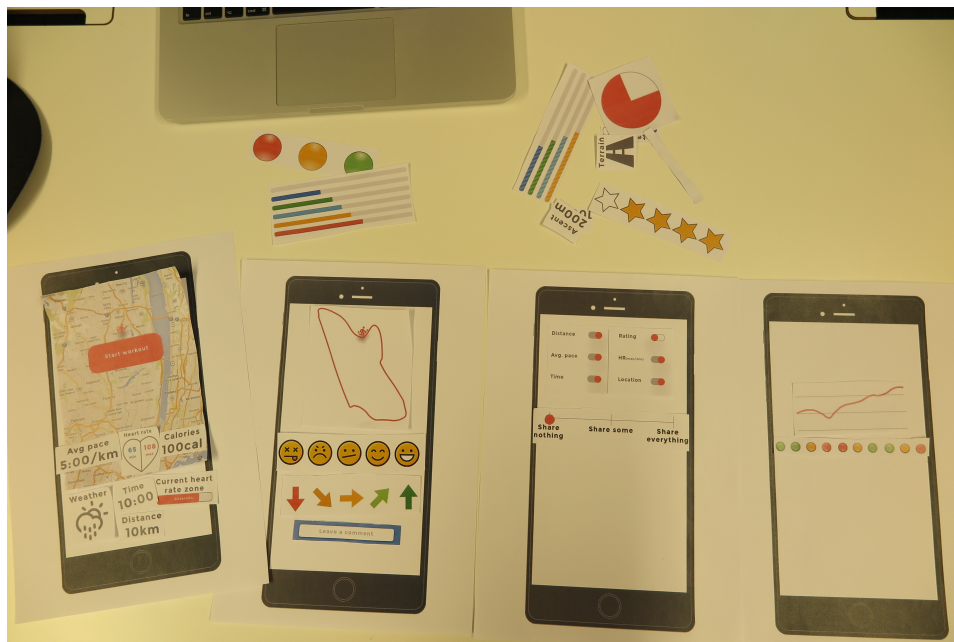


Figure 5.18: Results from part one from one of the participants

Part one

All three participants completed the tasks given in the time they had available, including time for discussion and questions to the tasks. One of the goals of the workshop was to introduce the participants to interface design in an understandable way, letting them reflect on design, based on the alternatives presented to them. This was in many ways successful because instead of having to create the design by drawing themselves, they could put the desired cutouts on the screens as shown in figure 5.18. None of the participants used the paper and pens available to create custom elements, but they orally expressed what they thought were missing instead. For example, as one of the participants pointed out: “Why is there no tracking of sleep presented here? Is not that a context?” When asked whether he would include sleep data in his design, he explained that he expected it to be a part of the design, but that he did not want it himself.

Since the participants up to this point had participated in the interview and the first workshop, I had preconceptions of what the last workshop would look like concerning the results. They were in many ways realized, given the attitude they have previously shown in earlier stages. The preconceptions did not lead the workshop and certainly not the results, it was rather my expectations of what the results would look like, to be confirmed or refuted after the workshop.

The first task was to discuss the level of detail, and the participants were to put the cutouts of data sets that they wanted on the paper screen as shown in figure 5.19. The results varied greatly, based on what they needed from the app. What was interesting though, and what contributed to the actual findings were the reasons for making the choices they made. The task was

meant for the participants to discuss and reflect on motivation and context. One of them even pointed out that he felt increased authority when he got to choose what to be included, whether this was pointed to the prototype or the task itself is unclear, either way, it is interesting regarding how it was experienced. For increased motivation, all the participants expressed that getting contextually relevant data was valuable and that it should be presented in a non-intrusive, simple manner. When asked to elaborate on what simple meant, one of the participants said: "I like textual, informative data when it comes to specific values about my activity. Symbols or fancy ways of showing the data is not important for me." I got the same impression from the other participants about how data should be presented. One of them added that any indication of progression towards a goal, e.g., step goals, would not be interesting on a day to day basis, but rather a weekly basis.

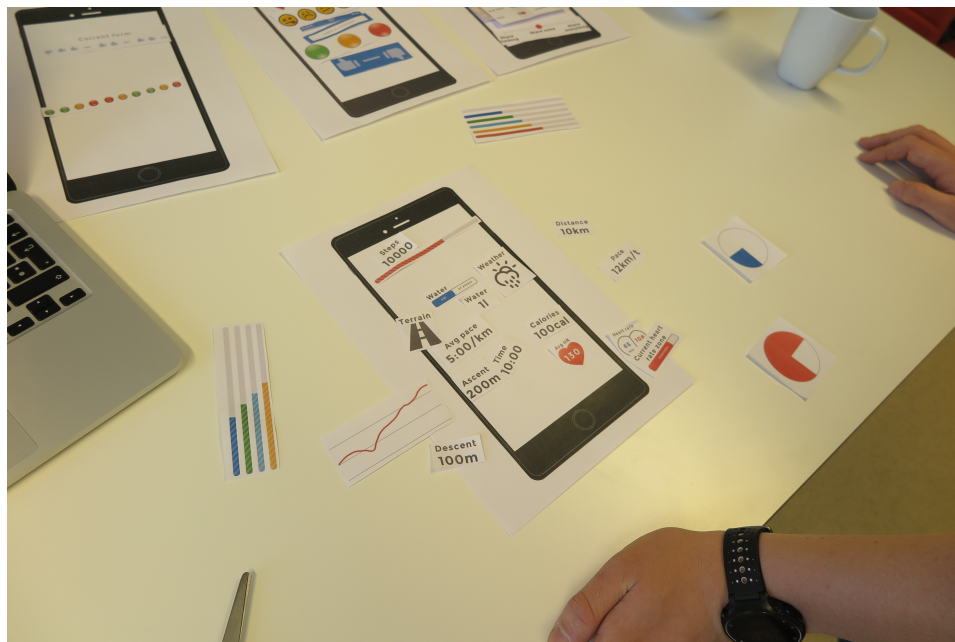


Figure 5.19: First task, completed by one of the participants

The second task was to consider different ways of giving subjective feedback on a workout. The importance of how a workout felt was something that came up in the interviews and the workshop. As one of the participants that only had time for the interview said, "One of my goals are to have a majority of workouts that I evaluate as good workouts. That is one way to know if I am getting better." They all expressed that they wanted the alternative to write a comment, a textual feedback to each workout in addition to the general indication on how it went. The feedback was designed as a scale, where they had two alternatives to the size, which shown in figure 5.15a, the scale had a size of three or five. All three participants picked five choices for grading the workout, as it gave them "more variation which is needed when considering a workout". Then there was the question of which of the representations of the five alternatives were preferable. We

thoroughly discussed the alternatives and ended up deeming the faces too emotional, and the stars too unrelated to the activity, i.e. it would be better to rate a movie with stars, not a workout. They all liked the arrows with the colors indicating the workout, red arrow down equals a poor workout and green arrow up equals an excellent workout.

Related to the second task, the third task was to discuss how the subjective evaluation over time would give an indication if form, as shown in figure 5.15b. There was a discussion during the workshop with two participants whether an overview of the last ten evaluations would be enough to say something about form. They concluded that the overview would give a short-term indication, but if they wanted a more comprehensive overview, they would prefer the graph, showing performance over time in a more understandable manner. The graph also made sense concerning the previous task, where the arrows indicated the direction of the graph. All the participants ended up wanting to have the graph, and one of them even wanted both, to get short term and long term indication.

The forth task was to discuss the authority over their data they had in the app, by looking at a sharing functionality. The alternatives they had were to manually control every aspect of their performance to share, while on the other hand have to choose from a set of presets for sharing as shown in figure 5.14b. Two of the participants liked the idea of having complete control over what they shared. Since they were both open to share workout data with an online community, they both saw positive sides of having to check the boxes of data that they were going to share. One of the positive sides they mentioned were the raised awareness of what they were sharing by actively having to choose it.

To summarize the first part, with a focus on the findings that relate to the themes, namely context, motivation, and authority. The participants expressed that contextually relevant data would increase motivation for usage. So here the themes are interconnected. This is related to the findings from the third task, making me believe that the participants are more interested in a long-term context rather than a short term, especially if they are motivated to use the app long term. The design for subjective evaluation seemed to be best motivated when having an emotionally neutral design, just using colors and arrows to indicate form, instead of emoticons. As for the last task, the sense of authority when having the full overview of what is shared seemed to resonate better with the participants. For even better authority, the participants who were not as open to sharing his data wanted an alternative not to share data at all.

Having these findings in mind, the second part of the workshop was to look at how I had solved the design problems related to the findings from the first workshop. Based on how the participants had solved it, and questions I had prepared, we reflected on how a more interactive prototype could tell us more about the design.

Part two

The second part was dependent on the participants' willingness to explore the interactive prototype handed to them. The authenticity gained by giving them the prototype on the intended device helped them keeping up the interest for the intended ten minutes they had to explore it, as shown in figure 5.17. The prototype was more comprehensive than what they had just participated in designing, giving them more features and designs, but it was made based on what was discussed in the first workshop. This was pointed out by one of the participants who wanted to have music integration in the app, and another who wanted to invite friends to join his workouts. Without asking, I got feedback that the navigational structure was easy to understand and that there was a lot of "space" in my design. This was something they liked because it did not clutter the screen with information, and presented the data it did in a very understandable way. As for the content, when I asked the participants what they thought about the level of detail, they could compare with what they had designed in the first part. We found out that there were differences compared to what they had designed, from representation to actual content. While they did not explicitly disagree with my design, they explained how they would have presented different sets of data differently to fit their specific usage.

Since all of them had chosen a five-alternative design for subjective evaluation of a workout, we talked a lot about how I had done it, since that was a three-alternative design using symbols. While they liked the way it had been implemented, they expressed that, over time, they would be missing more alternatives. This also applied to how performance was shown over time, by looking at how overall stats were presented and how the subjective evaluation could indicate current form. One of the participants concluded that if he was to invest in a long-term involvement in the app, the app should provide the right motivation to do so, especially considering that my participants are more than casual exercisers and would use this daily as a tool to control their activity.

As for sharing their workout, the two participants who were open to sharing their data, liked the way it was implemented, letting them manually control what to share. The last participant reassured me that he wanted a feature for not sharing any data at all, disabling the online community functionality completely.

To summarize, the comparison between what the participants had designed and what I presented in the prototype gave me some ideas on how to improve and drive my design further, which was the goal of the workshop. By discussing design decisions with the participants, letting them express themselves through design, we gained a deeper understanding of what is important when making a health app for athletes, which touches on the broader goal of the whole thesis and the research area. This raises a topic regarding design for long-term. It raises awareness of design that motivates long-term usage for a user group that is intended to use this health app as a part of their daily life. Their perception of how they perform should be reflected in the app in a way that resonates well with their lifeworld,

increasing understanding. I will come back to this in the discussion.

5.5.4 Summary of design process

The process consisted of a scoping interview, five individual interviews, a future workshop, prototype design, and a second workshop. This concludes the participatory involvement, and therefore also the design process. I could apply the changes that the participants wanted in the prototype, but without a way to validate my changes with the participants, the effort would be outside the methodological scope of PD, and therefore I deem it not necessary. Even though it might seem like the process was cut off at an awkward time, it makes sense to prioritize the theoretical contributions over using the time to redo design that will not generate further findings.

To illustrate the design process, I want to look at it as part of a user-oriented design cycle, as presented by Bratteteig et al. [9]. This cycle can identify the steps taken in the design process, connecting the methods to each step. In figure 5.20, the steps of the design cycle are illustrated as black boxes, and the methods I used illustrated by blue ovals with dotted lines to represent a connection with each step.

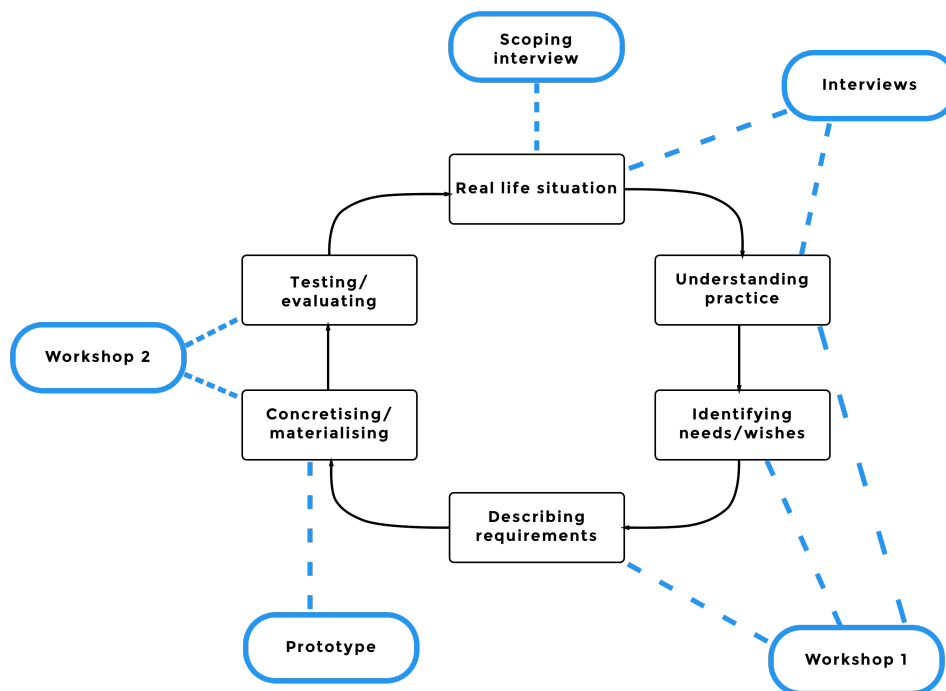


Figure 5.20: Design cycle based on Bratteteig et al. [9] illustrating my design process

Chapter 6

Discussion

I locate my discussion in the theoretical tension between the concepts of SQ and lifeworld. I will work toward answering my research question, which is: "How do young male athletes experience their bodies in the context of the design and use of health applications?" As I highlight findings that contribute to the understanding of the needs of the athlete, the answer to the research question might emerge. I will argue that the design process and the results of it have worked as a mean to an end, where the end is to reflect on how PD and AT have formed the results, facilitating a discussion led by the perspectives of SQ and lifeworld.

The chapter will be structured as follows; I will discuss important findings to answer the research question in the light of the literature and the conceptual and theoretical aspects of it. The topics of discussion are not an exclusion of each other, they are rather intertwined and create a holistic understanding of the participants' experience.

6.1 The experience of health apps as dehumanizing/humanizing

SQ activities might humanize or dehumanize how the participants experience their bodies [43], which I will argue can be extended to relate to their lifeworld, and hence, the lived body. The health apps used by the participants are experienced as dehumanizing, focusing on numbers and performances in the timeframe of the apps, and not the participants themselves. The apps are not concerned with the whole body, just the numbers it produces. A parallel can be drawn to how van der Velden and Sommervold [85] implement lifeworld-led care in their study, which focuses on the well-being of the whole body, not just a diagnose or a condition. What I have found through the PD process is that this is a complex manner that demands a lot from the designer to comply with the participants' needs and facilitate a lifeworld-friendly, humanized environment.

One of the findings from the future workshop was the critique against app's that made a promise of a quantitative result in a certain amount of time. The critique was primarily aimed at the apps promise of result, for example, weight loss or better stamina, but was also extended to the time

frame in which the result was promised. This critique corroborates the assumption that tracking only has relevance over time [85]. Lifeworld's dimension of temporality can tell us something about in what timeframe tracking has relevance, which is in the user's timeframe, not the apps, which is a good example of dehumanization of use. If the app makes a promise of results in a certain amount of time, for instance, weight loss in six weeks, it might collide with the user's temporal experience, as they experience time differently than the app. My findings indicate a long-term commitment to the tracking and analysis of health data by the participants. One of the participants were at a level where he reflected upon whether he had a majority of workouts that he would categorize as "good" over a period and that this dictated whether his performance was increasing or decreasing. This points to a deeper reflection than what an app can present, and the app can only serve as a tool for mediation of the data. Another finding from the interview indicates skepticism towards short-term improvements motivated by health apps, with little relevance to the participant's lifeworld, because in a temporal sense, they want to control the app in their time, not the apps time.

Lupton [42] is skeptical to the allure that happens when we produce or experience the lived body through SQ activities, trusting numbers over physical sensations. On the other hand, SQ practices can be experienced as humanizing. I tried to realize this by implementing functionality for subjective feedback after an exercise, which all the participants found useful, especially after they had a say for how it should function. Papadopoulos supports this view of some SQ practices [54, pp.151], calling it embodied subjectification, which in lifeworld terms would mean that the "here" of the body can be comprehensively understood through the SQ practices.

6.2 The experience of the miscommunication of data

The participants criticized the health apps and mHealth technology for not being accurate enough, or rather the conception of it being inaccurate. As an extension of the critique, it can be related to the potential of miscommunication between what the technology is presenting about the body, and how it is felt by the user. The participants also critique how the apps are poorly designed, and does not "feel" like it is giving them what they need - which also points to an experience of miscommunication. Even though the sensors might be accurate to record health data, the conception is that they are most likely not, and because of that, some of them are skeptical of the authority assigned to the numbers. Not because of the numbers themselves, but how they are perceived. Is this related to the narrative presented by the app about their bodies?

The miscommunication between quantitative data and the interpretation can be damaging to how the participants experience their bodies. My findings suggest that the participant's awareness to this varies, in fact, only one of them expressed concern about athletes not finding joy and progression of exercise outside the quantification of it. The same participant

spoke of taking control of the numbers, instead of the numbers taking control over how the body is perceived.

There is a contradiction between living quantitatively in a qualitative lived body. An argument that supports a lifeworld attitude in health apps is the point made by Mol towards people with diabetes always living in "calculative mode", while they "simultaneously accept that their bodies never behave according to the rules and refuse to completely fit into carefully made calculations"[48, pp.19]. The challenge of this contradiction is where the challenge for design lies. Is it possible to design a health app that copes with living quantitatively in a qualitative world? Or is it just a futile attempt to articulate the complexities of lived life? Todres et al. puts it adequately:

"Just as fish may take for granted the water they swim in, we as humans may find it difficult to notice and articulate the humanly qualitative nature of the world we live in." [81, pp.55]

When making the prototype, I took steps to implement a qualitative feature by making the user evaluate themselves subjectively after a workout, as the results of the first workshop indicated that they wanted. This was not a unique or innovative feature, but my findings support that the participants saw this as a way of balancing the narrative made by the app, letting them have control of the communication.

6.3 The experience of control over data

Having control of their data was relevant to my participants. Control in the sense of knowing and reflecting on what data that was relevant to their development as athletes. As a way of keeping track of development, the apps often set goals for the users. If the SQ goals are experienced as an anchor, something that provokes guilt and neglect, as experienced by the participants in the study by Sjolint et al. [74] where the preset step goal of ten thousand steps had negative effects on the motivation for use. The app set the goal, and the participants might experience this as lack of control over their own data, which also dehumanize the experience. On the other hand, during the scoping interview conducted for my study, the participants pointed out that goals were important for the motivation of use. The relation between setting activity goals and experiencing control over own data remains unclear, in the literature as well as the participants.

Weidemann sees SQ practices as a way of problematizing everyday life, the user's lifeworld. If the body is viewed as a place for quantitative improvement, the problematization might be very negative for the user's perception of themselves [88]. Augmenting bodily functions that previously were not available as quantitative data requires a high level of reflective thinking to take control of the data, something that might not have been necessary in the first place.

Some literature promotes quantitative data as a way of overriding the body's "natural" experience: "Your body is the ultimate interface problem. Sometimes it just doesn't give you the feedback you need... We create the

tight feedback loops your body is missing to keep you healthy” [42, pp.9]. Lupton is citing this quote and is critical to whether this is a healthy way to view mHealth technology. If this was considered the truth about the body, although it certainly might be in some cases, we risk of reducing our control of the lived body to something that can be quantified, which according to lifeworld literature falls outside the definition of it [14, 57, 81, 82, 85].

6.4 The experience of emotional attachment to data

It was important for my participants that the health app presents data that is relevant to their motivation for using the app, and that the design should be easy to understand, and at the same time comprehensive. Sjöklint et al. found through a study of self-quantifiers that it is a complex activity where the intention of use might vary from developer to user [74]. Sjöklint presents that the technology was used more as a tool for re-focusing by the participants in that study. As with my participants, the explicit attainment of goals by using health apps was not the primary reason for using it. The main reason for many of the participants was to organize, plan and track activity to get an overview over time. This contradiction between the intended goal from the creator and the expectation from the user might be the source of negative emotions towards the app, because of the attachment to the health data. I claim that when we consider the participant’s lived body in health app design, then we avoid negative emotions, unpleasant reactions or coping mechanisms that can occur when interpreting personal health data.

Lupton also points out the emotional implications of incorporating a certain technology into a lifeworld as a potential for ambivalence, which certainly can describe some of the experiences from the participants [42]. The width in my findings shows varying emotions and attitudes towards health apps from being reflectively negative, overly positive, and indifferent.

Ruckenstein defines SQ practices as something that “seeks to make known something that is typically not a subject of reflection” [65, pp.69], feeding the modern notion of control of the body through numbers. An effect of SQ practices is that the users subject their everyday lives, their lifeworld, to introspection and scrutiny. Their bodies become transparent, not only to themselves, but everyone they share their data with. The experience of knowing extensive information about the body and how it performs might have negative effects, as critics of SQ point out [42, 74, 88].

“Self knowledge through numbers” is the slogan for the Quantified Self webpage¹. How knowledge about the body is created and interpreted had consequences for the lived body. If the body is reduced to numbers on a screen, where the user feels the responsibility to act based on the numbers, seeking progression, success, and happiness based on the numbers, risking the emotional attachment of the data to dictate actions.

¹<https://quantifiedself.com>

6.5 Bridging the gap between SQ and the lived body

The tension between SQ and lifeworld has also been an area where researchers have wished to find a link, by discussing how the quantitative data are "capable of encroaching on the phenomenological triad of self, corporeal body and lived body" [88, pp.208]. In other words, the user's lifeworld might have a positive effect from the reflection upon the numbers given by the SQ practices, thereby bridging the gap between SQ and the lived body, easing the tension between them. My research data shows that this might be a simplification of the complexity of a person's lifeworld, especially given that all the participants were more or less skeptical about the use of health apps at one stage in the research process, no matter their preconception of the topics. At the same time, under the right conditions, SQ activities might be productive. While none of the participants experienced the apps to be productive in terms of results, Lupton points to an overwhelmingly positive SQ literature regarding the results of health apps, ultimately motivating her critical view [42, 44].

Patel et al. describes "The gap between recording information and changing behavior is substantial, however, and while these devices are increasing in popularity, little evidence suggests that they are bridging that gap" [55, pp.459]. They go on to show from a study done in the United States that half of the users quit using the health trackers, and a third of them within six months [55]. This being a study on wearable health trackers, they suggest a solution being to leverage the smartphone to track health, since this is less demanding for the users, and the smartphones are technically feasible to do that, as discussed in chapter 2. This potential solution fits well with what one of the participants frequently talked about in the interview and both workshops. He was predominately negative to the use of wearable health trackers, due to many of the same reasons that Patel et al. describe as the gap between recording information and changing behavior. Accuracy, price, design, and intrusiveness was discussed during the future workshop and correlates with the points made by Patel et al. [55]. While the emphasis on utilizing the smartphone's capacity to track health solve one aspect of the design problems related to the technology, the gap between a body presented as quantitative to a user living in a qualitative world remains.

Chapter 7

Critical Reflections

After working on a study for well over a year, the process of shaping the thesis needs a retrospective assessment. With the benefit of hindsight, and still in the course of writing the closing chapters, this chapter is dedicated to reviewing the process, looking at what went well, and what challenges I had. My aim is to present the strengths, weaknesses, and limitations of my work.

7.1 Positioning my work in the theoretical landscape

As mentioned in the introduction, a quick search revealed little previous research on what I wanted to study. However, a greater effort at the beginning of my research could have been focused on positioning my work related to relevant theoretical and conceptual terminology through a chapter that many call a literature review.

“So what I have to tell in the present book does not just relate to the events that figure in my stories. It also relates to other texts. Lots of them. Texts about hospitals and other medical practices, texts about bodies and diseases, but also texts about entirely different topics. Systems and events, controversies, similarities and differences, co-existence, methods, politics. If I am to make explicit how this text departs from others around it, if I want to show how it both differs from them and is made possible by them, I will have to relate to the literature.” [49, pp.2-3]

This quote provides clarity for why research has to be seen in context, i.e., the landscape that is the area of research. Writing an academic book often requires substantially more work with related literature, but the author makes a valid point for why relate to others who have written about the same topics to position the work. In my thesis, the positioning could be clearer in the context of existing research, even though literature is apparent, examined, and used actively throughout the paper. My background chapter presents the technology and its feasibility well but could benefit from a theoretical positioning as well.

7.2 User group

When reflecting on the selection of participants, I became aware of Stenberg's [78] findings indicating that single-gender studies are to a greater extent represented by men. In my study, which is a single-gender study, I am guilty of confirming her findings, contributing to only half of the potential participants. It is not my intention to make the male gender the norm for any research field, and Stenberg urges the discourse and justification of single-gender studies to avoid a systematic exclusion of a gender-group [78].

My reasons for choosing male athletes as my participants are twofold, and the decision was made after the scoping interview. The first reason was gender sensitive, as I am a man, asking female athletes explicitly about personal health information and self-tracking might have resulted in uncomfortable situations for either me or the athlete. The other reason was a practical one and relates to the access to participants. To get a representation of the user group, it would require me to have approximately as many female as male participants. Not that any less female potential participants are at the certain level of activity that I sought, but through my network, there were scarcely enough willing participants to complete the single-gender study.

Some may not agree with my justification for excluding female participants in my study, as gender sensitivity might be seen as a cowardly way of expressing reluctance towards studying on female participants. Maybe in a different setting, and with a team of researchers to be better equipped to meet different people and with a larger network, the user group could be expanded. However, I am not claiming any of the results to be gender-specific, the way I see it, but this is only speculation since the results might have been different if both genders were involved. The point here being Stenberg's encouragement to justify single-gender studies. I am, in fact, on the outskirts of the user group myself. Even though I am not at the same level as the participants, I still felt like a part of the community I was studying, which made it easy for me to communicate and relate to them.

7.2.1 Participants

Estimating the number of participants for the type of study I was embarking on was difficult. How many do I need to interview? How much time does it take? How many should attend a workshop? Also, before asking those questions, I had to figure out whom to invite to the study and how to contact them. I started out by conducting one scoping interview with two participants, which I, in hindsight, wish could have more impact on the findings by, for example, conducting several scoping interviews.

The interviews went well. It was easy to organize, the previous experience gave me confidence, and last but not least, the number of participants; five for the interviews, three for the workshops. Then, at the beginning of 2017, the workshops was to be organized which proved more troublesome than I had anticipated. In addition to no previous

experience conducting workshops, finding a time that corresponded with all the participant's schedules, made the process time-consuming. Considering the challenges of the numbers of participants and the lack of experience, the workshops went well, and the same three participants contributed to both.

7.2.2 My roles

As already mentioned, I was considered a part of the community, and I used my position to connect with them. I experienced trust, which I did not necessarily expect in the early stages of the study. They could have thought that I would not understand them and their experiences, given my role as a researcher, and I did not know whether they would be open to conversation, given the intimacy and privacy of the topics we discussed. I cannot recall an episode from any of the interviews or workshops that were uncomfortable in that way, thanks to the openness of the participants.

Many of the roles I had during the process, I had little or none experience of having. This was demanding at times, for example before the first workshop. I have experience conducting semi-structured interviews from previous projects, but being facilitator, co-designer and researcher at the same time during the workshops was entirely new to me. Qualitative studies often demand more from the people conducting them regarding getting data in-the-moment and is a skill that is developed over time. Measures were made to carefully plan the workshops, which was necessary and resulted in the successful completion of both workshops. I consider this to be a strength in the methodological framework, to ensure the right steps are made to use the methods within the framework. Nonetheless, a need to critically reflect on my role as a researcher is evident. How did I affect the results? What findings did I miss during the process? Could I have gone a different direction? In what way would the results be different if I had more experience? Would I have time for another iteration? Also, what difference would it make? These are questions that are relevant to ask, regardless of previous experience, and serves as a base of speculation for what could have been.

My role when making the prototype might be considered too dominant, i.e. I found it difficult to limit my role as co-designer. I wanted to show that I could design something that I would consider useful, and the result was a prototype that was too finished. A consequence of this might be that the participants found it hard to suggest improvements on a design that appeared finished. Even though this might have limited the co-designer role of the participants, a valuable learning experience can be drawn from the fact that my design deviated from what they preferred during the second workshop, showing that interpretation can be wrong.

7.3 Research design

The way I designed my research helped me immensely, and I consider it to be a strength in my thesis. Developed over the entirety of the project, with

help from my supervisor, the design guided my work from start to finish. It ensured that I kept track of how the elements of the thesis are connected and that the concepts I introduce are justified and serves its purpose in the creation of knowledge - It is also where I base the contributions and conclusions.

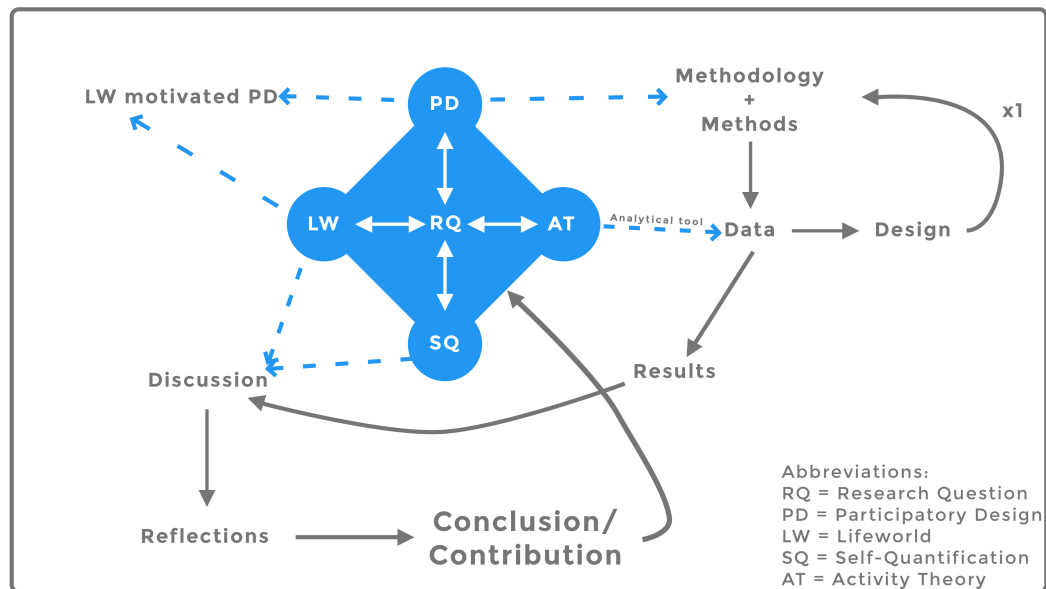


Figure 7.1: Framework

The purpose of figure 7.1 is to illustrate the research design. The solid arrows represent the process, and the blue dotted arrows represent the implication each topic had. At the center, there is the research question, which motivated me to explore the themes and implement them in different parts of the project. For the purpose of keeping the figure understandable, the arrows of implication are simplified, i.e. not excluding the topics from having implications on other parts of the process. Lifeworld motivated the inclusion of PD, which again influenced my choice of methods. AT was used as an analytical tool leading into the first design iteration. I only iterated once, giving me sufficient data to call results, acting as a base for the discussion. I saw the need to reflect on the process so far before stating the contributions, which concludes the framework by pointing back to the research question.

7.3.1 Methodology

PD had its strength in my project in that it provided insight to the participants lifeworld, letting them express their opinions and experiences. After reconsidering the way knowledge is developed through the theoretical framework, I realized that my perspective of knowledge has shifted from an interpretive research paradigm to a critical research paradigm. The way I have implemented a PD process fits a categorisation of critical research as Klein and Myers present it [51]. My aim is to understand the extent of

the "authority" of SQ systems in the circumstances of the participants, and apply a critical view to it to transform it, which can be realized through, for example, *mutual learning* and *having a say*.

The principles for critical research presented by Cecez-Kecmanovic also fits how PD was implemented in my thesis, especially the *principle of individual emancipation* that:

"reflects a fundamental idea about freeing individuals from repressive social and ideological conditions, realization of human needs and potential, **critical self-reflection** and **self-transformation**; critical researchers have the important task of identifying possibilities of change and assisting the dominated, powerless and exploited to have a voice and emancipate themselves." [13, pp.446-447]

7.3.2 The prototype

When addressing the role the prototype had in my process, I wrote in the previous chapter that the prototype has worked as a mean to an end, meaning that the prototype itself was not the goal of the study. Originally, I intended the prototype to play a bigger role in the thesis as a whole, with a focus on a contribution to PD, but three intertwined factors made me shift focus. The first one was time constraint - For practical reasons I could not have spent much more time conducting workshops if I wanted to finish my research within the deadline. Secondly, my shift towards a critical research paradigm made me focus my work on the tension related to my theoretical framework, while still using the results from developing and testing the prototype when going that direction. Lastly, and closely related to the second reason, was the sustainability of my PD project. Kensing and Blomberg [30] raise the issue of PD projects often ending as small-scale projects that are isolated, which is the case for my study. As a way of dealing with the sustainability issue, I applied the results of my PD project, the prototype, to the larger discussion that emerged in the tension between SQ and lifeworld.

The development of the prototype itself could have benefited from following a more strict PD process, focusing more on participant involvement instead of my interpretation of the findings from the future workshop. Interpretations that proved to be different than what the participants preferred, as discovered in the second workshop.

Chapter 8

Conclusion

The thesis has presented a process aiming to understand how young male athletes relate to, interact with, and experience their health data through health apps. The research on health apps used in everyday life of a young male athlete is lacking and was my motivation to research this topic. Being a part of KULU, I used PD as my methodology, which guided my choice of methods to gather data. First, I conducted a scoping interview to begin the exploration of the topics, and get an initial understanding of the user group. Then followed five individual interviews with athletes from different sports to get a deeper understanding of their experiences regarding SQ activities. Following the analysis of the interviews, I conducted a future workshop which led to a prototype design based on my interpretation of what the participants wanted through AT. The prototype was then used in a second workshop where the participants contributed to the design, as well as giving feedback on the prototype. The process uncovered findings of how the participants experienced SQ activities through health apps and served as a base for the discussion, which was located between the tension of the theoretical concepts of lifeworld and SQ. My research question is:

How do young male athletes experience their bodies in the context of the design and use of health applications?

I found in my study that the participants do not prefer health apps or SQ activities that only present a quantitative body, i.e., apps that only consider the numbers they feed it instead of the whole person. The young male athletes experience health technology in the tension between doing SQ activities and applying the results to their lifeworld. My findings indicate that they tend to experience the health apps as dehumanizing, rather than humanizing. They have to choose how much control the apps should have over them, and in the process, miscommunication might happen, and emotions related to the process are decisive to their future use of mHealth technology. The tension can also be experienced as being pulled in one or the other direction, either towards thinking the data the app presents are valid data to say something about their lives, or on the other hand, a critical view of that the data means for their lives, leaning more towards a lifeworld view of health data.

Health data presented by a health app is not a comprehensive representation of the empirical world, i.e. the lived body, and is solely subjected to interpretation by the participants, an interpretation that is affected and will affect the lifeworld of the user. When designing health apps, the presentation of data has to be relevant to the users lived body, which in itself might be seen as a contradiction because the app does not know the lived body, just the numbers it provides. As already mentioned, this is where the design challenge lies.

In addition to expressing their experience through discussions during the study, the participants show how they experience their bodies through the design of the prototype. The combination of lifeworld, PD and the methods I used enabled me to understand how they experience their lived bodies. The fact that they wanted to be in control and give subjective feedback on workouts points to this. Also, that they wanted to be able to control all the content they share when they share a workout. PD allowed the participants to express themselves, giving me a better understanding of their lived bodies.

8.1 Contributions

Within the field of HCI I locate the concept of SQ, AT as the analytical tool and PD methodology, from phenomenology I find the concepts of lifeworld and lived body. These elements guided my thesis and resulted in the research design shown in figure 7.1. As well as showing the conceptual, analytical and methodological topics, it shows how the process was organized and connected with the different topics, which has helped me organise my contributions, which are:

- The research design itself, adding a new perspective to a larger discussion about SQ-practices versus the lived body through rich description of the process and methods used to gather empirical data. Can be used to replicate the approach to study the implications of mHealth with other groups of participants.
- To use PD as a way of gaining insight to the participants lifeworld. Although my PD process was not ideally implemented, the flexibility of the methodological framework provided the data I needed to explore the design issues.
- Give a critical view of SQ activities, motivating a design for the participants' lived bodies. This was realized in the theoretical gap between SQ and lifeworld. Knowledge of the participants' lifeworld has given a critical view to how we implement SQ activities into our lives.
- Using AT as an analytical tool to organize features wanted from mHealth technology, as well as a comprehensive way of describing SQ activities.

8.2 Future work

As a contribution to KULU and the research on mHealth, I need to address the potential of future work. I have proposed a research design for uncovering design issues related to users interaction with health data, with a user group that has complex needs when it comes to data about their bodies. Other user groups might have different needs and could be complex in a variety of ways, but the framework provides an approach to explore the issues. Two things are required to utilize the framework; a user group, and activity related to mHealth data.

This study takes steps to understand how design can help users self-reflect on health data and experience health apps in a constructive manner. Additional measures can be taken towards understanding more about the implications of living quantitatively in a qualitative world, by continue exploring the gap between SQ and lifeworld to uncover more empirical data on how to design for a qualitative body.

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Appendices

Appendix A

Concent form

Forespørsel om deltakelse i KULU

Design av kul teknologi med unge

Dersom du ønsker å være med videre i studiet og være deltaker under et designverksted, vil en separat liste med dine opplysninger lages så jeg kan komme i kontakt med deg. Denne listen vil bare være synlig for meg, og kan ikke knyttes opp mot studiet.

5. Kontaktinformasjon

Hvis du har noen spørsmål angående studien eller hvis du senere har lyst til å trekke deg, kan du kontakte meg på tlf. 980 95 155 eller på e-post til eiriklil@ifi.uio.no.

Muntlig samtykke til deltakelse i studien

Grunnen til at jeg kun krever muntlig samtykke på å være med i studien, er for å følge retningslinjer fra NSD (Norsk Samfunnsvitenskapelige Datatjeneste) for å behandle persondata. Ingen enkeltpersoner vil være gjenkjennelige, ikke en gang på samtykkeerklæringen.

1. Bakgrunnsinformasjon

Vi er en gruppe forskere og masterstudenter ved Institutt for Informatikk, Universitetet i Oslo. Målet vårt er å lage kule digitale teknologier som støtter ungdom i sin hverdag, hjemme, på skole og i sykehuset når de har langvarige helseutfordringer. Jeg skal organisere intervjuer og designverksteder med unge idrettsutøvere i alderen 18-25 år der helse og trening står i fokus, og hvordan digital teknologi kan brukes for å støtte dette. Du trenger ikke ha omfattende kunnskap om digital teknologi for å være med i studien.

2. Hva innebærer studien?

Jeg ønsker å invitere unge med bakgrunn eller erfaring innen idrett til intervjuer og verksteder for design av en ny app for trening og/eller helse som skal støtte utøveren.

Studien tar utgangspunkt i appene som allerede finnes for å kartlegge helse og trening, treningspraksiser og ulike muligheter for bærbar teknologi. Vi skal snakke om apper, hva som er bra eller mangelfullt med disse og forslag til forbedringer. Vi skal også snakke om hva som ville vært en "perfekt" app for deg.

Intervjuet kan vare fra ti minutter til én halvtime.

Designverkstedene kan vare inntil én time.

3. Mulige fordeler og ulemper

Det vil ikke være noen ulemper ved å delta i denne studien, utover eventuelt ubehag knyttet til intervju situasjonen.

Fordelene ved å delta er at du som deltaker kan bidra til forskningen og utformingen av et design til en app som er tilsiktet idrettsutøvere.

Deltakelse er frivillig, og du kan når som helst trekke deg uten å oppgi grunn. Dersom du ønsker å delta er alt jeg trenger fra deg en muntlig bekreftelse.

4. Hva skjer med informasjonen om deg?

Intervjuet vil bli tatt opp med en lydopptaker, i tillegg til eventuelle notater på en papirblokk. Under designverkstedene blir det tatt lydopptak, i tillegg til bilder av prosessen. Du vil ikke kunne gjenkjennes på bildene. Informasjon om deg som jeg vil ta med meg videre i studiet er: alder, kjønn og eventuell idrett. Navnet ditt vil aldri kunne knyttes til studiet.

Appendix B

Interview guides

B.1 Scoping interview guide

Kartleggende intervju

Innledning

- Fortelle om prosjektet, KULU og samtykke.
- Hva slags telefon har du?
- Hva er din idrett?

Hoveddel

- Hva er din erfaring med helse/treningsapper?

Bruker du apper til å...

- Loggføre fysisk aktivitet?
 - o Hvis ja, spør hvorfor.
 - o Hvis nei, spør hva den tenker om det.
- Loggføre diett/matinntak?
 - o Hvis ja, spør hvorfor.
 - o Hvis nei, spør hva den tenker om det.
- Generelle kroppsfunksjoner? (Søvn, mens, osv)
- Helsedata (Blodtrykk, vekt, puls)
- Sykdom
- Bruker du aktivitetsmålere? (Hvis ikke dette har kommet frem tidligere)
- Hva ville vært en ideell trenings/helse-app for deg?

Avslutning

- Noe annet?

Takk for deltakelse!

Hva jeg vil finne ut:

- Hvorfor bruke trenings/helse-apper?
- Design, funksjon, pris?
- Ideell trenings/helse-app.

B.2 Interview guide

Intervjuguide

Først: overordnede spørsmål, få oversikt over hvilke apper og hvor mye de blir brukt, hva brukeren opplever at blir ”tracket”. Så gå dypere med å stille hvorfor man bruker nettopp den appen, hva er det som er bra med den, design, funksjoner, Hvordan oppfatter man sin egen kropp gjennom den. Hvilket inntrykk sitter man igjen med.

Tema og hvorfor jeg vil forske på dette:

Temaet er unge idrettsutøvere og deres bruk av helseapper. Jeg vil forske på dette for å se om en deltakende designprosess kan være med å sette lys på hvilke behov utøveren har i en helseapp. Jeg skal gjennomføre en rekke intervjuer for å avdekke disse behovene, lytte til ønsker om hvordan en slik app vil se ut for å forberede en design workshop der jeg vil designe en app og evaluere denne med brukere.

Innledning:

- ☐ Introdukere tema og hvorfor vi skal snakke om det.
- ☐ Samtykke

Hoveddel:

- ☐ - Hvilke helse/treningsapper har du på telefonen?
 - Hvis ikke, spør om de kartlegger helse på andre måter.
 - Hvor ofte bruker du den/de?
 - Passivt/Aktivt?
 - Automatisk/Manuelt?
 - Hva blir målt?
 - Hvorfor måler du det?
 - Har du et mål du prøver å nå?
 - Deler du treningsdata med noen?
- ☐ - Kan du fortelle om appen/appene du bruker?
 - Hva kan appen si om kroppen din? Kvantitativt, kvalitativt
 - Er det noe appen kan gjøre bedre enn deg? Dårligere?
 - Hva er det som gjør at du bruker nettopp den? Hvilken funksjonalitet?
 - Har du prøvd noen andre før, evt hvilke?
 - Hva er viktig for deg at appen gjør for deg?
- ☐ - Hvordan ville en treningsapp på best mulig måte hjelpe deg til å oppnå målene dine?
 - Hva vil den kunne måle, hvordan fungerer den?

Avslutning:

- ☐ - Noe du ønsker å legge til?
- ☐ - Har du lyst til å være med på en design workshop med en gruppe for å diskutere design av helse/treningsapper?

Appendix C

Workshop 1 presentation

Design workshop

19 januar, 2017

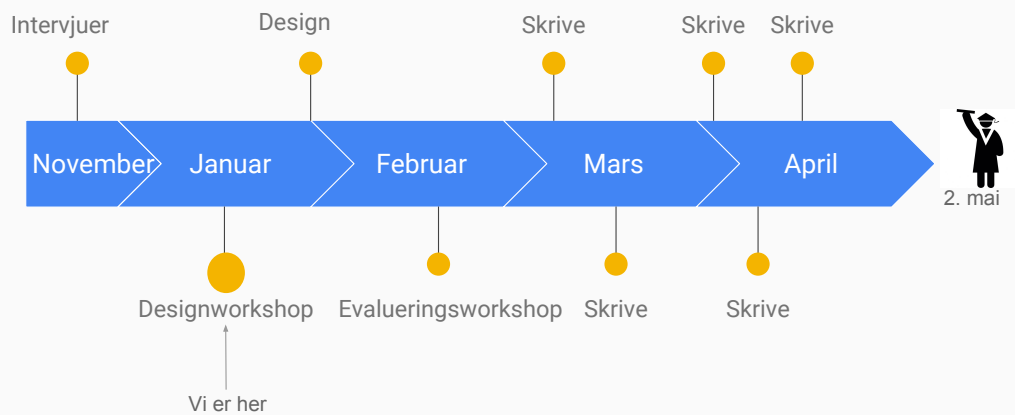


Design av en helseapp for unge
idrettsutøvere mellom 18 og 25 år

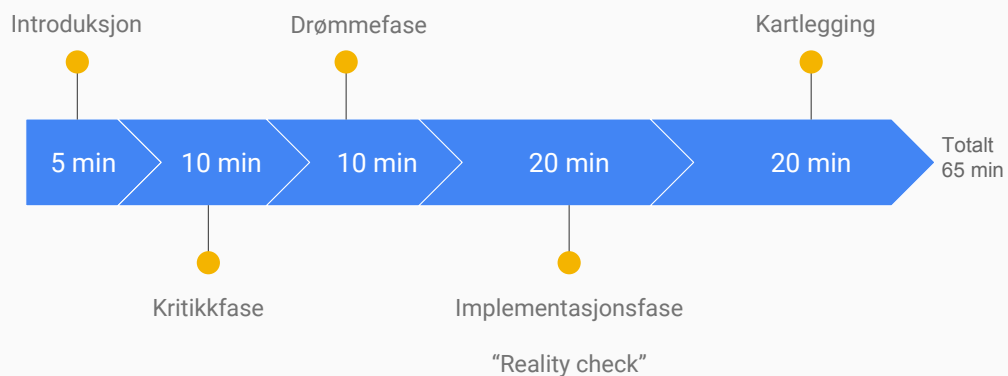
Hva er
interaksjonsdesign?

Å lage en så god og
brukervennlig løsning som
mulig

Plan for våren



Future workshop



Deres roller

- Brukere
- Domene-eksperter
- Med-designere

5 min

● Introduksjon

Mine roller

- Fasilitator
- Forsker
- Med-designer

10 min

● Kritikkfase

Dårlige erfaringer

Problemer med eksisterende tjenester

Ting som mangler i helseapper i dag

10 min

● Drømmefase

Respons til kritikken og de dårlige erfaringene

Hvordan kan det gjøres bedre?

20 min

● Implementasjonsfase

Hvordan kan ideene fra drømmefasen gjøres realistisk?

Hva slags funksjonalitet er viktig?

Tema - Funksjonalitet/Egenskaper

Autoritet: Kontroll over egen data. Deling. Manuell/automatisk input.

Motivasjon: Hva er viktig for å nå et mål?

Kontekst: Når og hvor?

Teknologi: Hva slags teknologi trengs?

20 min

● Kartlegging

Kartlegge egenskaper/funksjonalitet på temaene:

- Autoritet
- Motivasjon
- Kontekst
- Teknologi

Oversikt

Plan:

Kritikkfase

Drømmefase

Implementasjonsfase

Kartlegging

Temas:

Funksjonalitet

Autoritet

Motivasjon

Kontekst

Teknologi

Takk for deltakelse

Appendix D

Prototype preparations

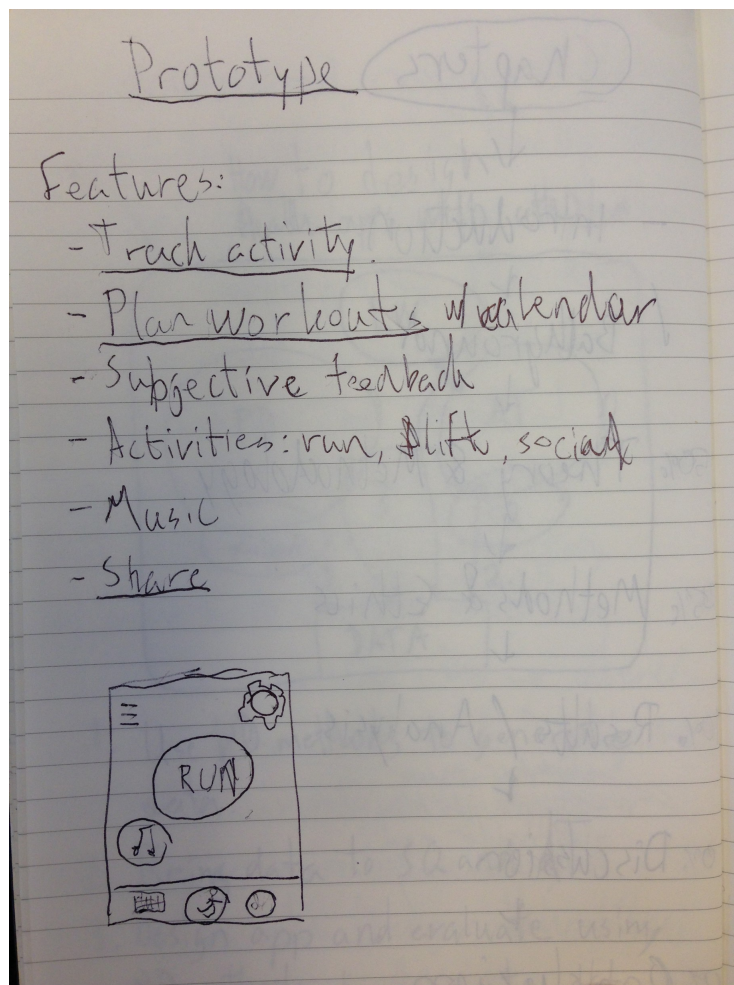


Figure D.1: Paper sketch before using digital tools

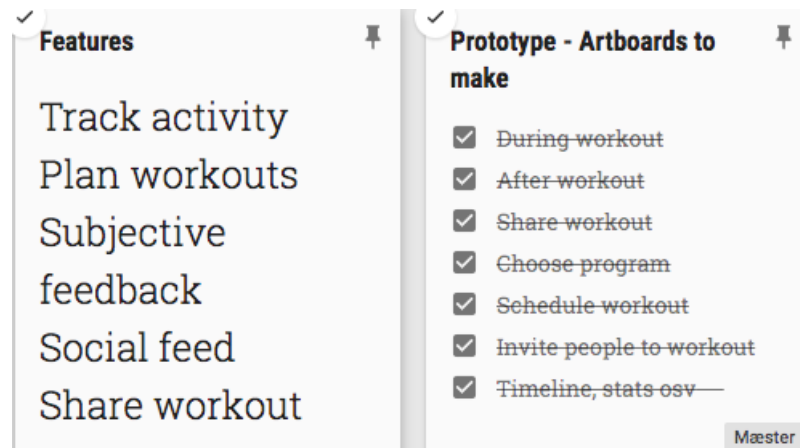


Figure D.2: Keeping track of the progress using Google Keep

Appendix E

Plan for Workshop 2

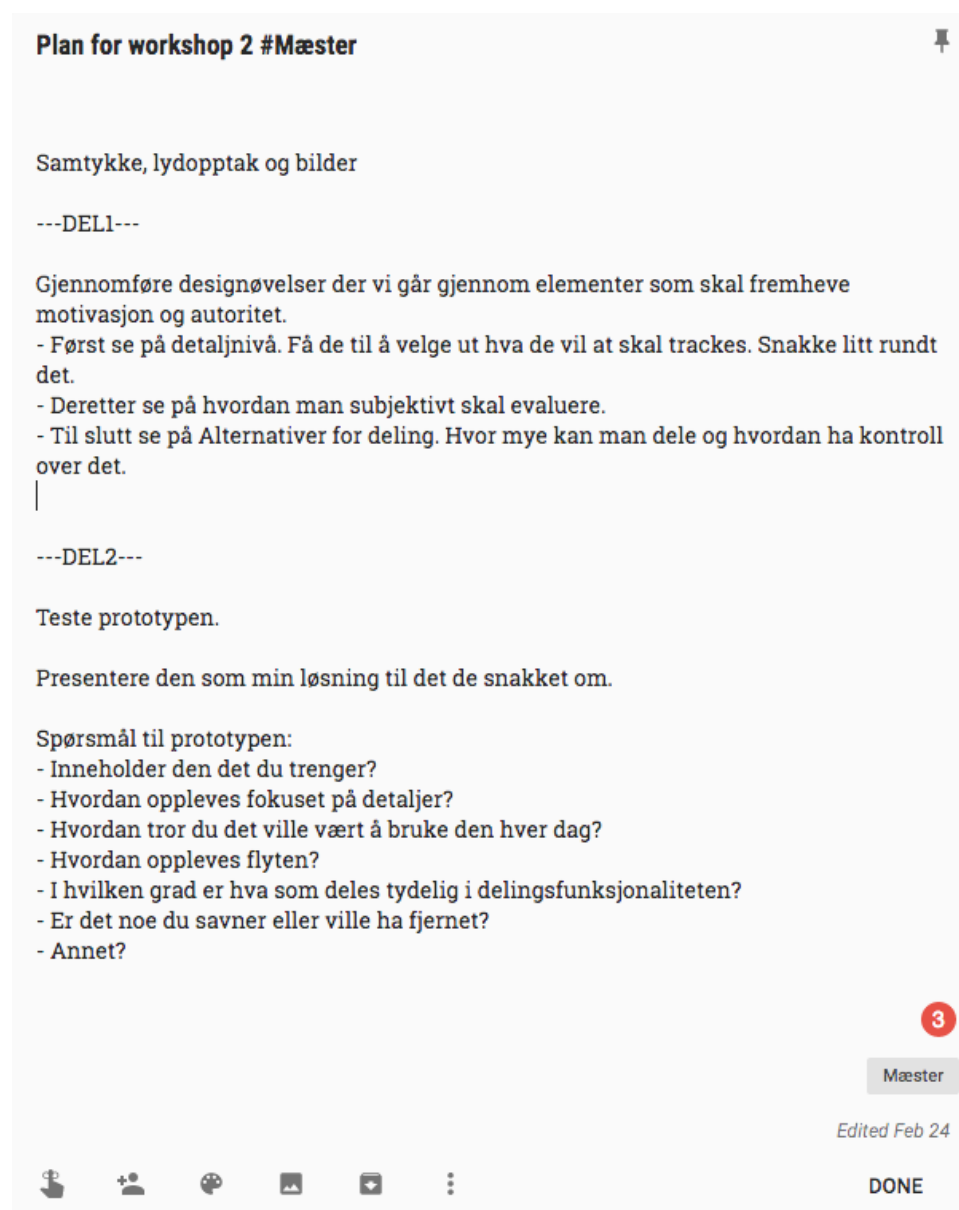


Figure E.1: Plan for workshop 2 organised in Google Keep

Appendix F

Design alternatives for workshop 2



Figure F.1: Alternatives for subjective evaluation

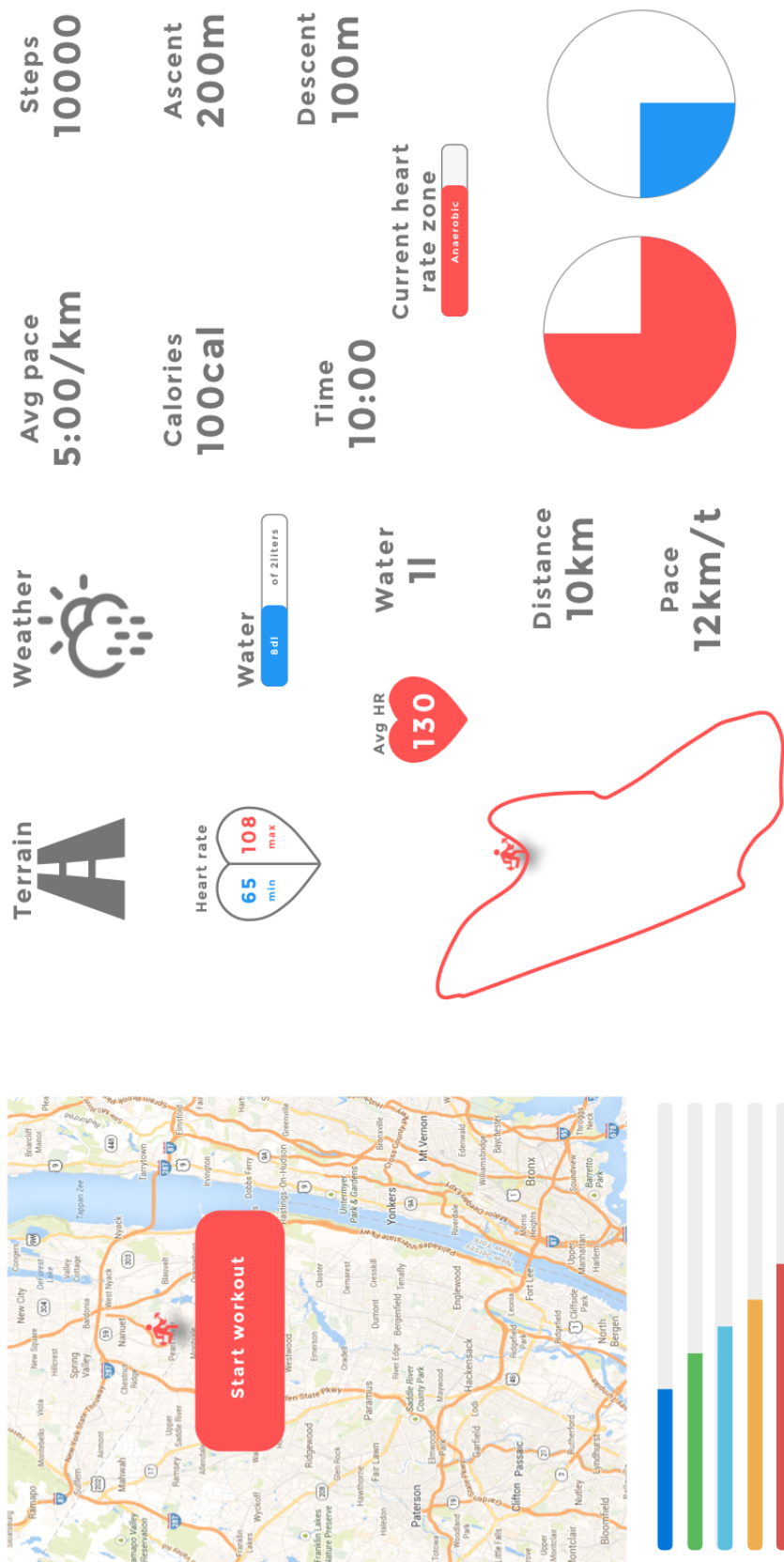


Figure F.2: Alternatives for design during workshop 2