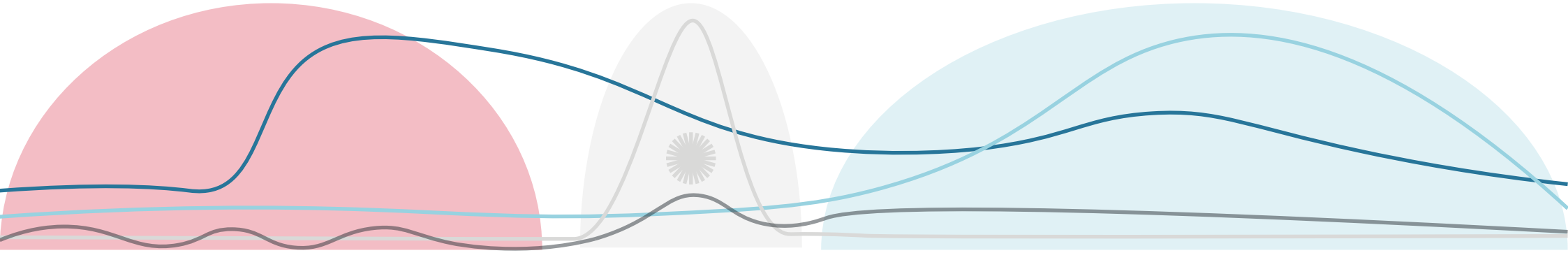


SPORTS AND MENSTRUAL DATA FOR HEALTH AND PERFORMANCE OF ROWERS

Thesis of Julia T. E. Rademaker
MSc. Integrated Product Design
Delft University of Technology

Julia T. E. Rademaker
March, 2024

Master thesis
MSc. Integrated Product Design
Industrial Design Engineering
Delft University of Technology

Supervisory team
Dr.ir. M.H. Sonneveld (Chair)
MSc. A. Gomez Ortega (Mentor)

Disclaimer on Gender Terminology

The terms ‘woman’ and ‘female’ have been used throughout this research. It must be acknowledged that different gender identities can experience the hormonal cycle and that not all menstruating individuals identify as female. However, in the specific context of rowing, the terms female and woman refer to the division that still exists in the sport. Therefore, the terms female and woman are based on the definition given by the World Rowing Federation (World rowing, 2021):

‘Eligibility to compete as a woman: a rower who was identified as and assigned woman and/or female at the time of the rower’s birth and did not medically transition to any other gender than woman by the time that the rower reached puberty shall, unless the Executive Committee determines otherwise, be eligible to compete as a woman; a rower may be declared by the Executive Committee, through the review and determination process under the Bye-Law, to be eligible to compete as a woman.’

An alternative term such as ‘people who menstruate’ may be considered more inclusive, but is not always relevant due to the occurrence of irregular or absent menstrual cycles in the rowing context.
I apologize for any discrimination or exclusion caused by my language, and I understand the necessity of using language that acknowledges gender diversity.

Executive Summary

Over the past few decades, there has been a significant increase in the number of professional female athletes. One thing that both professional and amateur athletes can experience is the effects of their hormonal cycles. These hormonal cycles can affect their performance, and in return, their performance can affect their hormonal cycle. However, the underrepresentation of female athletes in sports research has resulted in most sports guidelines not reflecting this possible connection between the menstrual cycle and performance, causing female athletes to be unaware of it.

Athletes should be aware of the connection between their menstrual cycle and performance. Female rowers, in particular, experience a rapid increase in training load and they may be hesitant to discuss menstrual problems with their coach due to their relative newness to the sport, which could cause them to perform less optimally or even unhealthily. This project aims to find an alternative approach to support female rowers to build their knowledge using their sports and menstrual data so that they can perform optimally and healthily.

This project followed a research-through-design approach. This meant that knowledge was generated through design activities (Stappers & Giaccardi, 2014). The design activities were performed in three cycles to iteratively increase knowledge and improve a design that supported rowers in understanding the connection between their performance and the menstrual cycle. Each cycle began with a theoretical investigation of current design practices. These practices were then applied during a practical phase. The primary objective of each practical phase was to deploy and evaluate a design prototype with rowers.

The first cycle of research investigated how sports and menstrual data could be implemented in designs for female rowers. During the practical phase, a digital prototype was used with rowers and the evaluations indicated that the design should be simplified and place more emphasis on visualization. After the evaluation, a co-creation session was held which suggested that the design should explore the value of sharing the data.

The second cycle of research explored how tracking could be a valuable experience for rowers. The findings from the first cycle led to a physical design prototype that was again used and evaluated by rowers. The evaluations of the second phase suggested that the design should take a broader view of performance, and the co-creation of the second phase placed more emphasis on having different levels of activities by the rowers to understand the data. The knowledge generated throughout the project was synthesized into a final design.

The final design was a mobile application that would support rowers in exploring the relationship between their performance and their menstrual cycle. By tracking their mental, physical, menstrual, and contextual data on a daily basis, rowers could reflect on their beliefs about this relationship. In conclusion, the continuous implementation of insights constructed with stakeholders led to a design that could support rowers in understanding their experiences with performance and the menstrual cycle.

Preface

This thesis documents the process I followed and the results I achieved with my graduation project. This project used a research-through-design approach to investigate how to support rowers in understanding the connection between their menstrual cycle and their performance.

Personal Positioning

As a former lightweight rower and now coach of a freshman women's team, I have seen the fine line that rowers try to walk. Rowers have so much passion and commitment to their sport, that is not uncommon for the training load to increase dramatically in a short period, which puts a lot of strain on the body. In addition to the inspiring dedication of these rowers, I have also seen a negative side. On my first crew, four out of six rowers (ages 18-21) lost their period, and little was done to support them during this time. As I began to learn more about the influence of the menstrual cycle on performance and vice versa, I felt that rowers needed to learn how to recognize and respond to their menstrual cycles. With this project, I wanted to provide the first implementable solution to help rowers recognize this interaction between performance and the menstrual cycle.

Acknowledgments

Marieke,
Thank you for your patience and honesty during this project. Your experience with design methods and sensitive topics was invaluable to this project and my personal development. As you stated, 'research is me-search,' and our conversations have supported me in realizing my strengths as a designer and how pausing and reflecting can further improve them.

Alejandra,
I cannot recall a conversation in the past six months where you did not inspire or excite me with a new perspective on the project. Your passion for data and sports, combined with your critical academic eye, was the perfect combination for this project. I cannot thank you enough for your advice, and I know that it has shaped me as a designer and data enthusiast.

Emma,
Your dedication to bringing the menstrual cycle to the table of athletes was one of the main reasons I landed on this project. Your work and medical knowledge have greatly improved this project. Thank you!

Rowers and coaches,
During this project, I have been inspired by many coaches and rowers from all over the Netherlands. Without their expertise and knowledge, this project would not have been possible. I would like to mention Judith in particular, as you have been a great inspiration in giving rowers a voice and showing me how coaches can see rowers as individuals with more personality than just rowing.

Family,
You have supported me through the ups and downs of this project and my studies in general. Thank you for giving me the space to completely lose myself in the project, which sometimes made me a bit absent. But Reinoud, you constantly reminded me that all will be well in the end and Mamma, you never stopped believing in me and I am so grateful that you will still get to see me graduate. As a family, you have supported me to take care of myself, while making the most of this project.

I hope this report inspires you to understand the importance of recognizing the connection between the menstrual cycle and performance and provides insight into how design can be used to support individuals in under-researched areas.

Julia Rademaker,
13th of March 2024

Table of Content

1.

Project introduction

This graduation design project focuses on the relationship between sports performance and the menstrual cycle of rowers. The aim of the project is to provide insights and tools that will support female rowers optimize their training and performance throughout their menstrual cycle. This chapter explains the context, aim, and structure of this project.

First, this chapter introduces the context of the project by explaining the importance of rowers understanding the complexities of their menstrual cycle. It also highlights the current problems that hinder the understanding of the relationship between sports performance and the menstrual cycle. These exisiting problems flow into what problems this project aims to solve, who this project is relevant to, and how this project positions itself within existing design research. Lastly, it describes how the identified problems and goals guided the structure of this report. The originally established Project Brief is presented in Appendix A1.

1.1 Project Context

Performance and the Menstrual Cycle

Since 1900, the percentage of female athletes in the Summer Olympic Games has increased from 2% to 48% in the 2020 Olympic Games (IOC, 2023). These professional athletes can be role models for young athletes, and the increased visibility of these inspiring athletes has been credited with increasing the overall number of female athletes (Stancometta & IASST, (2023). One thing professional female athletes and other female athletes have in common is that these female athletes can experience hormonal fluctuations as a result of their menstrual cycles. The effects of these hormonal fluctuations could influence the performance of both groups of athletes.

Recent studies have indeed indicated that performance and the menstrual cycle are interconnected. For example, a recent study on rowers has shown that the menstrual cycle can affect the perceived and objective performance of female rowers (Antero et al., 2023). The researchers discovered that rowers had a more negative self-evaluation of their performance during menstruation. This finding is similar to the review by Carmichael et al. (2021), which suggests that subjective ratings of female athletes are dependent on the menstrual cycle. This review compared studies on different sports and how performance was affected by the hormonal cycle.

Interestingly, Carmichael et al. (2021) found that objective examinations of performance do not significantly change across menstrual phases. Objective performance indicators are defined as measurable tests of (an)aerobic and strength performance. Therefore, negative self-evaluation of performance may be psychological, but this does not make the influence of the menstrual cycle on performance insignificant. Sports performances are influenced by various factors, not just objective measurements. For instance, while the maximum power a rower can deliver affects their speed during a race, other factors such as mental focus and technique also determine the winner of a race. Figure 1.1 provides an overview of how menstrual phases may impact performance and sports data (Antero et al., 2023; Carmichael et al., 2021; McKinley et al., 2009; Wundsam, 2023). Supporting this illustration, Figures 1.2 and 1.3 show a diagram of the ovary and the hormones relating to the menstrual cycle. The illustrations show how sports achievement can be influenced by both subjective and objective factors. Thus, knowledge of the effects of the menstrual cycle on performance can support performance optimization.

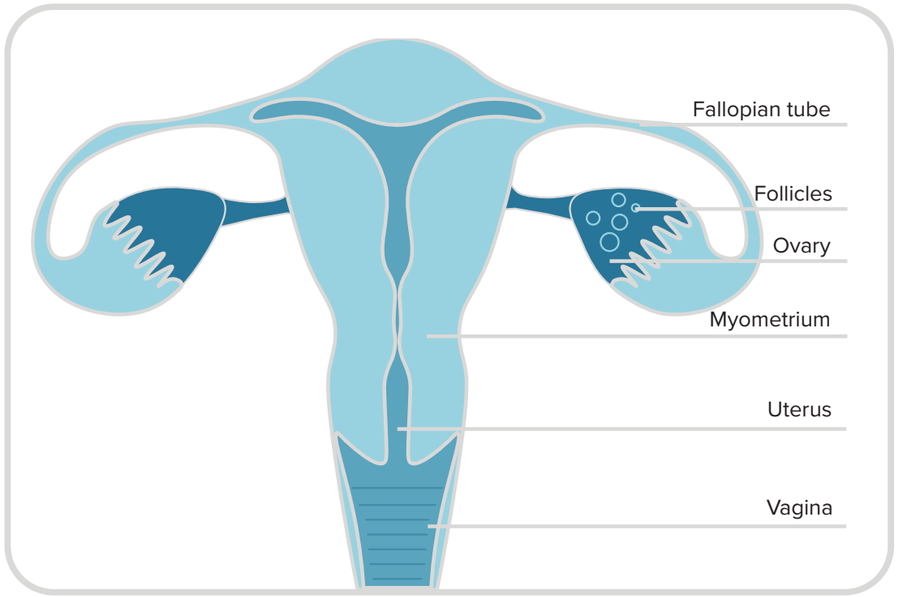
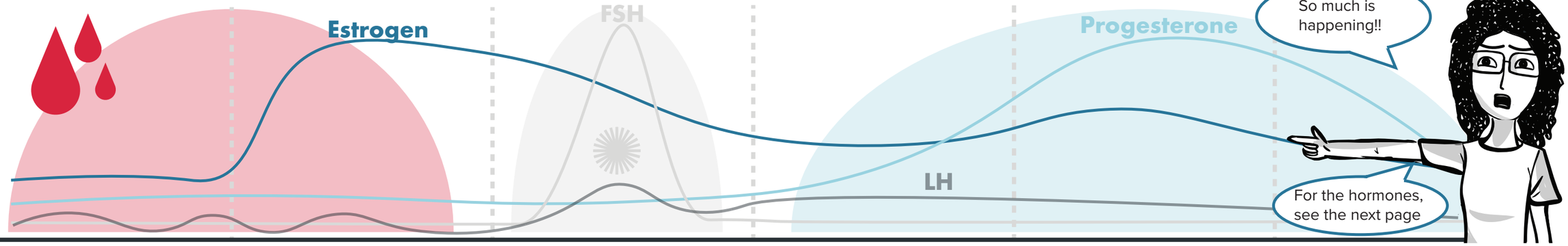


Figure 1.2 *Diagram of an ovary adapted from (News-Medical, 2021).*

How does your personal data fluctuate through the menstrual cycle?



Early Follicular | Late Follicular | Ovulatory | Early luteal | Mid luteal | Late luteal

Phases

This phase is well known: The Period. Easily recognized by bleeding days and just like my mood, all hormonal levels are low.[1]

The period starts the follicular phase, during which follicules (sacs containing eggs) grow in your overies.

After bleeding, we get to the late follicular phase. This estrogen peak enhances serotonin (feel-good hormone) production![1, 2]

This peak in LH causes the follicle to rupture and move the egg to the fallopian tube. Your basal temperature and testosterone levels can increase. [1]

Wheee!!

+2.33 bpm

The ruptured follicle produces progesterone. Research found that the resting heart rate increased 2.33 during the luteal phase.[3]

Apparently, I started the luteal phase. I am now a corpus luteum

During the mid luteal phase, the progesterone levels are highest. This hormone has a negative impact on force production.[1]

So I decided to sit down.

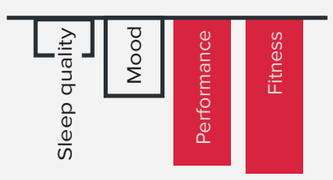
If the egg is not fertilised, the corpus luteum degrades and the cycle prepares to restart.

In the last phase, all hormone levels are dropping, this is linked to increased perception of anxiety and fatigue.[1]

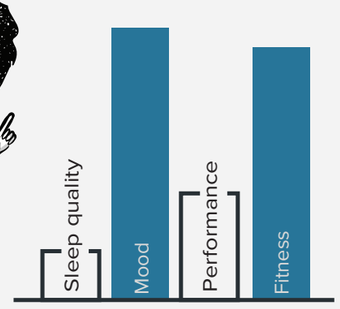
Observations

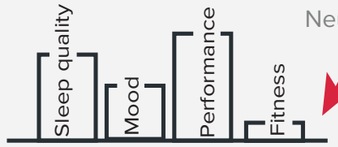
During the menstruation, the rowers evaluate themselves more negatively on performance and fitness.

But remember these experiences are always personal!



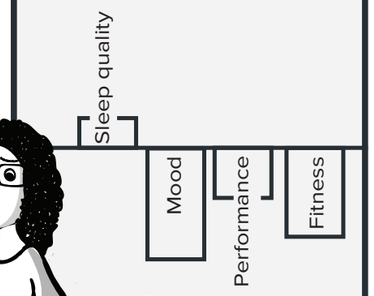
By now, you must have expected I would be feeling pretty good during this phase. And indeed the late luteal phase showed extremely positive self-evaluations!





During the early luteal phase, the perceptions were generally more positive; all the blocks are above the neutral line.

Blocks above the line are positivily evaluated, below the line they are negatively evaluated. The color indicates a clear connection of the evaluation to the menstrual cycle.



Just like the early luteal phase, none of the blocks are colored. This means that the evaluations are not as strongly linked to the menstrual phases

A study with 12 rowers also noticed specific perceptions accross the different menstrual cycles.[4]

They showed significant changes in self-reflection during their cycle, e.g. in this phase with sleep quality and fitness.

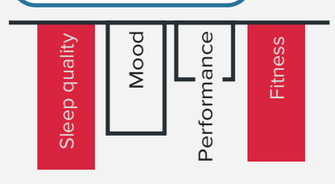


Figure 1.1: *Data comic introducing menstrual data fluctuations based on (Antero et al., 2023; Carmichael et al., 2021; McKinley et al., 2009; Wundsam, 2023).*

FSH

FSH and LH are both produced in the brain and work together to regulate reproduction. FSH regulates the menstrual cycle by stimulating follicles in the ovary to grow. During the growth the follicle produces estrogen. In the meantime, FSH prepares the eggs for ovulation. Ovulation is the release of the egg from the ovary. In the illustration, FSH is depicted as the figure blowing up a balloon, symbolizing its influence on the growth of the follicle. Once the follicle has ruptured the egg inside will be released.

LH

The 'brother' of FSH, LH, plays an important role in this rupture. LH, or luteinizing hormone, stimulates the ovary to release the mature egg into the fallopian tube. The corpus luteum develops from the empty follicle and produces progesterone.

Progesterone

Progesterone is a hormone required to support the early stages of pregnancy. Its function is to stop the thickening of the uterine lining and create a favorable environment for a fertilized egg to implant. In the illustration, it is represented by the figure decorating the home. If the egg has not been fertilized progesterone levels along with the estrogen levels drop. This causes the uterine lining to detach and leave the body, indicating the start of the period.

Estrogen

Like progesterone, estrogen is a crucial hormone in the menstrual cycle. Its role is to thicken the lining of the uterus in preparation for pregnancy. The accompanying illustration depicts estrogen as the figure making the bed.

Figure 1.3: *Overview of the four main hormones regulating the menstrual cycle, rephrased from (Clue, 2023) and (Cleveland Clinic, 2024).*

In addition to the influence of the hormonal cycle on performance, the effects of performance on the hormonal cycle have also recently received more attention. A decade ago, the International Olympic Committee (IOC) introduced the term RED-S (Relative Energy Deficiency in Sports) for reduced physical function caused by high energy demand and insufficient energy intake. The symptoms of RED-S include but are not limited to menstrual problems and reduced bone health, which indicates that a high training load for an athlete may result in menstrual problems. With the introduction of the term RED-S, the IOC tried to underline the complexity of this syndrome (Mountjoy et al., 2014). With this emphasis, the IOC acknowledged the possible impact of performance on the menstrual cycle and that this recognition is crucial to protect the health of athletes.

Apart from these recent studies, female athletes' health is generally underrepresented in sports research. Cowley et al. (2021) reported that only 6 percent of scientific research on sports and exercise focuses solely on women. In contrast, 31 percent of sports research between 2014 and 2020 had a male-only participant group. Sports research is the basis for academically sourced sports guidelines. Therefore, the lack of female-only research results in the majority of sports guidelines not reflecting physiological differences between sexes (Sims & Heather, 2018; Pandit et al., 2023). According to Cowley et al. (2021), the lack of female-specific guidelines in sports has two effects. First, without proper education on sports health, female athletes fail to recognize the effects of training on their bodies. Therefore, performance, which is extremely important to athletes, suffers due to the impact of the menstrual cycle (Wundsam, 2023).

The second effect is the lack of female-specific advice in sports coach education. As demonstrated by Verhoef et al. (2021), insufficiently informed coaches on female-only topics negatively impact the health of sportswomen. Both coaches and healthcare professionals normalize menstrual problems, which discourages Dutch female athletes from reporting these issues.

In essence, research has demonstrated that the menstrual cycle affects performance and performance can affect the menstrual cycle. To perform optimally and healthily athletes should understand this connection. However, they are often unaware of this relationship due to the lack of female-specific sports guidelines, which is caused by the limited research on female athletes. In addition, the lack of guidelines harms the health of athletes. So, there is an urgent need to prevent the consequences of the underrepresentation of females in sports research. Since medical research might be time-consuming (Hanney et al., 2015), a different approach should be introduced that can support athletes to understand the relationship between the menstrual cycle and their performance. This thesis aims to find this alternative approach to build the knowledge of athletes so that they can perform optimally and healthily with their menstrual cycle.

Rowing and the Menstrual Cycle

One sport in which the effects of the lack of female-specific guidelines are visible is rowing. Thousands of female Dutch rowers wake up daily to train, unaware of how their menstrual cycle impacts their performance. The Dutch Rowing Federation reports that there are currently 45,000 registered rowers in the Netherlands, half of whom identify as female, highlighting the significant presence of female rowers in the country (KNRB, 2024). One rower who gives a face to the growing number of female rowers is Karolien Florijn. She is the first Dutch rower to win a world championship in the open singles field (see Figure 1.4). Despite the number of female rowers and impressive results of the females in the Dutch national rowing team, the relationship between the menstrual cycle and performance is not a common topic among these female rowers. (Wundsam, 2023).

Rowers often start their athletic careers during their studies, attracted by the opportunity for quick advancement in the sport (Beenhakker, 2016). To successfully compete in the rowing sport, rowers significantly increase their training intensity within the span of a few years building up to training more than 10 times a week. However, this increase in training intensity poses risks for overtraining

Figure 1.4: *Karolien Florijn winning the first dutch female gold in a single at the world championships in 2022. Source: (AD.nl, 2023)*

and injuries. Van Beijsterveldt et al. (2015) conducted a study that found that 80% of the 137 novice Dutch rowers who participated experienced at least one injury or illness during their first year of rowing. The study concluded that effective injury prevention programs are necessary to ensure the performance and well-being of rowers.

Although female rowers who are new to the sport are at a higher risk of injury than non-novice rowers and research has demonstrated that the menstrual cycle can affect the performance of rowers, these rowers have limited awareness and understanding of how the menstrual cycle can impact their training, performance, and risk of injury. Additionally, Laske et al. (2022) found that novice rowers are less likely to communicate with their coaches about the effects of their menstrual cycle. Regular conversations with coaches or a better understanding of the menstrual cycle could help rowers reduce the risks associated with increased training intensity (Laske et al., 2022). Lastly, rowers are athletes who already log their sleep, heart rate, weight, and training, using, for example, self-designed Excel spreadsheets and they have reflective conversations with their coaches before and after their training. These habits suggest that they might be open to experience with different tools to execute these types of reflections. Thus, the high training load of these rowers, the fact that novice rowers are less likely to communicate with their coaches on the effects of the menstrual cycle, and their openness to reflective practices make rowers a relevant group for this thesis.

Existing Solutions

An existing solution to better understand the influence of the hormonal cycle is menstrual tracking. Eschler et al. (2019) argue that menstrual tracking is essential for understanding female health for two reasons. First, monitoring the menstrual cycle can provide insights into the overall health of a woman. Additionally, tracking can support women identify patterns and potential triggers for menstrual symptoms such as pain, mood changes, or fatigue. This information can be crucial for managing these symptoms and seeking appropriate medical care. When tracking, women use varying tools to monitor their menstrual cycle, including phone applications, digital calendars, handwritten diaries, monitoring birth control cues, recognizing symptoms, or relying on memory (Epstein et al., 2017).

However, most trackers currently do not reflect the needs of female rowers. First, registering sports activities is often not incorporated into menstrual tracking methods. Even though these rowers often already use tracking systems, which measure training or health parameters (sleep or heart rate) to guide the adaptation of the training load (Torres-Ronda et al., 2022), menstrual trackers are often not incorporated into these tracking systems, making it challenging to grasp the relationship between their performance and menstrual cycle.

Furthermore, menstrual tracking with a phone application relies heavily on digital calculations. These apps use the societal average to make predictions about menstrual cycles. For example, the assumption that the menstrual cycle lasts approximately 28 days may result in the tracker asking questions that are not relevant or useful for females with irregular bleeding, which can hinder their ability to effectively track their menstrual cycle (Epstein et al., 2017).

Lastly, Woytuk et al. (2023) indicate that the digital applications can create a disconnect between how a person is feeling and what the application tells her to feel. As Homewood and Vallgårda (2020) explain, existing self-trackers are built on the belief that scientific investigation can reveal scientific truths about the body and self-tracking technologies bring these “truths” about the body to the user. However, Homewood and Vallgårda (2020) argue that it is equally important to recognize that individual experiences and variations may deviate from these scientific trends. For example, while science may suggest that rowers might perform less during their menstrual cycle, it is essential to consider that individual experiences may vary and some rowers may perform better in certain ways during this time. The variation of experiences was also present in the research of Wundsam (2023). She found that 45 out of 56 rowers perceived a decrease in strength during their menstruation, but the other 11 rowers stated they perceived an increase in strength during their menstruation.

By combining scientific investigation and personal experiences, menstrual tracking applications can provide a more integrated approach to supporting female rowers, which can support rowers understand their bodies and make informed decisions for their performance and health.

Identified problems

Problem 1

Sport guidelines for female rowers are hindered due to limited female-specific sports research. So few instructions exist to investigate the connection between the menstrual cycle and performance.

Problem 2

The majority of menstrual tracking applications do not incorporate training and health parameters related to sports tracking. Rowing performance trackers do not incorporate menstrual symptoms.

Problem 3

Tracking applications focus on the digital storage of data and use computed predictions. It minimizes the listening of the rowers to their bodies.

1.2 Project Definition

Project Scope

As the context illustrates, a tracker could improve the understanding of the relationship between performance and the menstrual cycle of rowers. Trackers already exist, but this project focuses on the design of a new tracking system specifically for rowers as their needs are not met by the existing trackers.

Three reasons have led to the start of this project. First, the limited knowledge available on the menstrual cycle of rowers complicates designing a system for this target group. However, a tracking system could collect a larger set of data on sportswomen and increase the knowledge for this group. The project must balance collecting the required data and use the data to design the tool for individual female rowers.

Second, the menstrual cycle is often not incorporated into rowing practices. Even though some female rowers record data on their health and have regular reflective moments, the menstrual cycle is often not integrated into this routine. However, some reflective practices that exist might support the investigation of the connection between performance and the menstrual cycle. A practical tool that combines this performance reflection and menstrual data could create powerful insights for rowers.

Lastly, to optimize performance with the menstrual cycle and to avoid a negative influence of performance on the menstrual cycle, rowers should act on their personal experience. However, current menstrual tracking systems consist primarily of computational and digital translations. Woytuk et al. (2023) argue that women should use multiple senses to listen to their bodies and draw insights from multiple sources of knowledge to shape their experiences and be able to express them. A solution needs to be found that empowers rowers to recognize their stories and experiences of the menstrual cycle and performance. Thus, the goal of this project can be summarized by the project aim.

Project aim

Design a product-service combination that supports rowers to track and reflect on the interdependence of the menstrual cycle and their health and performance while ensuring that rowers feel in control over and in touch with their bodies. The end result should fit current personal rowing routines.

Project Stakeholders

This section discusses who is affected and influenced by the identified problems of this project.

DUTCH FEMALE ROWERS

This report mainly focuses on Dutch female competitive rowers aged 18-28. The majority of these athletes start rowing during their student years, typically increasing their training from 4 to 10 times or more per week within two years. While these rowers compete at the national level, they do not have federation guidance. Personal experience has indicated that rowers have routines to monitor their health. An overview of the category of athletes this report focuses on is illustrated in Figure 1.5.

COACHES

The guidance of rowers is built on the efforts of volunteers, often students. As a result, this group might lack professional knowledge, which is countered by coaching courses offered by the Dutch rowing federation (KNRB, 2022). The federation offers courses aimed at three different levels of coaching, which are identified as:

- RC2: coaches who are educated to guide starting and lightly advanced rowers.
- RC3: coaches who are educated to guide rowers to national level and actively guide and share knowledge with other coaches.
- RC4: coaches who developed a vision of the sport, the athletes, and all included stakeholders. This coach is focused on the planning and programs of the whole competitive section.

Most rowing clubs have at least one coach who has completed the RC4 coach course and guides the club's various coach teams. Every coaching team has one coach who has completed the RC3 course, and the rest are coaches who have not completed a course or have only completed the RC2 course. As a result, the level of professionalism might vary greatly between clubs and rowing teams.

The tasks of the coaches include guiding the rowers to improve both physically and mentally to grow in the rowing sport, which can be interpreted differently by every coach. The tasks are most objectively described by the different themes discussed in the coaching courses, which are shown in Table 1.1.

SPORTS GYNECOLOGISTS & SPORTS PHYSICIANS

Tracking the menstrual cycles of rowers interests gynecologists and sports physicians who support female rowers. Knowledge of their menstrual cycle supports patients to discuss menstrual problems with physicians (Eschler et al., 2019). If menstrual problems increase, rowers might reach out to sports gynecologists or sports physicians to increase performance. This project will focus on healthy rowers.

FUTURE TRACKER COORDINATOR

When this project is finished, it might be continued and a possible coordinator of the tracker might have to control the data collection or tracking applications that are used. Who will perform this role is outside the scope of this project.

Table 1.1: *Different topics per coaching course (KNRB, 2022).*

Topic	RC2	RC3	RC4
Rowing technique	X	X	X
Lifestyle guidance		X, incl. food	X, incl. motivation
Didactics and feedback	X	X	X
Guiding a team		X, coach team	X, sports team
Group dynamics		X	X
Boat adjustments	X	X	
Preventing injuries	X	X, incl. physiology and biomechanics	X, incl. physiology and biomechanics
Competition coaching	X	X	X, incl. mental process

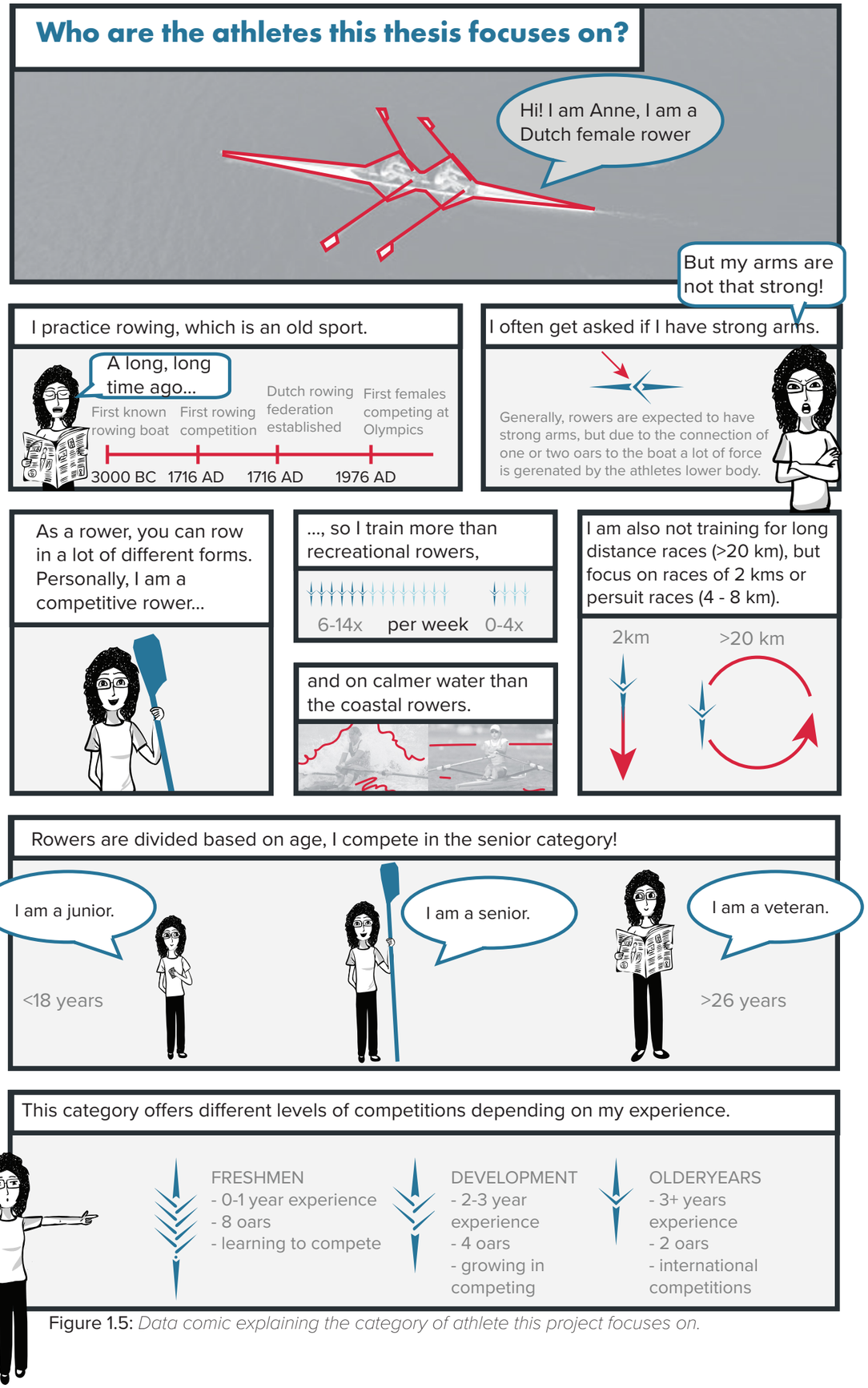


Figure 1.5: *Data comic explaining the category of athlete this project focuses on.*

Positioning of the Project

This project touches on three different research fields within design research: research-through-design, data-driven design and design for intimate care (see Figure 1.6). Publications in these three areas discuss methods or processes for research. Figure 1.6 contains a supporting block for sports and medical research. Throughout the design process, sports and medical literature are used to make decisions. These topics will later be addressed more extensively.

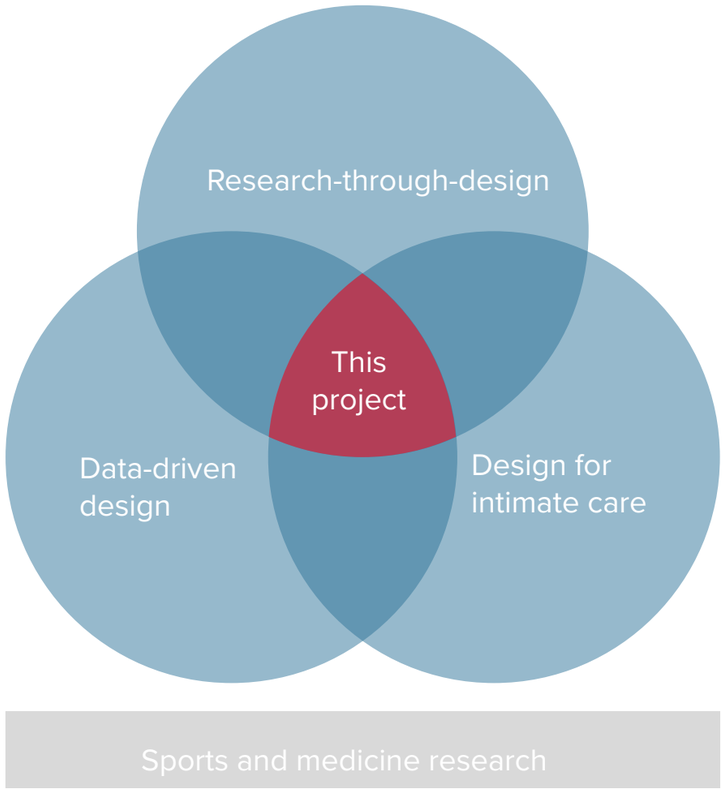


Figure 1.6: *Overview of positioning within current research fields. This project (red centre) is the combination of three research areas (blue circles). The project is supported by other fields (grey block).*

1.3 Project Set-Up

Research Questions for the Project

As indicated, the goal of this project is to design a product-service combination that supports rowers to track and reflect on the interdependence of the menstrual cycle and their health and performance. While ensuring the rowers feel in control of and in touch with their bodies. The end result should fit current rowing routines.

Three design research questions guided the process for this design goal. These questions link to the identified problems in Section 1.1.

1. **Intimate Data and Design (reflecting problem 1):** how can collected sports and menstrual cycle data be implemented in designs for female rowers?
2. **Motivating Insights (reflecting problem 2):** how can tracking be a valuable experience for female rowers?
3. **Empowering Rowers (reflecting problem 3):** how can female rowers be active participants in menstrual health and sports optimization, not just digital data collectors?

Structure of the Project

A research-through-design (RtD) approach guided the structure of this project. RtD 'is the production of knowledge through design activities' (Stappers & Giaccardi, 2014). RtD allows designers to go beyond traditional research methods and actively contribute to knowledge generation. By using their professional skills, designers can gain actionable insights into complex situations, reframe problems to find innovative solutions and create prototypes or artifacts that play a central role in the research process.

To follow an RtD approach, the design activities in this project are specifically tailored to address the research questions about the interaction between performance and the menstrual cycle. Despite the limited knowledge in this area, the RtD approach allows the project to meet the needs of the target group. The design activities involve gathering data from the rowers, actively involving them in the design process, and developing prototypes that meet their needs and preferences. By using this approach, the project aims not only to collect data but also to provide practical solutions that would improve rowers' performance at different stages of their menstrual cycle and guarantee the maintenance of a healthy menstrual cycle while performing.

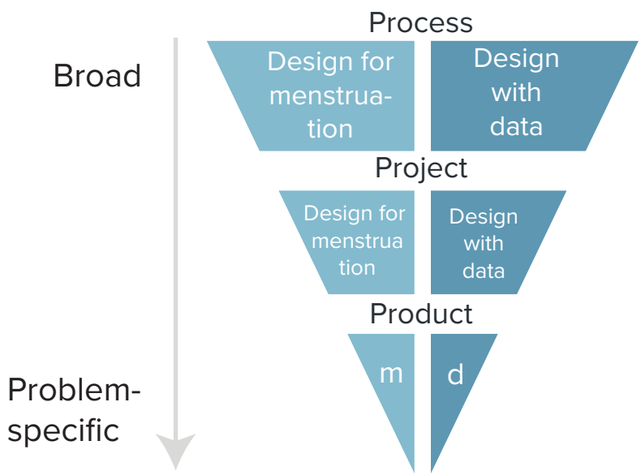


Figure 1.7: *Illustration on the structure of the literature.*

The project uses three prototype cycles to investigate the presented design research questions.

Each cycle starts with a literature review. The reviews explore existing methods and approaches to support the design activities of that phase. Each review consists of two sections: one on designing with data and another on designing for menstruation. However, it might not always be possible to find relevant papers on the menstrual cycle. So, the studies examine topics related to the menstrual cycle, including intimate care (which is also under-researched) and pregnancy (which is related to female health). As the project progresses, the literature review focuses more on the project and is less generally related to designing. The combination of the three literature parts provides a foundation for designing with data for menstruating rowers (see Figure 1.7).

After a literature review, a prototype is developed. Following the development of each prototype, users test it, while desktop research and evaluations are conducted. The goal of these tests and evaluations is to collect rower feedback and assess the effectiveness and usability of the prototypes. Participants are also asked to complete an evaluation of their tracking process and submit the tracked data. This allows for a more thorough understanding of the prototypes' impact. In addition, following the first two prototype tests, a co-creation session was held in which participants actively collaborated with the designers to investigate the goals of the next prototype. The findings from these tests, evaluations, and co-creation sessions aid the development of the next prototype, ensuring that each iteration builds on the previous one and eventually leads to the third prototype and final design, which is a built-up of the previous prototypes, see Figure 1.8.

The first research prototype is a digital prototype to lower the threshold for participants to participate. A digital product is closest to what the rowers are already using; more novel prototypes are introduced after this start. In total, the three prototypes are:

1. Quick digital prototype to build the first database (Design Question 1)
2. A digital or physical prototype to support rowers in interpreting their data (Design Question 2)
3. A mobile application that allows the rowers to be in control (Design Question 3)

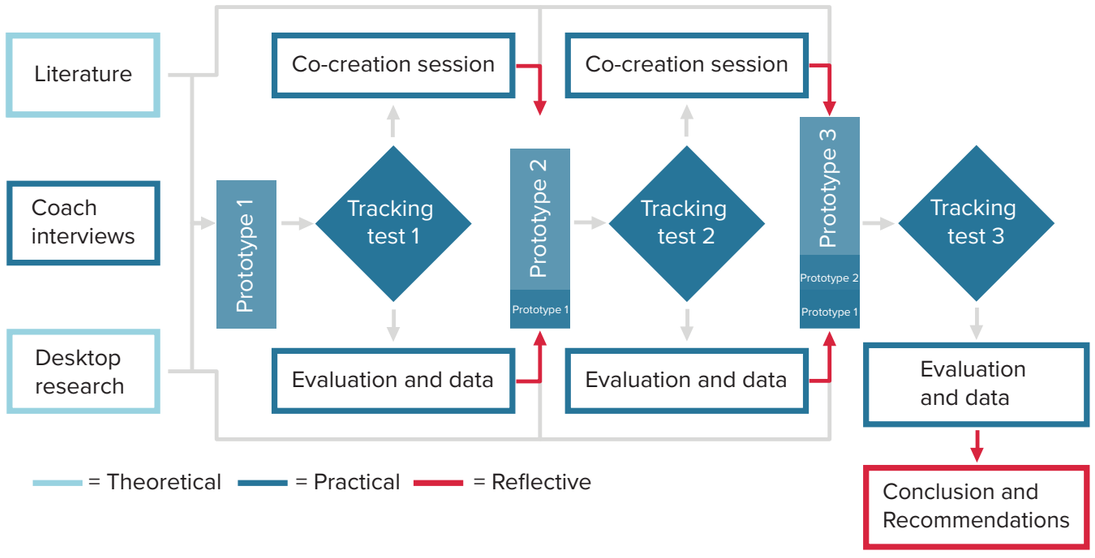


Figure 1.8: *Illustration on the structure of the report.*

1.4 Report Structure

The structure of the report is based on the the structure of the project. Every cycle is presented with three chapters. First, a theoretical chapter, followed by a practical chapter and lastly a reflective chapter. The three chapters together answer one of the three design questions:

Chapter 2: Intimate Data and Design

PART 1: PRACTICES FROM THEORY

This part explores theoretically how data can guide this design process. These findings start the design of the first prototype. Second, this chapter presents research on design for a sensitive topic like menstruation.

PART 2 - APPLIED PRACTICES

This part focuses on how design activities are used to understand current tracking experiences. The design of the first prototype are explained and the first interviews are presented. It also discusses the design and results of the first two evaluation activities of the first prototype.

PART 3 - REFLECTION

This part reflects on the results of both the theory and the practice and presents the changes to the prototype.

Chapter 3: Motivating Insights

PART 1 - PRACTICES FROM THEORY

This part discusses the theory behind data interpretation for this project and looks at an approach to tracking the menstrual cycle.

PART 2 - APPLIED PRACTICES

This part outlines the activities related to the second prototype, including its development, distribution, and evaluation. This section describes the co-creation process that will lead to the final prototype and presents the results.

PART 3 - REFLECTION

This part presents the prototype's modifications and considers the findings from both the theory and the practice.

Chapter 4: Empowering Rowers

PART 1 - PRACTICES FROM THEORY

This part presents the final parts of the theory on designing with data for rowing performance by investigating performance indicators of rowers and how rowers can be empowered to control their tracking experience.

PART 2 - APPLIED PRACTICES AND FINAL DESIGN

This part outlines the activities related to the third prototype and final design, including its development, distribution, and evaluation. In addition to the evaluation of the stakeholders a reflection on the final design is performed.

Chapter 5: Project Reflection

This chapter presents the final reflection on the project and a conclusion on the design.

Chapter 6: Recommendations

This chapter provides the recommendations on the design and process, which should be acknowledged when the design would be further developed and it discusses the future steps for the project.

Chapter 7: Conclusion

This chapter presents the conclusion of the project.

Chapter 8: Personal Reflection

This chapter includes a personal reflection on the process and the growth as a designer during the project.

2. Intimate Data and Design

Part 1 - Practices from Theory

How can collected sports and menstrual cycle data be implemented in designs for female rowers?

The initial phase of this research project aims to explore the implementation of data in designs for female rowers. Relevant design papers on data and female health were researched to determine the most effective methods for this project.

Specifically when designing for the menstrual cycle of females, the literature on designing for intimate care is consulted. This topic was researched because both the menstrual cycle and intimate care are understudied topics due to societal taboos. The research on intimate care provides insight into how design processes related to taboo health topics can be carried out. Additionally, data-driven design research is presented to offer guidelines for collecting and incorporating data into design. Combined these research topics offer insights and guidelines for designing intimate care solutions while using data to meet the needs and preferences of female rowers. Both topics will be explained with a definition, an example, and an explanation of how the methods are used in this project.

2.1 Design for Intimate Care

Definition

Similar to female-specific sports research, intimate care is not a subject that is sufficiently researched. Intimate care is defined as “those care tasks associated with personal hygiene, bodily functions, and bodily products that demand direct or indirect contact with or exposure to the sexual parts of the body as defined culturally by the individual” (Ward & Whittick, 2011). These sexual parts of the body are linked to cultural taboos, which creates barriers to conducting research. Almeida (2017) acknowledges that intimate care-related studies are frequently perceived as emotionally charged and risky for participants, leading to researchers’ reluctance to investigate this topic and establish guidelines.

The gap in intimate care research suggests an opportunity to improve women’s well-being. By fostering a deeper understanding of one’s body, women can recognize changes or abnormalities early on, leading to timely medical intervention and improved health outcomes. Neglecting intimate care can lead to negative psychological impacts such as low self-esteem and body image issues (Almeida et al., 2016). Therefore, addressing the gap in intimate care research and providing designs that promote self-awareness and self-confidence can have a significant positive impact on women’s physical and mental well-being.

Almeida et al. (2016) proposed filling this gap in research by distributing designs to females that foster a deeper understanding of one’s own body, allowing women to recognize changes and reach out. These designs can include tools or technologies that facilitate exploration and interaction with intimate parts of the body. Digital tools can be used to project scientific knowledge onto the body. For instance, augmented reality can be used to explore organs, allowing users to view their bellies as a biological image (see Figure 2.1). These techniques might enable women to gain knowledge about their bodies in a comfortable and empowering way, potentially leading to early detection of issues and improved overall well-being.

Example: Labella

In the research of Almeida et al. (2016), a system (Labella) was designed to investigate the vagina. This is a naturally “hidden” part of the woman’s body and it relates to intimate care. With Labella, participants used a cell phone in addition to a pair of underwear to use augmented reality to explore their intimate area. These users open a mobile app on their phone after putting on their underwear. They start exploring when their phone prompts them to point the phone at their underwear and the application becomes an interactive mirror.

Labella shows how design can help participants learn about their bodies by combining a physical element (the underwear) with a digital element (the application). The researchers define “awkward learning” as looking at an unexplored area of the body and having previously uncomfortable discussions (Almeida et al., 2016). Labella demonstrates that “awkward learning” expands the body knowledge of the participants.

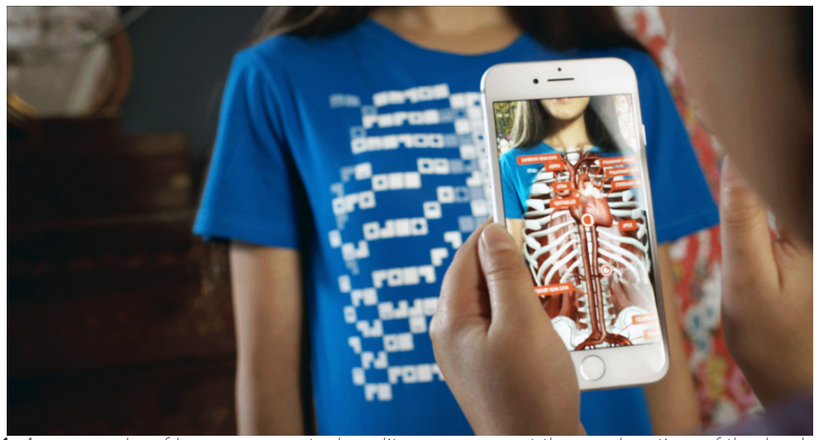


Figure 2.1: *An example of how augmented reality can support the exploration of the body. Retrieved from (Curiscope, 2023).*

The research uses a qualitative approach and observational studies to collect data. The observations show that women often feel uninformed about what is happening to their bodies. Additionally, this report indicates that societal taboos surrounding women's intimate health often hinder self-care practices.

Application to this Project

Two findings from the research on intimate care contribute to the framework of this research project. First, Labella demonstrated how self-exploration facilitates knowledge generation on sensitive topics. Therefore, the choices in this project are focused on enabling the exploration of personal data and protecting the authority of the participants. Furthermore, Almeida et al. (2016) indicate that intimate care-related studies are frequently perceived as risky for participants, which highlights the need for caution in communication with stakeholders during this research. In light of these findings, the research project prioritized creating a safe and supportive environment for participants to openly express their thoughts and experiences.

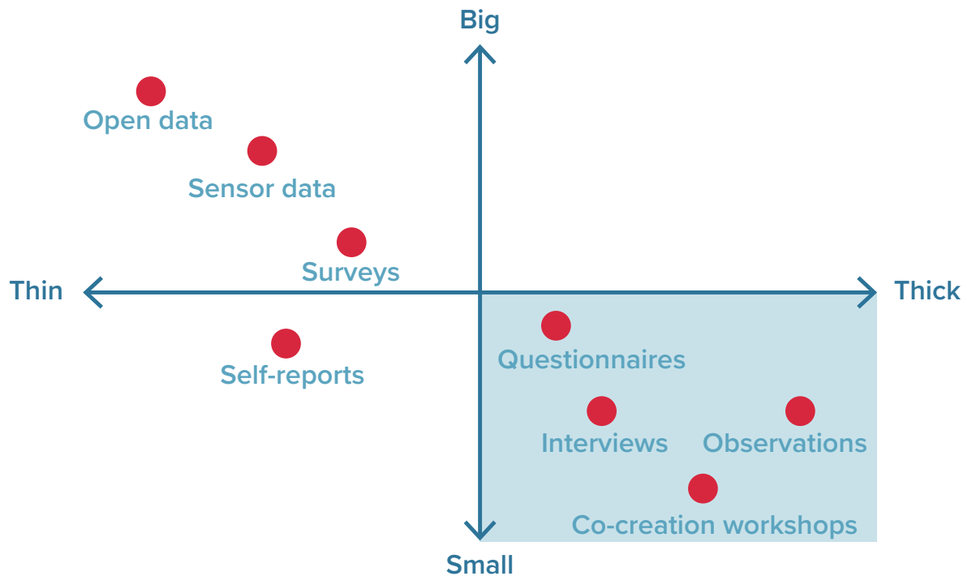


Figure 2.2: *The different sources of data, adapted from (Bornakke & Due, 2018).*

2.2 Data-Driven Design

Definition

Data-driven design has the potential to enhance the design process. By collecting and analyzing contextual data, data-driven design can guide the development of (product) design. This contextual data can be collected quantitatively through sensors or usage data and qualitatively through user evaluations (Gorkovenko et al., 2020). Contextual data enables iterative improvements, real-time insights, and remote prototyping, resulting in rich user input and improved designs.

Data is currently primarily collected in the early stages of product design, before production. In contrast to digital products, which are continuously updated based on real-time usage data. Product data can guide the improvement of various aspects of a design; for example, Tao et al. (2017) propose the creation of digital twins that use previous end-of-life data to improve the production and service of future products.

Ortega et al. (2023) define three main challenges when incorporating behavioral data into design: First, designers iteratively explore different types of data and must find ways to combine and understand these types of data. The designers use small/thick data and big/thin data (see Figure 2.2), which are terms related to the type of data. Thick data is the term for qualitative data (e.g. observations), while thin data relates to less contextualized data (e.g. continuous measurements of a sensor). Big versus small indicates the sampling size of the data, where big data is quantitatively collected and small data focuses more on individual collection. Originally, design mainly collected qualitative data (small or thick); this area is highlighted in light blue in Figure 2.2. Now designers seek to incude more combinations of data types.

The second challenge is to establish contact with the participants. This can be difficult due to factors such as participant availability, location, or negative feelings towards the research.

The final challenge is interaction with regulatory authorities concerned with the ethics of research. A necessary step in behavioral research is to ensure legal and ethical methods. Appendix A2 includes the documents regarding the ethics applications for this project.

Example: Data-Driven Bottle Design

Bogers et al. (2016) discuss the potential of data guidance in the design process. They focus in particular on a case study of a connected baby bottle. First, these researchers examined the potential of data collection with a baby bottle ("contextual phase"). They developed a probe with sensors that was given to users to collect quantitative data. Additionally, qualitative data were collected through visits to participants and a final interview. The data collected informed the development of the second "informed" probe. In this phase, a digital platform was designed and updated while the physical probe was placed in context. The insights gained by the researchers could be sent to this application so that users could experience gaining insights from their data in real time.

This example demonstrates how a digital probe in context enables an iterative design process with unique insights for and from participants. The ability to make adjustments remotely makes it possible to refine prototypes without physically retrieving them or requiring participants to make conscious changes. Bogers et al. (2016) argue that this prototyping approach is more interactive and enriching.

Application to this Project

Bogers et al. (2016) demonstrate the importance of an iterative process in data-driven design research. The iterative framework proposed by Bogers et al. (2016) highlights the functions of multiple prototypes in a research. Using the first prototype to collect data on the context, the second prototype can be 'informed' by this information. This structure addresses the challenge identified by Ortega et al. (2023) that relates to the integration of diverse data types. The first data on the context is more quantitative, which can inform the more qualitative collection of data with the 'informed' prototype. In addition, the participants only have to be recruited once for both researches.

2. Intimate Data and Design

Part 2 - Applied Practices

How can collected sports and menstrual cycle data be implemented in designs for female rowers?

This part is the first applied phase of the research-through-design approach. This part focuses on the first gap: 'Sport guidelines for female rowers are hindered due to limited female-specific sports research thus few instructions exist to investigate the connection between the menstrual cycle and performance.' Design activities will be used to produce knowledge on this problem.

2.3 Overview of Activities

The main goal of this chapter is to develop and test the first prototype. With this prototype, the context can be better understood and an initial foundation can be laid for designing with athletic and menstrual data for rowers. This chapter documents the methods of the activities and presents the knowledge generated by the activities, which are bold in Figure 2.3 to demonstrate how they are part of the entire project. The performed activities described in this chapter are stakeholder interviews; recruiting participants; deploying a prototype; and a co-creation session. The sections on these activities will include a motivation, method description, and results.

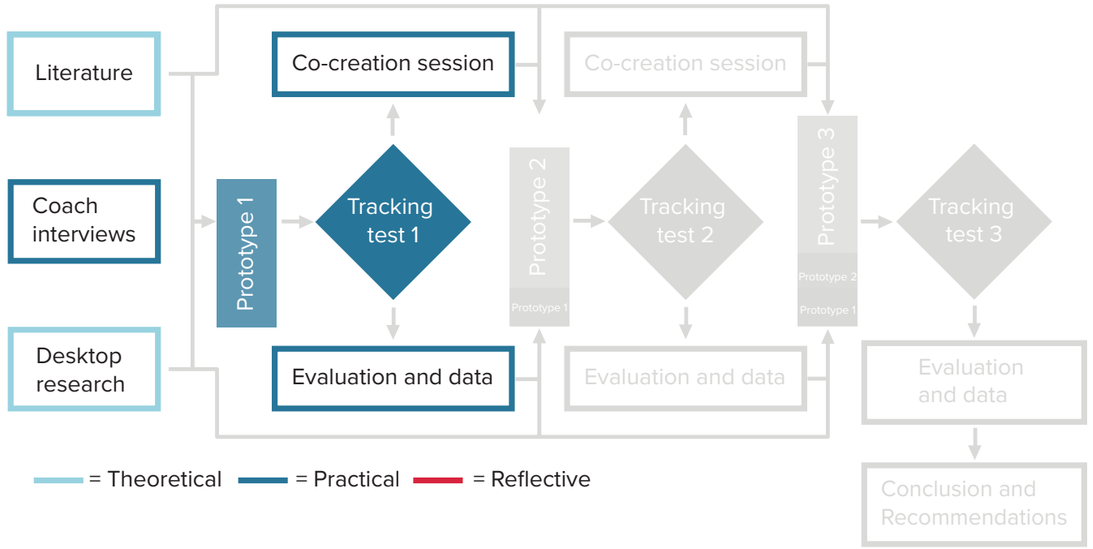


Figure 2.3: *Illustration on the structure of the report, with the topics relevant to this chapter in bold.*

STAKEHOLDER INTERVIEWS

First, to create a prototype that rowers will feel comfortable testing, the context, and current rowing habits will be investigated. Given the different tracking practices of rowing associations, it is necessary to gain a deep understanding of these practices to deploy the prototype. Therefore, coaches of rowing associations will be interviewed to provide an overview of the current context of tracking in the rowing community. Coaches were chosen for this conversation as they might have a broader view of the existing habits within a rowing association.

RECRUITING PARTICIPANTS

At the end of these interviews, the coaches are asked if they could invite their rowers to participate in the study; this will be the way the participants are recruited.

DEPLOYING FIRST PROTOTYPE

With the knowledge of the context, the prototype will be developed, deployed, and evaluated. Specifically, a digital prototype will be chosen for data collection because it is common practice in the rowing community to collect data digitally. Therefore, introducing a similar system is expected to lower the participation threshold of participants.

CO-CREATION WORKSHOP

A co-creation workshop concludes this phase and provides ideas for the next phase of the project.

2.4 Stakeholder Interviews

Motivation

To develop the first prototype, the context of the prototype was researched by contacting coaches. These coaches could provide a global view of different rowing societies.

Method

Nine coaches from nine different student rowing associations (out of the total 19 in the Netherlands) were available for an interview. These rowing associations used various methods of tracking and reflection, which were investigated with an interview conducted via recorded phone call. The recordings were then summarized before being deleted. The coaches were asked to consider what tracking methods they currently used, what parameters these trackers included, and whether they discussed the menstrual cycle with their rowers. The communication used before and during the interviews can be found in Appendix B1.1.

Results

TRACKERS

Figure 2.4 depicts whether and how the nine rowing clubs introduced tracking for the female rowers. Resting heart rate, sleep, physical and mental state, and general training statistics (number of training minutes and training intensity) were all recorded by the two clubs using self-designed trackers. The external tracking systems only used data from smart watches (resting heart rate, sleeping time, heart rate during exercise, and exercise duration). Because no rowing club tracked menstrual cycle data, they only tracked parameters related to health (resting heart rate, weight and sleep), performance (metrics on their trainings), and any other comments. One coach stated to ask about the motivation of a rower, as she had experienced that it was a great measure for rest and mental well-being.

DISCUSSING THE MENSTRUAL CYCLE

During the interview, the coaches stated that they were eager to discuss the menstrual topic. They recognized the potential health benefits of improving the conversation about the menstrual cycle.

Coach 1: "I mentioned that we are open to discussions about the menstrual cycle, even if we are men. And I repeated that when discussing illness."

The conversations also highlighted that discussing the menstrual cycle is often still a taboo.

Coach 2: "I generally do not ask specifically about the menstrual cycle, I prefer not to burn my fingers on that topic because I do not know a lot about it"

When discussing the tracking application all 9 coaches mentioned how they use reflective conversations with their rowers to understand the well-being of the athletes.

Coach 2: 'We use an external application to record data and I can access everything, but I prefer to have conversations with the rowers before the training.

DATA AND CONVERSATIONS

Additionally, 2 coaches mentioned how they looked at tracked data specifically to start a reflective conversation:

Coach 3: Last year, I looked at all the Excel sheets every morning and if I saw any unexpected fluctuations in heart rate, I messaged to check if they were well.

The added value of tracking can be explained by the knowledge that can be created from the data. Specifically addressed by an example mentioned by a trainer.

Coach 4: "Since this summer, we have implemented a different training style. The urgency to understand the effect of this new training demand on the athletes was underlined and we see now that the rowers take the tracking more seriously and have extremely valuable conversations about their well-being weekly.

Thus, coaches acknowledged the potential health benefits of discussing the menstrual cycle, but noted that discussing it is often taboo. All coaches use reflective conversations with their rowers to understand their well-being. Tracking is not always used, but when the rowers have implemented a tracker they only track data related to performance and recovery and never the menstrual cycle.

2.5 Participant Recruitment

Motivation

To perform research-through-design with participants, it was important to find an appropriate group that would be willing to participate. The participants should be female and have at least one year of experience as competitive rowers, ensuring they have the relevant training experience.

Method

To invite rowers to participate, the interviewed coaches were asked to forward an invititation to their rowers. After two weeks, a reminder was sent out for the coaches to forward the invitation. In this manner, rowers received invitations through a reliable source: their coach.

To have these interviews and invite the rowers, the coaches first had to be contacted. The goal was to reach these coaches through warm contacts: former teammates or acquaintances. If no warm contacts were known at a rowing club, open contact information (e.g. board members) was also pursued. In this manner, a coach at every Dutch student rowing organizations was contacted.

Results

The warm contacts resulted in sending an invitation to rowers in 66.7% of cases (8 out of the 12 contacted rowing societies), while the cold contacts only had a success rate of 11.1% (1 coach from the 9 rowing societies), see Figure 2.5.

After calling a coach directly and discussing the issue, all coaches forwarded the invitation to their rowers. The invitations initially resulted in 3 participating rowers. The reminder two weeks later added two more participants.

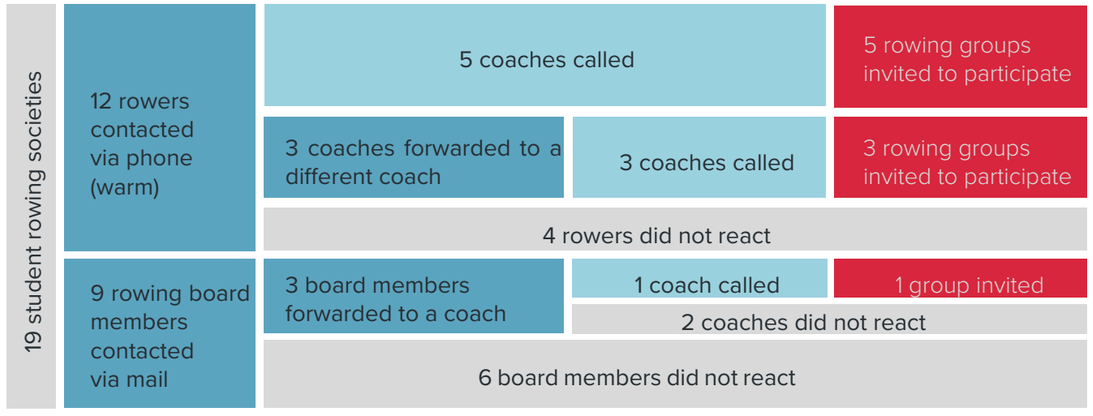


Figure 2.5: *The process of pariticpant recruitment.*

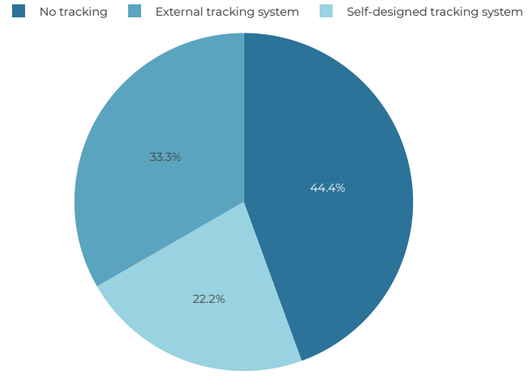


Figure 2.4: *The different tracking styles implemented at nine different rowing clubs.*

2.6 Prototype Deployment

Motivation

Once the participants had been found, a prototype could be deployed. The prototype's goal was to find a first approach to investigate the connection between sports and menstruation data. By evaluating how the prototype was used and gathering feedback from the rowers, the prototype aimed to provide valuable insights into the rowers' preferences, challenges, and needs for this investigation.

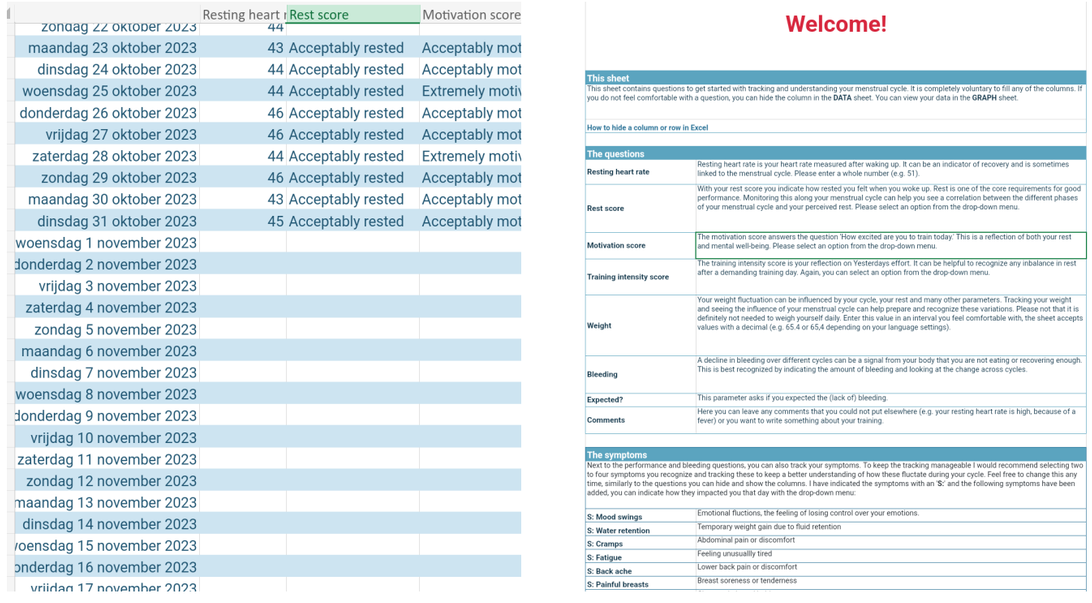
Method

During the preparation of the prototype, the choice was made to develop two prototypes. The original goal of the prototype was to automatically extract data from a smartwatch. This automation would mean that the tracking took less time, making this activity hopefully easier to sustain for rowers. However, the creation of the automated prototype took longer than expected. To avoid further delaying participants to start testing, a lower-fidelity prototype in the form of an Excel spreadsheet, which was quicker to develop, was deployed. Participants who joined the test later were still invited to test the automated prototype.

The prototypes' structures and questions were similar, but their interactions differed. Both prototypes allowed the user to engage in three types of activities. To begin, the user could input daily data. This section of the application included questions about the participant's recovery, training, and feelings, as well as questions about bleeding days and menstrual symptoms. Second, users could access their data. Participants were invited to create graphs from their data to allow the self-exploration of their data. Finally, the user could modify the application's settings. Changing the questions was one of the settings intended to give users control over what information they wanted to share. In addition, the higher-fidelity application had the option to export the data and link the application to external smartwatch data in the settings.

Figure 2.6 depicts the Excel sheet prototype, which follows the prototype's structure, with three separate sheets in the file. The settings were mirrored on a welcome page. The page included a description of each question as well as instructions on how to hide or show the questions. The data page was where questions were asked and values were entered using a drop-down menu. Finally, a page with a graph for all numerical numbers was provided as a viewing option.

Figure 2.7 shows the Beeware application, which was coded in Python using the package Beeware to package it into Java. The application included a home page, settings page, data entry page, and viewing page.



	Resting heart r	Rest score	Motivation score
zondag 22 oktober 2023	44		
maandag 23 oktober 2023	43	Acceptably rested	Acceptably mot
dinsdag 24 oktober 2023	44	Acceptably rested	Acceptably mot
woensdag 25 oktober 2023	44	Acceptably rested	Extremely motiv
donderdag 26 oktober 2023	46	Acceptably rested	Acceptably mot
vrijdag 27 oktober 2023	46	Acceptably rested	Acceptably mot
zaterdag 28 oktober 2023	44	Acceptably rested	Extremely motiv
zondag 29 oktober 2023	46	Acceptably rested	Acceptably mot
maandag 30 oktober 2023	43	Acceptably rested	Acceptably mot
dinsdag 31 oktober 2023	45	Acceptably rested	Acceptably mot
woensdag 1 november 2023			
donderdag 2 november 2023			
vrijdag 3 november 2023			
zaterdag 4 november 2023			
zondag 5 november 2023			
maandag 6 november 2023			
dinsdag 7 november 2023			
woensdag 8 november 2023			
donderdag 9 november 2023			
vrijdag 10 november 2023			
zaterdag 11 november 2023			
zondag 12 november 2023			
maandag 13 november 2023			
dinsdag 14 november 2023			
woensdag 15 november 2023			
donderdag 16 november 2023			
vrijdag 17 november 2023			

Welcome!

This sheet

This sheet contains questions to get started with tracking and understanding your menstrual cycle. It is completely voluntary to fill any of the columns. If you do not feel comfortable with a question, you can hide the column in the **DATA** sheet. You can view your data in the **GRAPH** sheet.

How to hide a column or row in Excel

The questions

Resting heart rate	Resting heart rate is your heart rate measured after waking up. It can be an indicator of recovery and is sometimes linked to the menstrual cycle. Please enter a whole number (e.g. 51).
Rest score	With your rest score you indicate how rested you felt when you woke up. Rest is one of the core requirements for good performance. Monitoring this along your menstrual cycle can help you see a correlation between the different phases of your menstrual cycle and your perceived rest. Please select an option from the drop-down menu.
Motivation score	The motivation score answers the question 'How excited are you to train today.' This is a reflection of both your rest and mental well-being. Please select an option from the drop-down menu.
Training intensity score	The training intensity score is your reflection on Yesterdays effort. It can be helpful to recognize any inbalance in rest after a demanding training day. Again, you can select an option from the drop-down menu.
Weight	Your weight fluctuation can be influenced by your cycle, your rest and many other parameters. Tracking your weight and seeing the influence of your menstrual cycle can help prepare and recognize these variations. Please not that it is definitely not needed to weigh yourself daily. Enter this value in an interval you feel comfortable with, the sheet accepts values with a decimal (e.g. 65.4 or 65,4 depending on your language settings).
Bleeding	A decline in bleeding over different cycles can be a signal from your body that you are not eating or recovering enough. This is best recognized by indicating the amount of bleeding and looking at the change across cycles.
Expected?	This parameter asks if you expected the (lack of) bleeding.
Comments	Here you can leave any comments that you could not put elsewhere (e.g. your resting heart rate is high, because of a fever) or you want to write something about your training.

The symptoms

Next to the performance and bleeding questions, you can also track your symptoms. To keep the tracking manageable I would recommend selecting two to four symptoms you recognize and tracking these to keep a better understanding of how these fluctate during your cycle. Feel free to change this any time, similarly to the questions you can hide and show the columns. I have indicated the symptoms with an 'S:' and the following symptoms have been added, you can indicate how they impacted you that day with the drop-down menu:

S: Mood swings	Emotional fluctions, the feeling of losing control over your emotions.
S: Water retention	Temporary weight gain due to fluid retention
S: Cramps	Abdominal pain or discomfort
S: Fatigue	Feeling unusuallly tired
S: Back ache	Lower back pain or discomfort
S: Painful breasts	Breast soreness or tenderness

Figure 2.6: *Screenshots from the Excel sheet with the data page (left) and welcome page (right).*

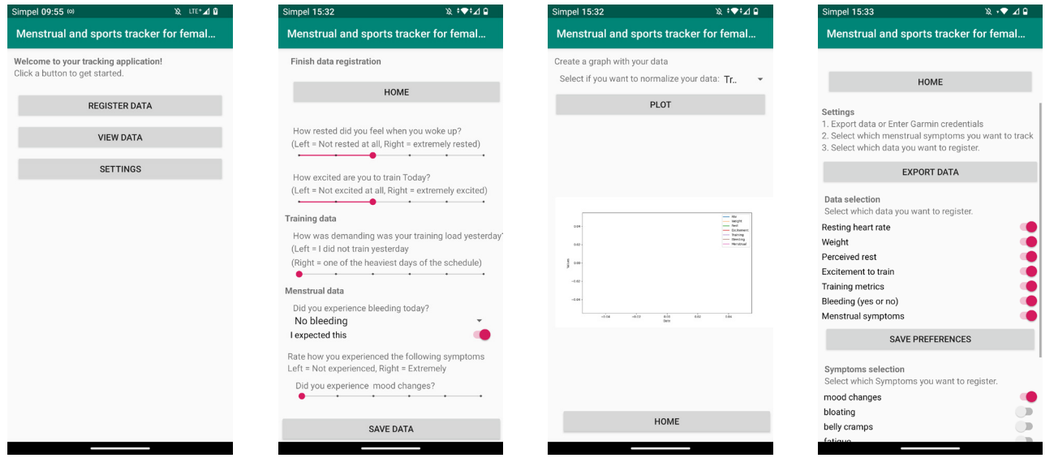


Figure 2.7: *Screenshots from the android application with from left to right the welcome page, the data page, the viewing page and the settings page.*

QUESTIONS OF THE PROTOTYPE

An overview of all the questions asked by the application is shown in Figure 2.8. The goal of the questions was for the rowers to reflect and explore different measures of performance and menstrual data. The questions included objective parameters and subjective parameters. The users could answer the objective questions with a number input (weight and resting heart rate). The subjective questions asked for a perception. Therefore, the questions could be answered with a slider to enter a point between one and six. With that number, users were forced to not select neutral, but the number of options is not yet overwhelming. Lastly, the rowers had the option to leave any comments. The question topics:

- **Resting heart rate** The first question asked for the resting heart rate. The coaches who indicated they were tracking their rowers mentioned this parameter as highly indicative of well-being. The resting heart rate is the heart rate measured after waking up, either manually or using a smartwatch.

- **Weight** The applications asked users to enter their weight. Coaches indicated that the fluctuation of weight during the menstrual cycle can be of great influence for lightweight rowers. Many parameters influence weight fluctuation including rest and the menstrual cycle. Tracking weight and seeing the influence of the menstrual cycle could support the recognition of these variations.

- **Rest score** With the rest score particpants indicated how rested they felt when they woke up. Monitoring this along the menstrual cycle could help to see a correlation between the different phases of the menstrual cycle and the perceived rest. The users entered their rest score on a scale from 'not rested at all' to 'extremely rested'.

- **Motivation score** TThe motivation score answered the question 'How excited are you to train today.' This is a reflection of both rest and mental well-being. The users entered their rest score on a scale from 'not excited at all' to 'extremely excited'. One of the professional coaches mentioned during the interview that this was the only question she required to test how the rowers were feeling. The question covers all mental aspects of rowing training.

- **Training load** The training intensity score is a reflection of Yesterday's effort. Research showed that the Rate of Perceived effort is a good indicator of training intensity (Tibana et al., 2019). The users could enter this value on a scale from 'I did not train Yesterday' to 'Extremely demanding'.

- **Bleeding** A decline in bleeding over different cycles can be a signal from your body that you are not eating or recovering enough (Verhoef et al., 2021). This process is best recognized by indicating the amount of bleeding and

Register performance and health

1. Resting heart rate (number)
What is your resting heart rate?

2. Weight (number)
What is your weight (in kg)?

3. Rest score (slider)
How rested did you feel when you woke up?

4. Motivation score (slider)
How excited were you to train when you woke up?

5. Training load (slider)
How demanding was your training load Yesterday?

Register menstrual cycle

6. Bleeding (options)
Did you experience bleeding today?

7. Expectation (switch)
Did you expect this?

8. Symptoms (slider for all)
Do you experience the following symptoms? (Psychological symptoms, Water retention, Stomach ache, Fatigue, Back ache, Painful breasts, Stool problems, Issues to concentrate, Head ache, Other

9. Comment (text)
Do you have any comments?

Figure 2.8: *Overview of the questions in the prototype.*

looking at the change across cycles. Additionally, bleeding is a clear marker for the phase of the menstrual cycle. The users indicated the level of bleeding by selecting 'no bleeding', 'light bleeding', 'medium bleeding' or 'heavy bleeding'.

- **Expectation** The rowers were asked if they expected their (lack of) bleeding. The expectation could impact the experience of a bleeding day. This question initiated a reflection in case of unexpected (lack of) bleeding.

- **Symptoms** Lastly, the rower could select menstrual symptoms to track. A set of menstrual symptoms was selected based on the research by Wundsam (2023), which investigated the most experienced symptoms by a survey of more than 200 rowers. The following symptoms were included **mood swings** (emotional fluctuations, the feeling of losing control over your emotions), **water retention** (temporary weight gain due to fluid retention), **cramps** (abdominal pain or discomfort), **fatigue** (feeling unusually tired), **backache** (lower back pain or discomfort), **painful breasts**, (breast soreness or tenderness), **stool problems** (changes in bowel habits), **concentration issues** (difficulty focusing or mental fog), **headache** (head pain or tension) and **other** (any additional or specific symptoms not listed). The participants could select symptoms to track and then indicate how each symptom impacted them from 'no symptom' to 'extreme impact on me'.

Results

After the rowers tracked their data for approximately three to four weeks, their data was collected and their experiences were evaluated.

PROTOTYPE DATA

The collected prototype data was converted to a visualization to better investigate the data. Figure 2.9 depicts a representation of Participant 2's sports and menstrual data. This dataset was moste extensively investigated as this was the largest and most consistently collected dataset. From the data, a round visualization was created to represent the cyclical nature of the menstrual cycle, and it contains various layers of data. The outer (red) circle depicts rough estimates of menstrual cycle phases. The inner circle depicts the perceived intensity of bleeding, which is combined with the experienced impact of symptoms depicted by the red circles. The greater the size of the symptom circles, the greater the influence of menstrual symptoms. The single grey circle represents the participant's average resting heart rate, while the other two grey lines represent the mode of the indicated perceived training motivation, rest, and training intensity of the previous day.

As can be seen, a connection could exist between the training intensity and the training motivation in the early follicular phase. When the training intensity of the previous day was lowest (lowest score), the motivation increased (highest score). This connection is not as evident as in the other phases when the training intensity and motivation seem less correlated, which could indicate that training at a lower intensity is critical for motivation during bleeding. However, it could also relate to the increased fitness of the athlete as the tracking test continued, resulting in less time required to recover from training intensity.

Additionally, training motivation and rest score seem to follow the same patterns, so when rest improves, motivation improves, or vice versa. However, this is not true for the last tracked day, when the participant indicated feeling rested, but the motivation score was low, which was a day the participant stated to be injured. This data suggests that to feel motivated, under normal circumstances, the athlete should be rested.

Another notable finding is that during the follicular phases, the resting heart rate was close to or below the average and increased during the early luteal phase. This finding corresponds to the research of McKinley et al. (2009), which suggested that the heart rate can be lower during the follicular phase. The visualization of dataset 1 and 3 are depicted in Figure 2.10.

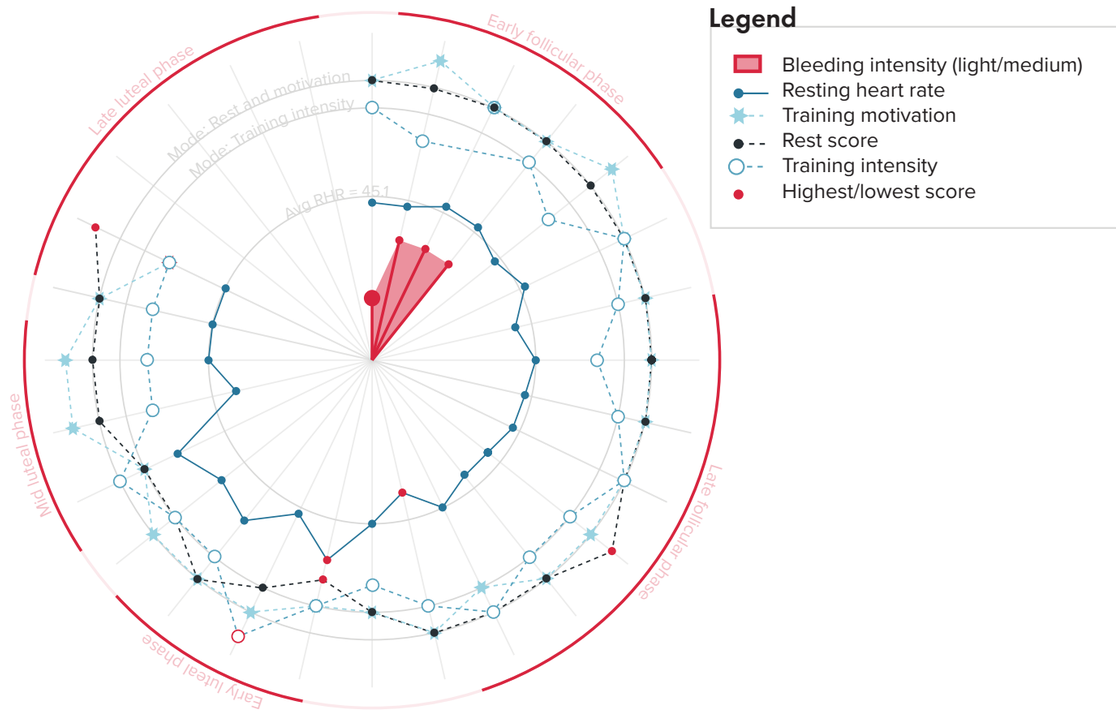


Figure 2.9: *Sports and menstruation data of dataset 2.*

Figure 2.10: *Sports and menstruation data of dataset 1 (left) and 3 (right).*

PROTOTYPE EVALUATION

Participants were asked to evaluate their tracking experience via a survey, Alternatively, they could share their experience in a meeting. However, none of the participants opted for this activity. An overview of the participants that filled in the evaluation is presented in Table 2.1. The evaluation form used to perform the evaluation can be found in Appendix B.1.2.

Table 2.1: *Participants who performed the evaluation.*

ID	Contraceptive	Bleeding regularity in the past six months	Training goal (per week)	Category	Aplication used to track	Number of days registered
P1	Not using any contraception	A loss of bleeding	12	Lightweight rower	Excel sheet	10
P2	Not using any contraception	Irregular bleeding	8	Lightweight rower	Excel sheet	29
P3	Not using any contraception	Regular bleeding	8	Heavyweight rower	Application	11

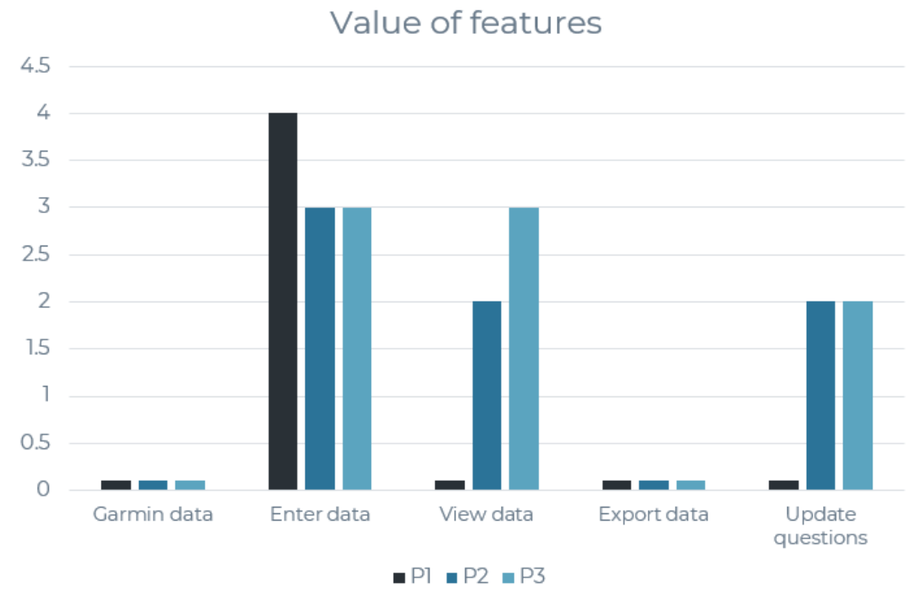


Figure 2.11: *Rated values of different functions of the prototype.*

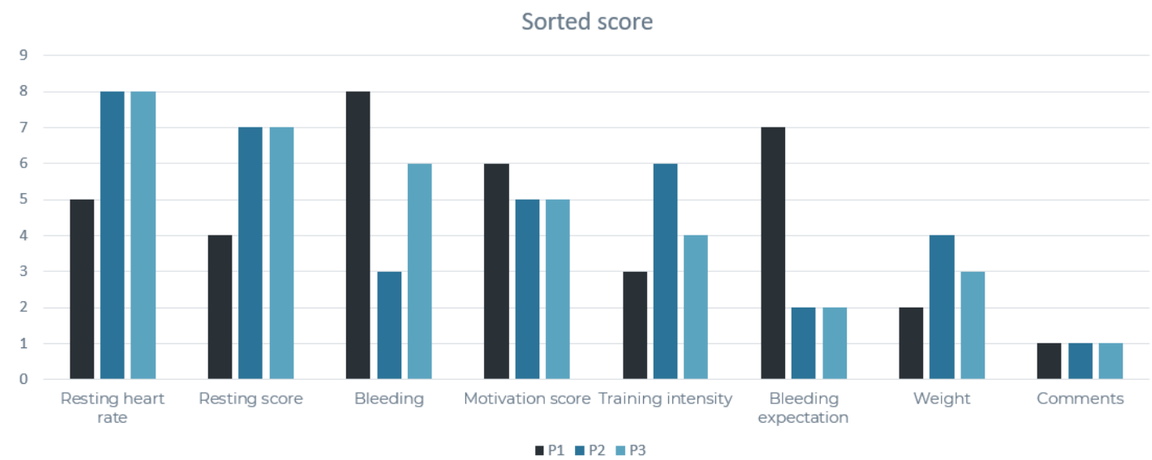


Figure 2.12: *Rated values of different questions of the prototype.*

The participants showed similarities in their entering habits. They stated that often they entered data for multiple days. This practice is illustrated by these quotes:

"'I did it (entering) at night, mostly. Sometimes I did it on a later day - in some cases I would make a record in my phone at night, and then enter it at some point in the following days" - p1

"Usually I entered data every 2 or 3 days and then also for the days before." - p3

Figure 2.11 shows how the participants rated the different functions of the prototype on a scale of 0 (not valuable) to 4 (extremely valuable). This graph illustrates that viewing data is not perceived as valuable as entering the data. Additionally, Figure 2.12 shows a similar graph for the value of the questions of the prototype. The participants were asked to sort the questions in order of value and based on this the questions were numbered from most valuable (8) to least valuable (1).

2.7 Co-creation Workshop

Motivation

The initial prototype experiment involved collecting data and an evaluation from rowers. The results of this test showed that the tracking did not effectively support rowers in interpreting their data (Section 2.6), which lowered the value of this experience for rowers. Hence, the second prototype required an improvement in the tracking of the data that aligned with the needs of the users. The possible improvements in tracking to improve this experience were explored with a co-creation workshop, which is a meeting where a designer works with relevant parties (e.g. users or investors) to investigate a problem. IdXF (2021) describes a co-creation workshop as an effective approach to designing for these user needs. So, the inclusion of this type of workshop could aid in the improvement of the second prototype, and encourage participants to share their insights and perspectives on how menstruation and performance are viewed in the rowing community. These conversations aim to generate novel ideas for interpreting sports and menstruation data.

Method

First, participants had to be recruited. The workshop's recruitment strategy emphasized the inclusion of different functions of the rowing sport to gather diverse perspectives. The activity included athletes, coaches, and coxswains with more than two years of experience in rowing, which ensured a rich view of the sport and fostered creative discussions. Furthermore, these participants were approached only if they had not previously been involved in the project, which minimized the influence of prior experiences and ensured fresh perspectives. All participants were members of the same rowing club. An overview of the attendants is presented in Table 2.2. Despite efforts, no male coaches were available to participate in the workshop, so the activity consisted solely of females.

Additionally, the setup of the workshop aimed to establish an open atmosphere. By making participants feel at ease, they were more likely to share their experiences with rowing and the menstrual cycle. Therefore, the activities were organized at the participants' rowing club in a private room and the main language was Dutch, which allowed the participants' ideas to flow. Similar to the method of Søndergaard et al. (2021) the workshop began with a brief overview of current menstrual and sports-tracking practices, which was followed by the workshop's goal and setup. The final step before addressing the problem was to create a non-judgmental environment using the 'Yes, AND'-game method described by Heijne and Van Der Meer (2019). An overview of the complete preparation for the workshop can be found in Appendix B.1.3.

Table 2.2: *Participants who participated in the workshop.*

ID	Role	Age	Study background
P1	Coach	26	Crisis & security management
P2	Ex-lightweight rower, now cox	22	Technical medicine
P3	Ex-lightweight, now heavyweight rower	22	Technical medicine
P4	Heavyweight rower	20	Industrial design engineering
P5	Ex-heavyweight rower	28	Civil engineering

After the warmup, the workshop started by asking the participants to share any ideas on the question

'*How can rowers get value and understanding from their sports and menstruation data?'*

By purging these first ideas, participants could move past their initial ideas. Participant 1 (P1) asked what it meant to get value from data. P3-4 (both current rowers) wrote down if it was possible to change the training schedule according to the menstrual cycle. P2 and P5 wrote down that they wanted more understanding as a female athlete or more understanding of the importance.

After this purge, an association exercise was introduced on the phrases: 'value and understanding'. Words that linked to these phrases were written out, a translated version is presented in Figure 2.13.

Figure 2.13: *Word association diagram on 'Value and Understanding'.*

The association diagram led the group to discuss whether they wanted to change the problem question. P1 stated that value and understanding 'was very abstract, and I would want the data to feel more concrete'. P4 agreed saying that she wanted 'something understandable to happen with the data', P3 phrased it as 'I want a practical insight, like with resting heart rate, if it is high, I am going to train less'. Combining these observations, the group changed the problem definition to:

'How can your menstrual data give you practical insight and be meaningful to you as a rower?'

The participants created a first wave of ideas for this question. After approximately 10 ideas, the group started discussing why they were currently not sharing their menstrual cycle within their team. P5 indicated she felt that she 'would be whining if she mentioned the menstrual cycle to their coaches'. P1 mentioned that as a coach it felt like an inbreak on privacy 'It is normal to ask about a cold, but it is all of sudden more personal if you ask a rower if they had their period recently.' These experiences lead to a new wave of ideas.

As soon as the ideas stopped flowing, a new idea-generation technique was introduced. The participants had to think of actions with the menstrual cycle that would be illegal or unacceptable. For example, 'throw your menstrual blood on your coach to let him know you have your period'. The 'criminal' technique can support participants to move beyond the obvious solutions. The participants created around 15 illegal ideas and they rewrote these ideas to answer the problem definition in a legal way.

Results

The participants clustered and organized the generated ideas; This process allowed them to identify common themes and patterns, which served as the foundation for developing solutions. Therefore, the clustering served as the transition between generating ideas and selecting concepts. Figure 2.14 demonstrates the (translated) ideas, and Figure 2.15 displays the categories that the participants established. One participant had to leave earlier; the other four participants took one of the clusters and further developed the ideas into a concept.

Figure 2.15: *Overview of the clusters of ideas and concepts.*

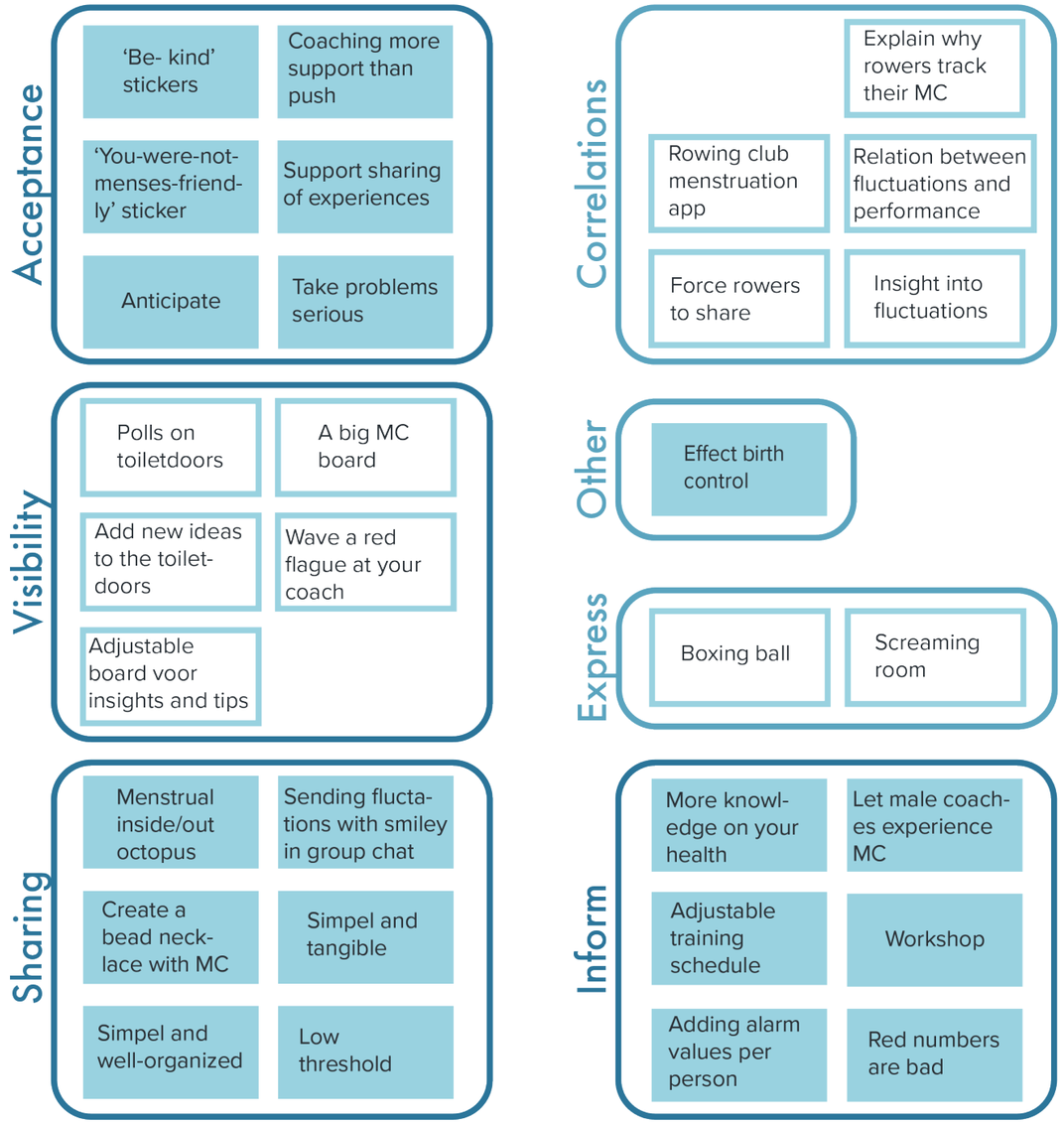


Figure 2.14: *Overview of the generated ideas and concepts.*

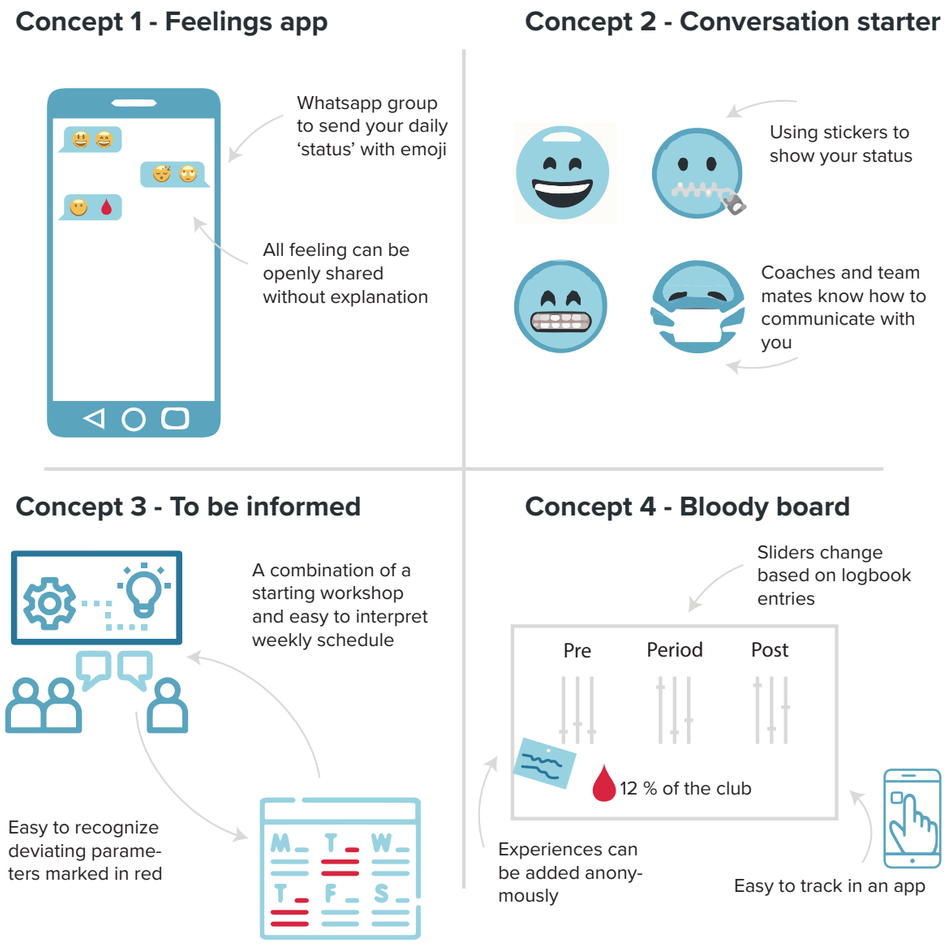


Figure 2.16: *Overview of the defined concepts.*

The defined concepts are shown in Figure 2.16:

1. **SHARING – The Feelingsapp** promotes easy and open communication among coaches and rowers. By sending two emojis every morning to a dedicated WhatsApp group chat, participants can express their mood and any factors that may influence them that day. This approach allows for honest and transparent communication without the need for lengthy explanations or questions. By using emojis, coaches and teammates can quickly understand and respond to each other's feelings, fostering a supportive and empathetic environment.

2. **ACCEPTANCE – The conversation starter** consists of stickers to quickly and easily express what your status is. By saying how you feel, the coaches know how to best support you Today. Additionally, your teammates can understand how to react to you that day: push/encourage you, leave you alone/have a conversation, or give you space after the training.

3. **INFORMATION – To be informed** is a combination of a workshop and a tracker. At the beginning of the year, the importance of the menstrual cycle and health is discussed in a workshop. Followed by a discussion on why certain parameters are tracked. The parameters in the tracker should be easily interpretable, 'bad values' are colored red, in one glance it is visible if you are doing well or not that day.

4. **VISIBILITY – Bloody Board** is a centrally placed board at a rowing club that displays the current experiences per menstrual phase experienced by club members. Experiences can be shared in an app or via buttons on the toilet. The board can be a conversation starter and raise awareness of the menstrual cycle.

Interestingly, these solutions all included using experiences depicted by the data to interact with others, showing that data value can be created by sharing menstrual and performance experiences among others.

2.8 Summary & Conclusion

The first empirical phase of this research included establishing the first contact with stakeholders and finding new design possibilities with a co-creation workshop.

First, contact with coaches provided a basis for the development of a prototype. This prototype was a digital tracker that was deployed to five rowers. These rowers indicated that the not all functions were valuable and the tracking could be further simplified.

After this, the co-creation workshop provided possible solutions to increase the value of the tracking experience. They stated that using the data to interact with others could be important, in addition to offering practical insights within the tracking.

2. Intimate Data and Design

Part 3 - Reflections and Conclusion

How can sports and menstrual cycle data improve the performance of female rowers through design?

This part reflects on the results of the first phase of the research. The text discusses the lessons learned from the process and design of the prototype. The lessons are categorized into themes, and for each theme, it is described what was learned, why it is relevant, and the implications for the next phase and prototype. Finally, the sub-question 'How can sports and menstrual cycle data improve the performance of female rowers through design?' is answered to conclude this part.

2.9 Reflection on the Process

Evaluations are Insightful

The prototype helped to understand the experiences of the rowers. The prototype test enabled rowers to discuss their experiences with menstrual cycle tracking and sports data. These evaluations revealed tracking challenges that the coaches did not initially communicate, making these insights valuable.

Therefore, the prototype evaluations will be applied again during the next phase. The use of prototypes to understand user experiences was found to be effective. Furthermore, interviews will be conducted instead of surveys to provide more context to the participants' responses.

Prototyping should be Time-Effective

During the initial stage of this research, prototyping accelerated the development of the design, despite devoting significant time to these decisions. Specifically, developing a digital prototype required extensive research on coding. So, it may be worth considering alternative methods to develop a prototype and tests that are less time-consuming, such as using an Excel spreadsheet. Nevertheless, the prototyping did drive the design forward and raised questions about which parameters to track and how to give agency to participants.

Thus, the next prototype should be as simple to create as possible. So that the amount of time spent developing is minimized and the time can be focused on investigating what questions the prototype should investigate. This adjustment would mean making use of existing platforms and a more low-fidelity prototype.

Co-Creation questions Design Direction

Finally, the co-creation session led to a reflection on the design direction. The participants of the co-creation session dared to question the original problem definition. As, the participants suggested looking at the possibility of sharing the data with peers, rather than looking at the interaction of the rower with their data. This questioning shifted the focus of the design and sparked new energy to change the second prototype. This highlights how a co-creation session can make the designer aware of their perspective and assumptions.

So, co-creation is an effective tool to question the direction of the design. A co-creation will be hosted during the next phase as well.

2.10 Reflection on the Design

Sharing the Data for Exploration

The testers of the prototype indicated that they often did not explore their data thoroughly. As a result, they did not discover many correlations, which implies that the rowers did not extract all possibilities from the prototype. One way to increase the exploration of data is by letting the prototype focus more on a visualisation of the data. Another way to increase the exploration off the data was proposed by the participants of the co-creation session. Their input suggested that sports and menstruation data could be more valuable when sharing the experiences described by the data among coaches or team mates. For example, through a daily check-in with teammates or by using stickers to show your current state of mind.

Thus, the second prototype should investigate whether rowers can increase the exploration of their data by sharing their data and if a more prominent visualisation is a way to increase the value of the tracking.

Simplify the Tracking

The evaluation indicated that not all participants understood every question in the prototype or used all of its features. This suggests that the tracking system was too complex. Participants reported that they did not find all of the features in the first prototype valuable, which could hinder their commitment to tracking. Furthermore, the participants in the co-creation session argued that data is often seen as abstract.

Therefore, the second prototype should be simplified in comparison to the first and include only the most valuable features.

2.11 Conclusion

In conclusion, the theory suggested that the performance of female athletes can be improved through the design process by implementing iterative research on sports and menstrual cycle data. Due to the limited available knowledge on this topic, a qualitative approach can be taken, focusing on rowers. The applied activities of this phase showed that by combining evaluations of the data collection and co-creation sessions, the design needs of female rowers could be investigated.

3. Motivating Insights

Part 1 - Practices from Theory

How can tracking be a valuable experience for female rowers?

The second phase of this research project aims to investigate how tracking can be a valuable experience for female rowers.

The reflection of the design suggested that the second prototype could be improved by highlighting the visualization of the data and implementing the sharing of experiences. To further understand the theory of applying these practices this part covers theoretical practices related to data visualization and sharing personal experiences. As no relevant papers could be found specifically on sharing menstrual experiences. This part investigates how females share experiences on pregnancy platforms and how these platforms could inspire the design of the second prototype.

3.1 Data Visualization

The evaluation of the first prototype revealed that participants in the first phase of this research had little contact with their data. A common solution to improve the exploration of data is data visualization. According to Marchese (2018), data visualization is the presentation of data that helps analysis. It can improve data interpretation, and exploration, and can promote discovery. Similarly, Islam and Jin (2019) suggest that data visualization simplifies identifying patterns, trends, and correlations in text-based data that could otherwise be overlooked. Furthermore, according to Tufte (1985), visual aids are generally the most effective approach to explaining, examining, and synthesizing numbers. In short, data visualization could support rowers to better understand data.

While data visualization can be effective, it is crucial to consider the context of the data when creating visualizations. D'Ignazio and Klein (2020) argue that important details related to individuals in data, such as emotion, affect, embodiment, and expression, are often excluded from data visualizations. Similarly, Lupi and Posavec (2016) suggest that adding context to data is necessary to fully comprehend its meaning. They stated that 'we shouldn't expect an app to tell us something new about ourselves' (Lupi & Posavec, 2016). Therefore, the second prototype should incorporate contextual information when visualizing the rowers' data. Figure 3.1 shows an example of how Lupi and Posavec added context to their data.

One approach to integrating individual contexts into data collection is provided by phenomenological principles. Phenomenologists argue that knowledge is constructed from past and present experiences; they do not argue that scientific findings (e.g. the average menstrual cycle lasts 28 days) are wrong but believe in the relevance of personal experience (Homewood & Vallgårda, 2020). For example, science may suggest that the menstrual cycle can influence the rowers' performance. However, the phenomenologists believe that it is the rowers' personal experiences that are most relevant to their performance. This approach is also reflected in the vision of Lupi and Posavec (2016), who stated that data can be a way to think about how we experience our world. Homewood and Vallgårda (2020) suggest that these personal experiences can be highlighted in designs by minimizing prescriptive or external information, to support the exploration of the individual's experience. Therefore, to integrate more context of the rowers, the design should focus on asking and displaying the experiences of the rowers, allowing for an effective data visualization.

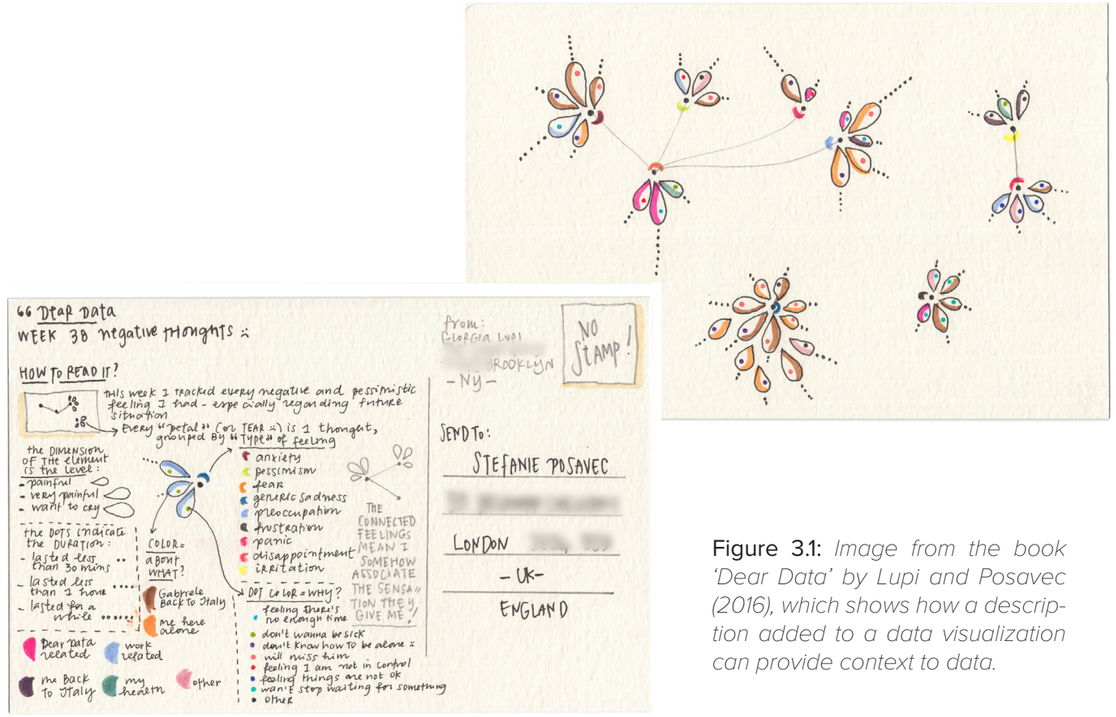


Figure 3.1: *Image from the book 'Dear Data' by Lupi and Posavec (2016), which shows how a description added to a data visualization can provide context to data.*

3.2 Sharing Experiences

The co-creation session of the previous phase suggested that sharing experiences could be another way to improve the exploration of the menstrual data. An area where sharing experiences is common is on pregnancy platforms. Users of these platforms share their experiences of their pregnancy when professional advice is limited (Peyton et al., 2014). The lack of professional advice is also a significant aspect in designing for rowers' menstrual and performance experience. As pregnancy communities are more active than menstrual-sharing communities, more research exists on this topic. Therefore, this knowledge may be inspiring for designing the sharing of menstrual experiences.

The pregnant communities are a place for females to share their pregnancy experiences. Gui et al. (2017) found that limited contact with a medical expert harms the experts' appreciation of the embodied knowledge and experiences of pregnant women. As a result of minimal conversations between pregnant women and health care providers, medical results and written reports about the fetus are their main sources of knowledge. These sources of information cause healthcare providers to see the pregnant body as predictable and manageable with medical interventions (Lupton, 1999). However, pregnancy can be experienced differently by all women, and asks for interventions that fit the women's experiences.

To find more personalized information pregnant women use forums. On these forums, they can find a combination of formal medical advice and the experiential knowledge of peers. These findings allow them to think about how their embodied experiences relate to the information they received from medical experts. A sharing platform for the menstrual cycle and performance of rowers could also support rowers to share their medical advice and experiences. The platform could allow the rowers to learn from each other's experiences and gain a deeper understanding of how their menstrual cycles may impact their training and performance.

One way the pregnancy platforms are designed to encourage users to share is to group them by their phase of pregnancy (Gui et al., 2017). This approach could also be applied in a design for rowers by grouping the rowers approximately by their phase of the menstrual cycle. For example, a group where you can post when you are on your period or a group when you are approximately ovulating. Furthermore, online conversations are anonymous, and Kang et al.'s (2016) research suggests that platform users feel that anonymity allows for more honest, real, and varying opinions. So, introducing anonymity in a rowing platform could improve the experience sharing of rowers.

3. Motivating Insights

Part 2 - Applied Practices

How can tracking be a valuable experience for female rowers?

This part is the second applied phase of the research-through-design approach and it focuses on the second gap: 'The majority of menstrual tracking applications do not incorporate training and health parameters related to sports tracking. Rowing performance trackers do not incorporate menstrual symptoms.' This chapter discusses how a prototype aims to fill this gap. Moreover, the prototype explores the hypotheses established during the previous phase, which state that the rowers might get value from their tracking by sharing, simplifying the questions, and increasing the presence of the visualization.

3.3 Overview of activities

This chapter discusses the activities applied during the second phase of this thesis. This phase investigates how tracking can be a valuable experience for rowers. The design methods applied aim to investigate the hypotheses from the first phase, which suggested that sharing can be a way to make sports and menstruation data more valuable to rowers and that the visualization should be more prominent in the second prototype. This chapter presents the deployment of the second prototype, the co-creation session that followed this prototype, and the results these activities generated. Figure 3.2 illustrates how these activities form a part of the overall project.

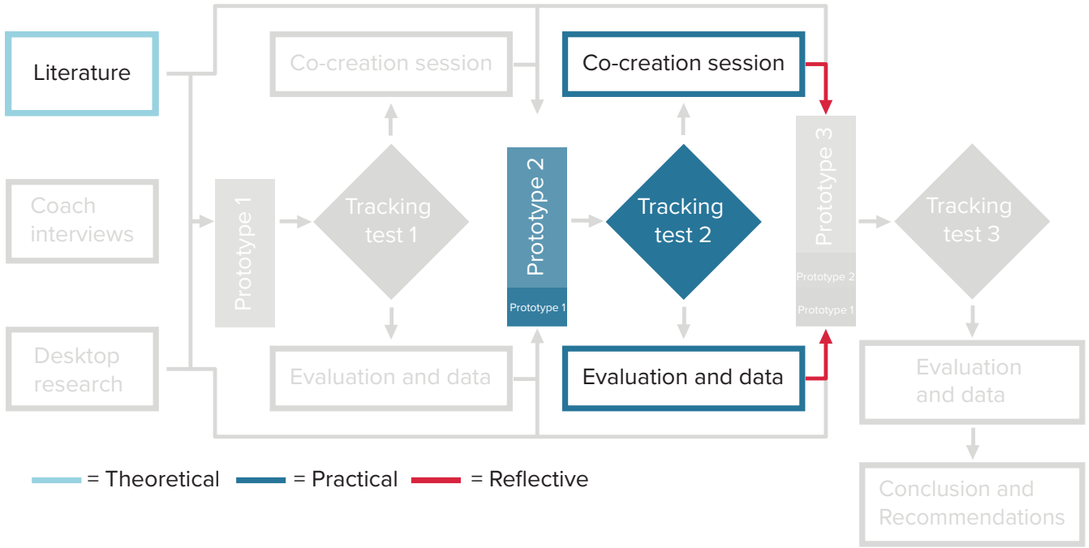


Figure 3.2: *Illustration on the structure of the report, with the topics relevant to this chapter colored.*

The performed activities described in this chapter are deploying the second prototype; and a co-creation session. The sections on these activities will include a motivation for the activity, a method description, and a results description.

DEPLOYING SECOND PROTOTYPE

The conclusion of the first phase has provided new directions for the design. These findings suggested that sharing can be a way to make sports and menstrual data more valuable to female rowers. Additionally, the results indicated that tracking should be simplified and more emphasis could be placed on the visualization. Lastly, the theory from the previous section highlighted the importance of including context during data collection. This section describes how these changes will be implemented in the prototype and how the prototype will be evaluated.

CO-CREATION WORKSHOP

Similar to the first phase, a co-creation workshop concludes this phase. The outcomes of this workshop will provide ideas for the next and final phase of the project.

3.4 Prototype Deployment

Motivation

The second prototype aimed to investigate three topics: whether sharing can create value from data for female rowers; and whether tracking can be simplified while allowing for visualization and context.

Method

The prototype was deployed for three weeks to two rowers who participated in the first phase of the project, specifically participant 2 and 3 as identified in Section 2.6. The communication used to invite the rowers to participate can be found in Appendix B2.1. After the tracking, they were invited to participate in an evaluating conversation to share their experiences with the prototyping test, which was a semi-structured interview. At the end of this conversation, they were asked to share their tracker.

SHARING

The second prototype incorporated a sharing element, which was implemented with three steps. Before the start of the test, participants were added to an anonymous group chat on the existing Telegram application. This allowed rowers to share in a way that was comparable to sending a text on WhatsApp—a familiar action for the participants. Then during the test, a primary goal for each week was communicated in the group chat to align rowers' interactions with their data. These weekly goals were informed by the phenomenological theories as elaborated by Søndergaard et al. (2021). This was done by minimizing the external knowledge shared and focusing on asking the rowers what they were experiencing. Finally, daily questions about the primary goal encouraged the rowers to share their data. For example, during the first week, which focused on investigating

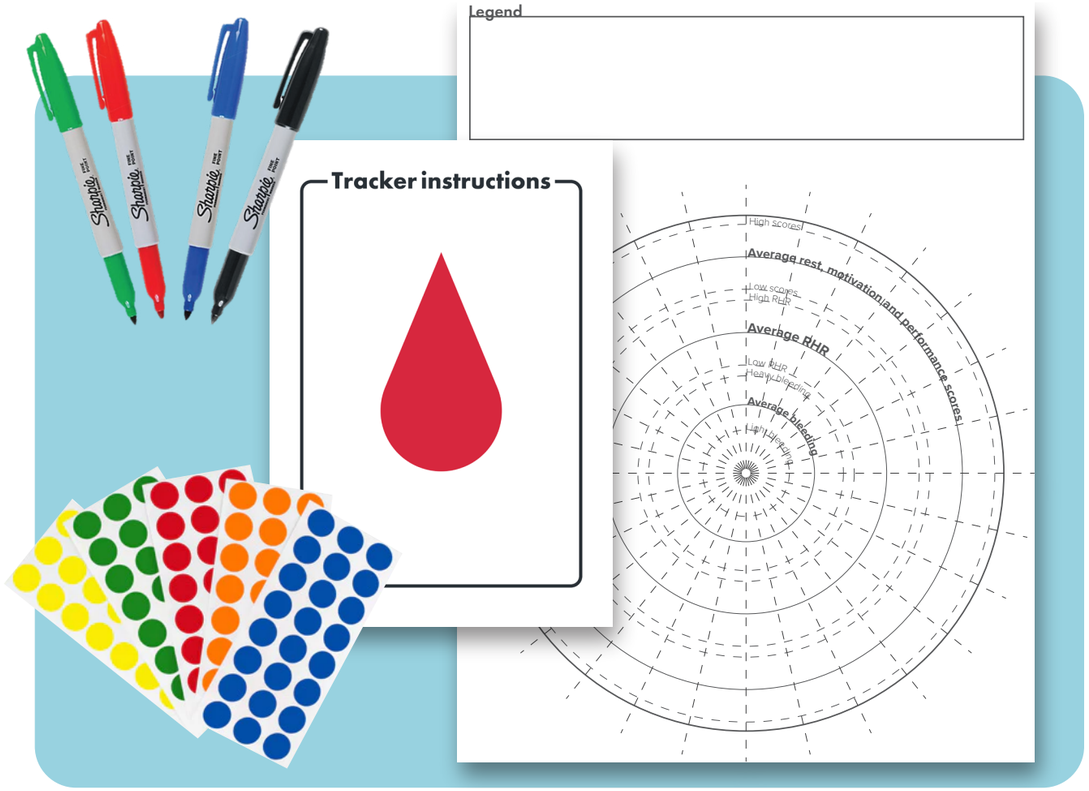


Figure 3.3: *Image of the package send out to the participants of the second prototype test.*

how tracking values (e.g., performance and rest) influence each other, participants were asked to take pictures of any outliers they identified in their data. This question was designed to get them to think about whether, for example, poor rest had caused a drop in performance.

SIMPLIFICATION, VISUALIZATION AND CONTEXT

Moreover, three changes were made to the tracking element of the second prototype compared to the first prototype. First, the number of questions was reduced by eliminating the question about bleeding expectation, weight, and symptoms, which were the lowest-rated questions on average. In addition, the question about the previous day's training intensity was changed to a question about how the rowers rated their performance. By explicitly reflecting on performance, the tracker was intended to be more in line with the goal of this research.

Second, the prototype was changed from numerical and digital to visual and physical. This first prototype constructed a visualization from the digitally tracked numbers, and the visualization was in a different location from the data. The rowers did not inspect this visualization extensively, which may have hindered their exploration of the data. Therefore, the second prototype made the visualization more prominent by asking the rowers to track directly on the visualization. To accomplish this, the second prototype consisted of a paper template (shown in Figure 3.3) along with markers and stickers. Additionally, the rowers were asked to mark their experiences on the tracker relative to an average day, which made their data more ambiguous. For example, heart rate was asked to be recorded as high or low compared to their average, rather than a specific number such as 47.

Finally, participants were more explicitly encouraged to annotate their tracking to provide contextual insight into their recorded data. This could be as simple as writing next to their tracked data.

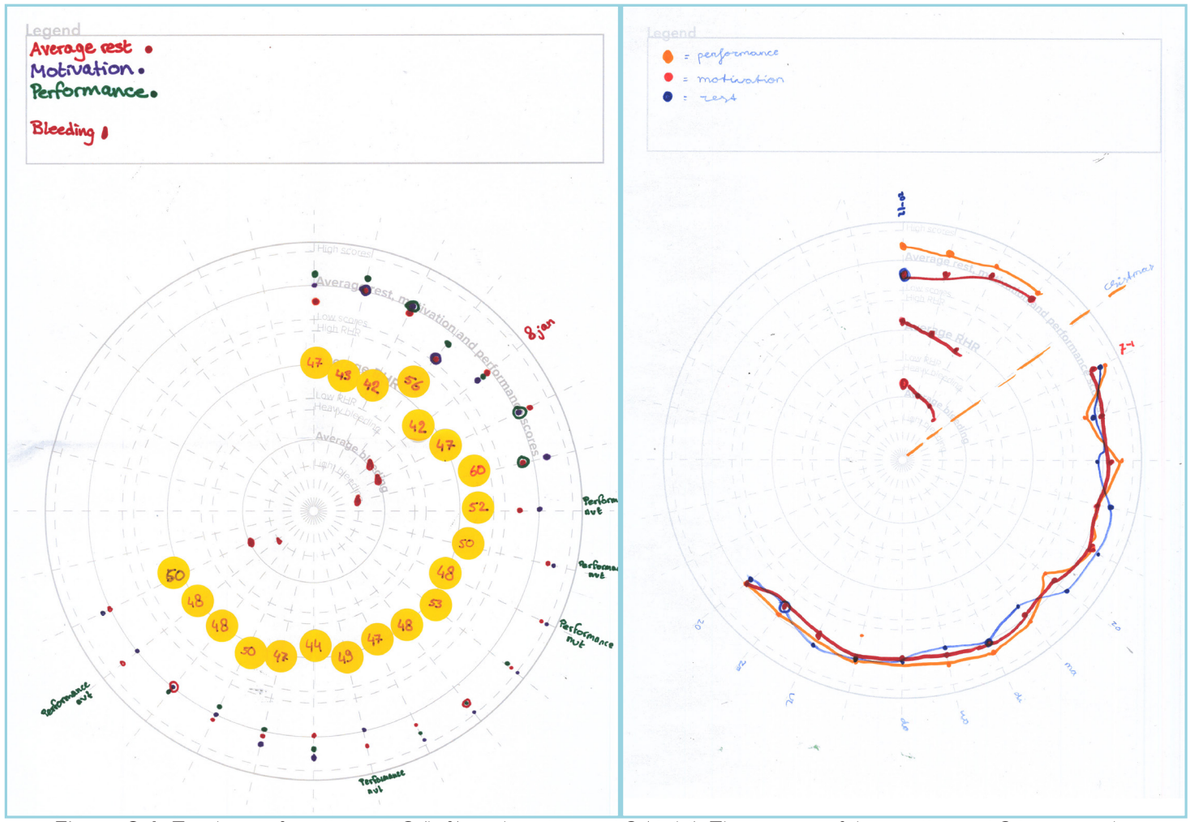


Figure 3.4: *Trackers of participant 2 (left) and participant 3 (right). The image of the participant 3 is a remake of the tracker by the participant as the original tracker was lost.*

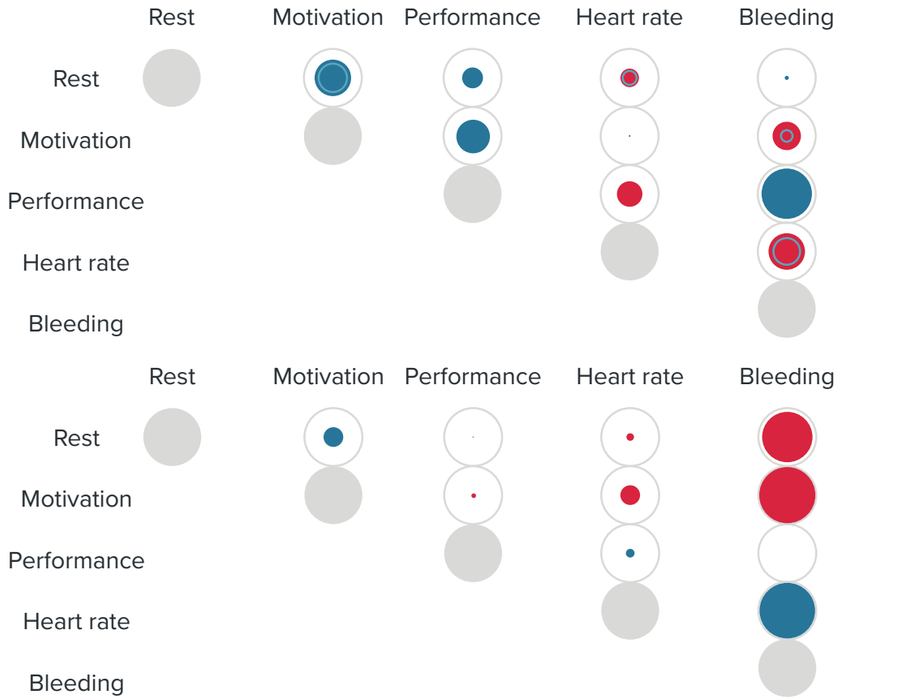


Figure 3.5: *Correlation coefficients of participant 2 (top) and participant 3 (bottom) for the different tracking parameters*

Results

PROTOTYPE DATA

Figure 3.4 contains the trackers of participant 2 and participant 3. Both rowers tracked their data for 20 days during the second tracking test. Neither of the participants has added any contextual comments to their tracker. When comparing the physical tracker (second prototype) to the digital tracker (first prototype) of the second participant, similarities between the cycle phases could be observed. Similar to the first tracking test, the participant recorded a lower heart rate during the early follicular phase of the second tracking test. Furthermore, the strong relationship between motivation and rest was again evident during this phase. The datasets of the third participant did not exhibit these types of similarities. This may be because she only tracked for 10 days during the first test.

To further inspect the tracked data the correlations between the different parameters of the tracker were calculated. First, the tracked data was converted back to digital data based on their location on the lines of the circles. Specifically, the values have been converted to a value between 1 and 5 according to their position on the circles. The scale was chosen because this format was easy to identify with the circles present in the format and reflected the variation of input from the rowers better than with a scale of 3. In this case, 1 is the low line, 3 is the middle line, 5 is the highest line and 2/4 are the imaginary lines in between.

A table of the converted numbers can be found in Appendix B2.2. The correlation between the values of the different parameters was calculated using the PEARSON function in Excel. This function was used based on the research of Mukaka (2012). The calculated correlation coefficients are shown in Figure 3.5. The outer gray circle indicates a per-

fect correlation. The calculated correlation coefficient is represented by a colored circle, where the diameter ratio is the correlation coefficient. For example, if the diameter of the perfect circle is 10, then the circle with a correlation coefficient of 0.63 has a diameter of 6.3.

As can be seen, the correlation coefficients of the two participants are not very similar. This may be due to the small number of days recorded. However, it is also important to consider the different experiences of the two individual rowers. The two similar correlations are the positive correlation between motivation and rest and the negative correlation between motivation and bleeding. It is not unexpected that a well-rested rower is more motivated to train.

The correlations between bleeding and other parameters may seem extreme. However, due to the single cycle followed by the rowers, only 5 or 6 days were marked as bleeding days and this low number of data sets makes the correlation coefficient calculations less stable. Therefore, these observations are less significant. For participant 2 the light blue circles show what the correlation would be if the data of the previous prototype is included. As can be seen, the correlations are less strong. Unfortunately, participant 3 did not register any bleeding days in the previous tracking test, so this dataset could not be investigated for a similar trend.

EVALUATION DATA

After the tracking, participants were asked to evaluate their experience in an interview. First, they were asked to share their usage patterns, which served as a conversation starter and allowed them to consider the differences between the first digital and second physical tracker. The questions then shifted to how they engaged with the data collected, specifically whether the more demanding interaction of the second prototype increased the value of the data to them. The interview explored whether the tracker supported the rowers to understand changes in their performance and how this related to sharing their data. They were also asked about their comfort level with sharing tracked data. Finally, participants were allowed to make suggestions or comments.

The interviews with the participants were recorded and transcribed in Dutch semi-verbatim, after which they were translated into English, see Appendix B2.3. The recordings were converted into semi-visual summaries. This allowed an understanding of the different topics discussed by the rowers relating to their tracking experience.

MENSTRUATION VAGUENESS

First, both rowers stated that they thought that their menstruation was vague, which led them to conclude that it had limited influence on their performance. As stated by participant 2:

'My menstruation is a bit irregular, so I find it hard to say anything about it. It is not always the same number of days. So, I find it difficult.'

When asked about its influence on her performance she indicated:

'For now, I don't have the idea that it has a clear influence. I also do not have cramps, so that is fine. I also have the feeling that many other parameters are of influence'.

Participant 3 stated what she believed about the influence of her menstruation on her performance:

'I always think that it has an influence, but the influence is irregular and vague.' & *'I sometimes have the just before my period when I think, nice, how strong I am. I can do a lot. And another time right after. And that fluctuates a bit.'*

The observation suggests that the prototype may have failed to support the rowers in finding relevant information in their data regarding their menstrual cycle. Additionally, the observations show that the effects of the menstrual cycle may be obscured by other factors that affect performance.

RETROSPECTION

The second theme the rowers discussed was that the tracker caused them to reflect on previous feelings. For example, Participant 3 stated when asked about how she filled in the tracker:

'For me, that was retrospectively filling in once every four to five days' and 'I did not use the questions, but I thought about "What did I think?" and "How did I feel?".

Participant 2 explained that every morning she would check what her heart rate was, how tired she was, and how she felt about motivation. She stated:

'In the morning I could quickly check my heart rate, how tired I was, and how I felt regarding motivation. When I was tired, I could look if that could influence my performance.'

This could indicate that the tracker caused them to be aware of previous feelings and experiences, which is the first step to understanding the connections between parameters. This finding suggests that the tracker is on the right track to support rowers to understand their experiences.

SHARING

Another theme identified was regarding the sharing element of the prototype. Both participants expressed that they felt comfortable sharing their sports and menstruation data. However, they have not used their data in communication about the menstrual cycle. Participant 2 said that she had not discussed the menstrual cycle more since she started tracking:

'This is something I did for myself, but I did think about it way more.'

Participant 3 mentioned that she already discussed this and related topics with her teammates, but did not use the tracker for these conversations. When asked to what extent the tracker could support these conversations, she replied

'I do not think that much, Maybe if you track longer and more rigorously and stricter, then it could give more results.'

This finding suggests that the sharing element did not contribute to the participants' understanding of their menstrual cycle.

PRACTICALITIES

Lastly, more practical remarks of the rowers were made on the prototype. Participant 3 mentioned that she preferred the digital prototype as she had it always with her. Furthermore, she would have preferred a horizontal graph, so it was easier to compare the fluctuations, therefore, she also would have preferred the columns of rest, motivation, and performance to be separated.

3.5 Co-Creation Workshop

Motivation

Another co-creation workshop was organized to support the development of the third and final prototype. This final prototype will be used to explore how a female rower can take action using menstrual and sports data. As discussed, data could be a way to start discussing the menstrual cycle in rowing communities. However, it was unclear what rowers would need to become active advocates for their menstrual data and performance and if a conversation was the action rowers wanted. In short, do rowers want to start these conversations and how would a tracker support this? The co-creation session explored the possible actions rowers would take if they could express their menstrual experiences.

Method

The workshop only included rowers with a design background, so that the group would feel comfortable to share their experiences and quickly come up with solutions. The session was recorded with notes during the session and pictures of the post-its. The session took place in the design faculty.

An overview of the preparation for the second Co-creation Workshop can be found in Appendix B2.4. The introductory activities aimed to create an open and understanding mindset among the participants, based on the methods of Heijne and Van Der Meer (2019). The activities included an introduction that set the goal, explained the planning, and an icebreaker game, which could help ensure that all participants had spoken before the start and could feel comfortable sharing their insights during the subsequent activities. Finally, the participants were informed about the issue of the menstrual cycle not being a common topic within rowing communities, to establish a shared understanding of the problem. Following this, a potential solution to this problem was presented in the form of the tracker element of the second prototype, as shown in Figure 3.6.

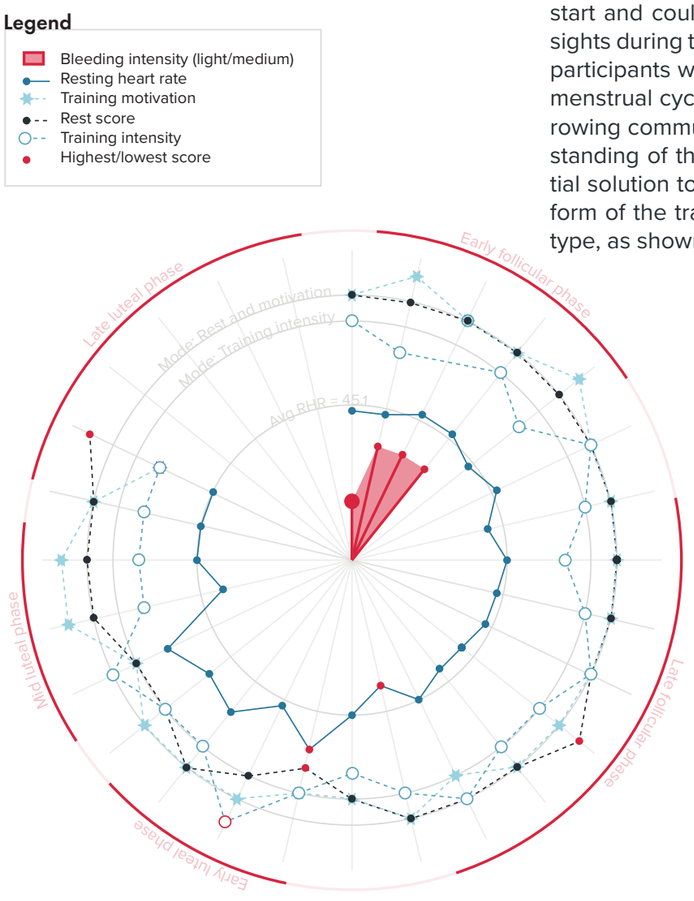


Figure 3.6: *The tool that was explained as a possible solution to bring the menstrual cycle to the table within rowing communities.*

After the introduction, the rowers were asked to identify the characteristics or values of the tracking tool. This was done by working in pairs on large sheets of paper, drawing, and writing down the possible values of the tool. After five minutes, the sheets were passed around so that participants could draw inspiration from each other's findings.

A wide variety of tool characteristics were discovered, as shown in Figure 3.7. Participants identified different values in the tool that could be categorized as creating understanding, expressing data, patterns, and others. During this activity, one of the participants noted the importance of creating a balance between pushing oneself and not crossing the line, and that data could be a way to find that line, which all participants agreed with.

The characteristics identified provided a basis for exploring the potential applications of this data. With these characteristics in mind, the participants were asked to explore:

How can menstrual and sports data be used for a rower to take action?

The participants could place post-its with their ideas on a flip-over sheet and were encouraged to write out any idea and postpone their judgment on the ideas until after the exercise. Once their ideas stopped flowing, the participants were invited to think as if they were a coach, which shed new light on the possible actions.

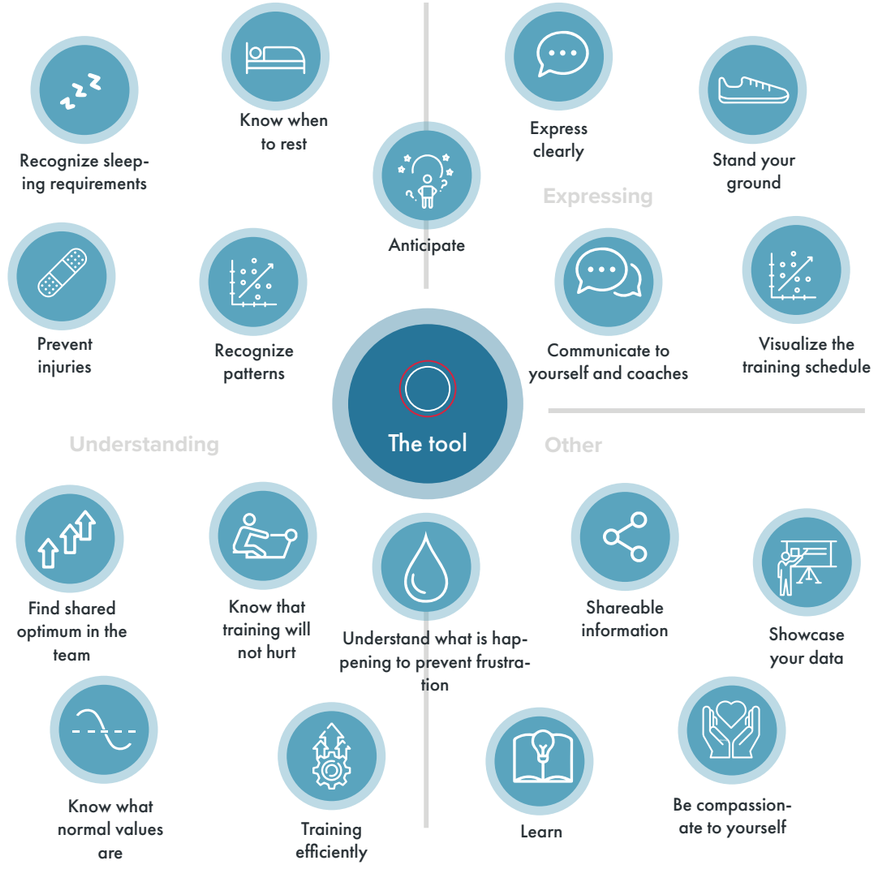


Figure 3.7: *An overview of the translated characteristics the participants identified.*

Results

The generated ideas placed along a grid line are illustrated in Figure 3.8. The participants had four ideas with more than two votes, which were taken to further develop into solutions. The solutions are illustrated in Figure 3.9.

The ideas generated were mostly focused on a passive activity of the rower, away from the body. For example, “track to change schedule” would use the rower’s data to adjust the training schedule with minimal effort from the rower. However, this idea lacks context. Interestingly, the four most valued ideas were all in the ‘passive and away from the body’ quadrant. This suggests that the rowers preferred activities where the tool provided insight and interpretation. This observation contrasts with the phenomenological methods that focused on allowing users to express their experiences. For example, a more active, phenomenological idea might be that the rowers would explore a specific experience they have with their menstrual cycle and use it to have a conversation with their coach, which places control in the rowers’ hands. However, the rowers did not emphasize this type of solution during the workshop, so the final prototype should explore how a design can give the rowers control while providing the insights they want.

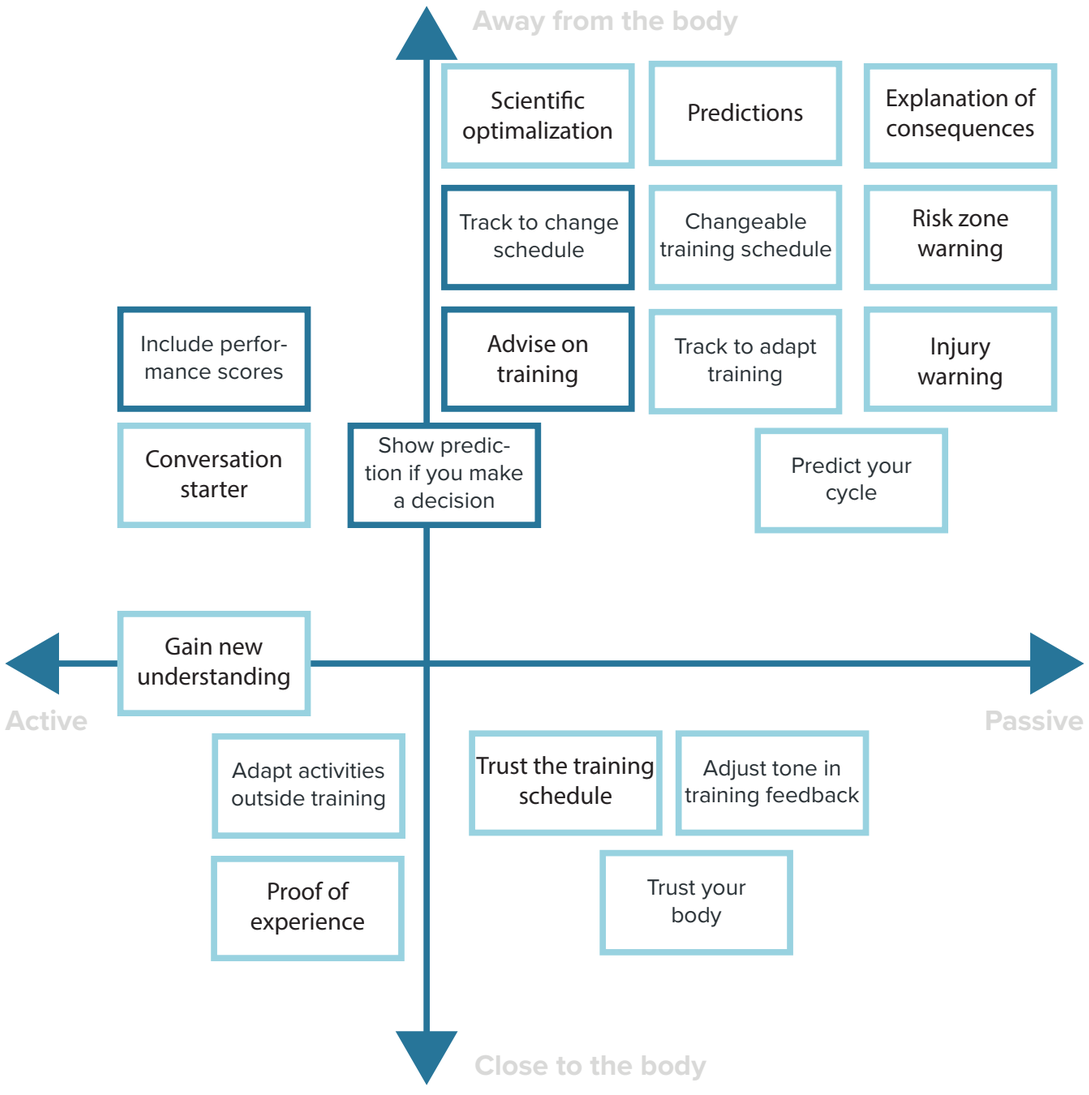


Figure 3.8: *The solutions found by the participants placed along two axes.*

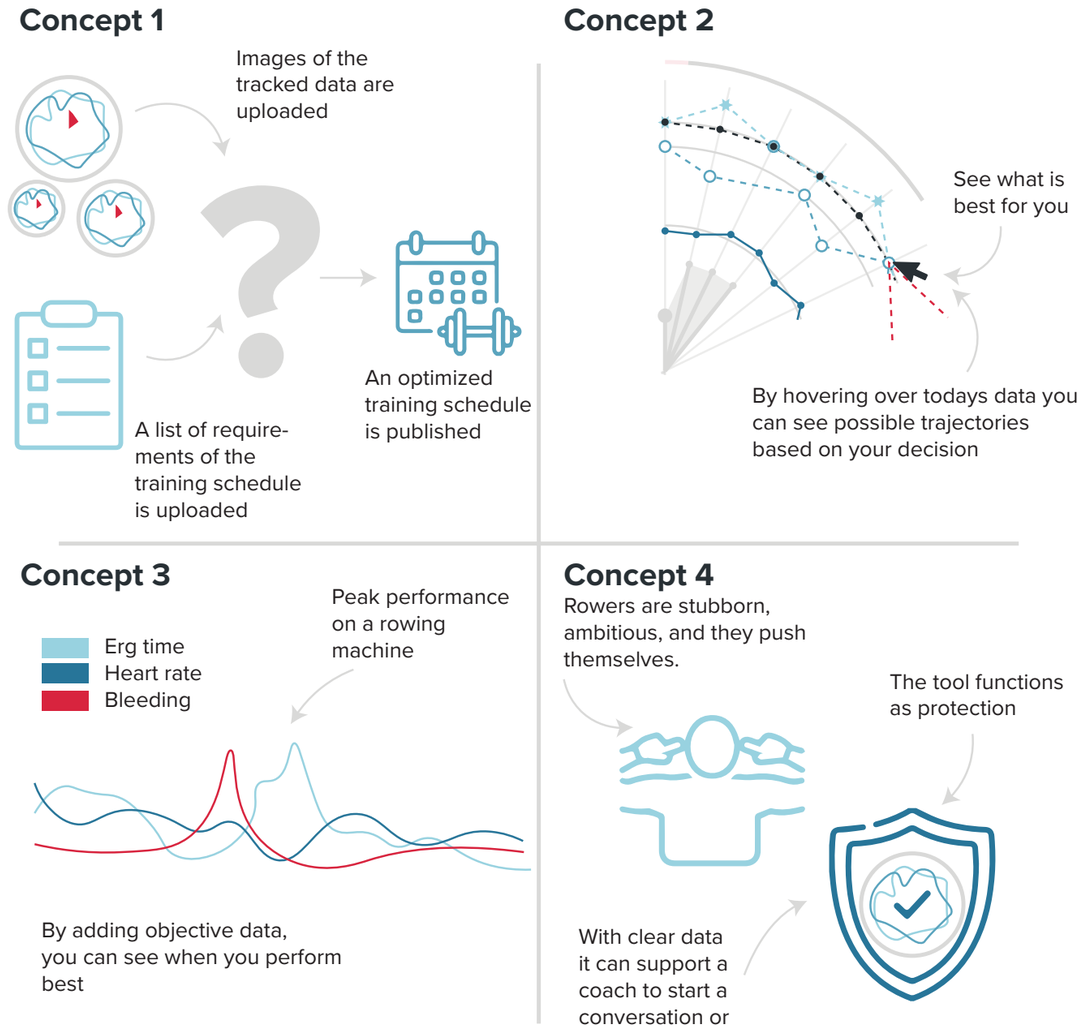


Figure 3.9: *Further defined solutions of the participants*

3.6 Summary & Conclusion

During the second phase of the research, a tracking test was conducted to investigate a physical and sharing prototype. The results showed that the participants perceived their menstrual cycle to be vague. This could be attributed to either shortcomings of the prototype or the interplay of other factors influencing the menstrual cycle. Additionally, the tracking made the participants reflect more on previous feelings, but sharing did not make the data more valuable.

During the test, a co-creation workshop was hosted to investigate the actions that rowers would want to take with their sports and menstruation data. The results showed that the rowers were looking for passive actions, away from their bodies. This could mean a tool that provides insights and interpretations of their data. However, in return this reduces the control of the rower over their data and this is an aspect that the final design should balance.

3. Motivating Insights

Part 3 - Reflections and Conclusion

How can tracking be a valuable experience for female rowers?

This part reflects on the results of the second phase of the research. Similar to the previous reflection, this chapter discusses the lessons learned concerning the process and the design of the prototype. Finally, the sub-question 'How can tracking be a valuable experience for rowers?' is answered to look forward to the final part.

3.7 Reflection on the Process

Fruitfulness of the Conversations

Even though the evaluation of both participants resulted in more commonly known information, the evaluations also contained valuable insights. For example, the mentioned retrospection of the rowers demonstrated that the tracking technique could support them to understand and learn more about their experiences, which is a valuable validation of the design. However, they also made more obvious comments that made it more difficult to find these significant insights. A more common remark for example was concerning the effectivness of the visualisation of the prototype. On the other hand, the co-creation session with a larger group of new participants produced more innovative insights. This suggests that involving more and different future users in the next phase could further improve the learning curve of the project. For the final design, additional stakeholders will be asked to provide feedback on the prototype, including parties beyond the rowers, such as coaches.

Repeating of Activities

The preparation of the activities in the second phase was easier than in the first phase. The improvements mentioned in the reflection (time-efficient prototyping, using co-creation, and the tracking test for evaluation) made the activities more goal-oriented and efficient. For example, the prototypes could be compared by the participants. This made it easier to talk about how they experienced the prototype. In addition, the documentation of the process was accelerated because the structure for the documentation had already been created and more time could be spent reflecting on the meaning of the results. Even though, it might have been expected that running the activities a second time would reduce the amount of preparation time required. The increased goal orientation was notable. So, the final design phase will maintain the same structure for developing the theory and implementing the prototype. However, the co-creation session will not be included as this prototype represents the final design for this research.

3.8 Reflection on the Design

Interdependence of Parameters

As shown by the interviews, recognizing the influence of the hormonal cycle on performance can be difficult. This could be because many factors influence performance and these influences fluctuate from day to day. For example, one day a good night's rest might positively influence performance, while another day a bad diet might negatively impact performance and these prominent impacts may overshadow the effects of the hormonal cycle. However, the subtle influence of the hormonal cycle on sleep or mood, for example, can still indirectly influence a workout. Accepting the fact that the hormonal cycle may affect these parameters and cause fluctuations over time could improve the analysis of the menstrual cycle's impact on performance. Thus, the final design should not just be only a menstrual and performance tracker, but a tool to recognize the interdependence of all parameters. Acknowledging the primary influence on performance for that day may be a more effective way to improve performance and support the main goal established in this research (understanding the interconnection between performance and the menstrual cycle). A literature review on the primary factors that affect female rowing performance can be a starting point for investigating this implementation.

Balance of Insights and Control

Although there is a phenomenological belief that designing for personal experiences is important, the participants in the co-creation workshop mostly sought practical and passive insights. Specifically, the rowers indicated a preference for calculated interpretations rather than finding those insights themselves. This phenomenon may be attributed to the power dynamics present in the rowing community, which can lead rowers to prioritize the opinions of others over their own. Alternatively, it may be a result of the constant push to improve, as described by one of the workshop participants. To determine their true limits, rowers may sometimes disregard past experiences. However, the objective of this project is to empower rowers to actively utilize their data for sports performance. Therefore, the final design should strike a balance between offering practical insights and granting rowers control over their experiences.

3.9 Conclusion

In conclusion, the theory suggested that a tracking visualization should allow for context and that sharing can be valuable specifically when experiences are shared. This way rowers might be able to reflect on medical advice and their experiences using the experiences shared by others. The applied activities of this phase showed that the rowers wanted practical insights and that the influence of the menstrual cycle on performance might be better investigated by zooming out and looking at the menstrual cycle as being part of a bigger story.

4. Empowering Rowers

Part 1 - Practices from Theory

How can female rowers be active participants in menstrual health and sports optimization?

The last phase of this project aims to conclude the design for rowers by exploring how rowers can be active participants in menstrual health and sports optimizations.

The second phase of reflection suggested that the design for rowers should strike a balance between practical insights and placing control in the hands of the rowers. In addition, the reflection also indicated that to provide effective and practical insight into performance patterns, it may be necessary to recognize different influences on performance. Therefore, this section first explores what influences rowing performance, and then goes on to explore how designs can enable control by the user of the tracker.

4.1 Performance Indicators

To support rowers in improving their performance, it is important to identify the parameters that influence it. Rowing is a demanding sport that requires both strength and endurance. Competition performance is determined by several factors, including aerobic and anaerobic power, physical power, rowing technique, and tactics (Mäestu et al., 2005). Therefore, Mäestu et al. (2005) proposed that the most effective to improve training is to monitor stress and recovery in addition to mood and measurable performance parameters. Another study investigated how rowers experience their maximum effort, also known as 'the wall'. The rowers indicated that they both used mental and physical resources to combat their mental boundaries. Thus, rowing performance relies on both physical and mental characteristics.

Different measures can be used to indicate the mental and physical influences on performance. Mäestu et al. (2005) found that VO2-max and rowing machine tests are effective measures for physical effects. They also noted the use of psychometric instruments such as the one-item Borg ratio scale to measure perceived exertion, the Profile of Mood States to investigate current stress, and the Recovery Stress Questionnaire to focus on athlete recovery. It is important to note that both the Profile of Mood States and the Recovery Stress Questionnaire contain more than 20 questions, making them unsuitable for daily completion. The Borg ratio scale is a scale to indicate how demanding training is, where 6 is the lowest point (the effort is similar to the effort when lying in bed) and 20 is the highest point (this is an effort too high to train at, at 17 the effort is already equal to the hardest task you have performed).

In short, the presented research on rowing suggests that a reflection on the performance should include parameters that both reflect mental and physical aspects.

4.2 Tracking Control

To find inspiration on how designs can support trackers to be active participants during tracking, papers were sought about tracking designs mentioning active, empowerment, or control. Two design examples were found. First, Homewood and Vallgårda (2020) designed a menstrual tracker that allowed users to adjust the device's light colors according to their menstrual cycle phase (see Figure 4.1). Secondly, Kim et al. (2019) designed a tracker that enabled users to track personal data and evaluate that data. The similarity between these researches is that both designs included a visual aspect that users could customize, creating a 'personalized visual vocabulary' that gave them control over their data. Participants in both studies expressed enjoyment of the process, indicating that this approach could be an effective way to give users more control. Thus, these researches proposed that personalized visuals can be an option to give users more control.

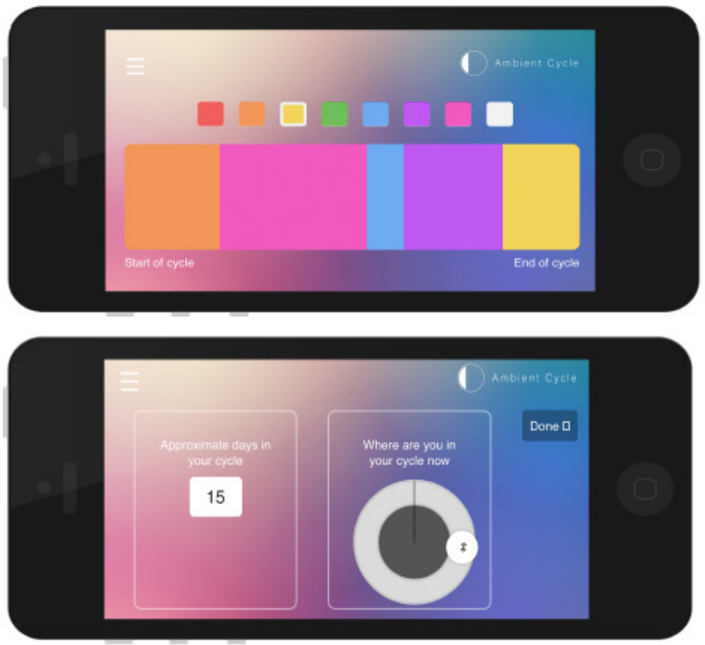


Figure 4.1: *Application that allowed participants to change the color of a light for different phases of their menstrual cycle.*

4. Empowering Rowers

Part 2 - Applied Practices

How can female rowers be active participants in menstrual health and sports optimization?

This part is the last applied phase of the research-through-design approach. This part focuses on the last gap: ' Tracking applications focus on the digital storage of data and use computed predictions. It minimizes the listening of the rowers to their bodies.' A final design and prototype will be used to investigate an approach to this gap.

4.3 Overview of activities

This chapter discusses the activities applied during the last phase. This phase concludes the project and focuses on combining the insights from the project in a final design. This design should allow rowers to be active participants in their health and sports optimization using data. The performed activities described in this chapter consist of the description of the final design and the evaluations executed with this prototype (Figure 4.2).

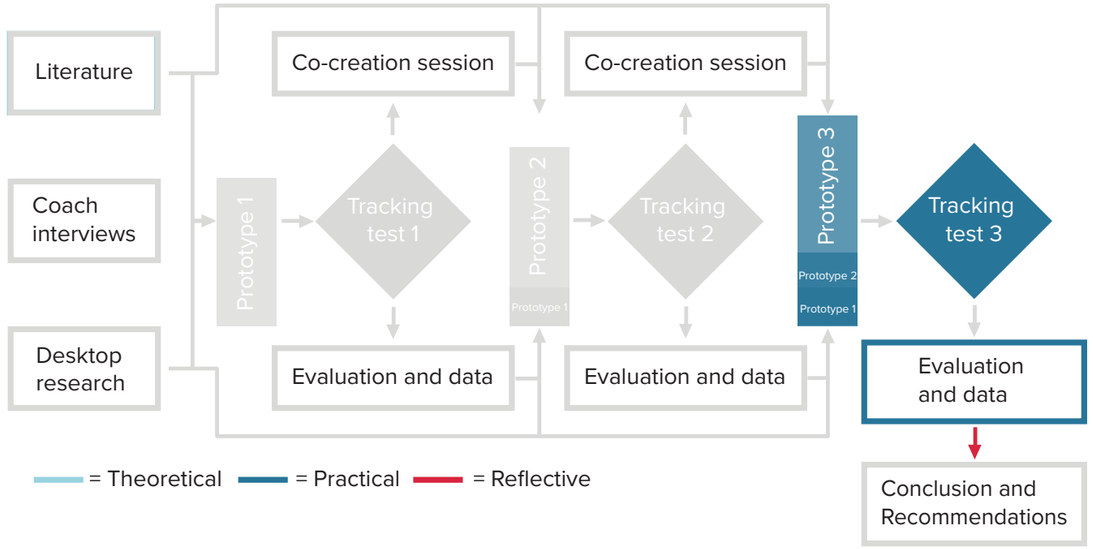


Figure 4.2: *Illustration on the structure of the report, with the topics relevant to this chapter colored.*

Although the original plan was for the final prototype and design to be the same, the choice of the final design has led to a change in this plan. The final design will be a mobile application to reach a wide audience once it is implemented. However, fully programming the final design would be time-consuming and not in line with the learning goals of this thesis. The evaluation of the design aims to validate how the final design answers the project goal, which is less dependent on the modality of interaction of the final design. As learned during the first phase of the project, it is important to consider what method is effective for testing the prototype. So, it was decided to develop a final (paper) prototype with elements from the final design to test the final design. To understand the elements in the prototype, this chapter will first present the final design and then continue with an explanation of the final prototype and its evaluation.

FINAL DESIGN

As mentioned earlier, the final design was chosen to be a digital mobile application. This choice was made so that it would be possible to distribute the design to as many users as possible at minimal cost and allow those users to access their tracker anywhere, which was mentioned as one of the advantages of the digital design during the evaluation of the second prototype. This part discusses the goals for the final design based on the findings of the project so far and how they are combined in the final design.

DEPLOYING FINAL PROTOTYPE

In this part the final prototype is presented and how different aspects of the final design are tested with the prototype. The evaluation and results are then presented.

4.4 Final Design

Motivation

Throughout this project, new insights and lessons have been learned. To combine these lessons and reflect on the original project goal, a final design is constructed. Below is an overview of the goals based on the project brief and the lessons learned from the previous phases.

Method

With these goals in mind, different steps were taken to create the final design.

EMBODIMENT

The first step was to decide on the embodiment of the final design. A personal goal for this project was to create a design that could be implemented at the end of the project. Ideally, the design would then be able to reach a larger group of rowers. This second goal led to the conclusion that the final design would be a digital product, as a physical product would be too expensive to distribute to a larger group of rowers. Specifically, a mobile application was chosen because it made the design easily accessible to the rowers, which was highlighted by one of the rowers who used the mobile application during her interview in the second phase: 'The digital tracker I could fill in everywhere, so I filled that in more consistently'.

ELEMENTS

The second step was to establish the structure of the application and ensure that the elements within that structure reflected the goals of the design. One of the main goals for the final design was to find a balance between control and insight and allow for the rowers to be active participants in this design. Therefore, it was decided to give the rowers a choice between a design with more practical insights and a design with more control, and the mobile application would have a track for both of these choices.

1. Based on project goal

1.1 The design must support rowers to **track and reflect**.

1.2 The design must **integrate** the menstrual cycle, health and performance.

1.3 The design should fit with **rowing routines**.

2. Based on first phase

2.1 The design must offer to **share** the data.

2.2 The design of the tracking should be as **simple** as possible.

3. Based on second phase

3.1 The design must include **context**.

3.2 The design must allow for **insights and control**.

3.3 The design must support rowers to **reframe** menstrual beliefs.

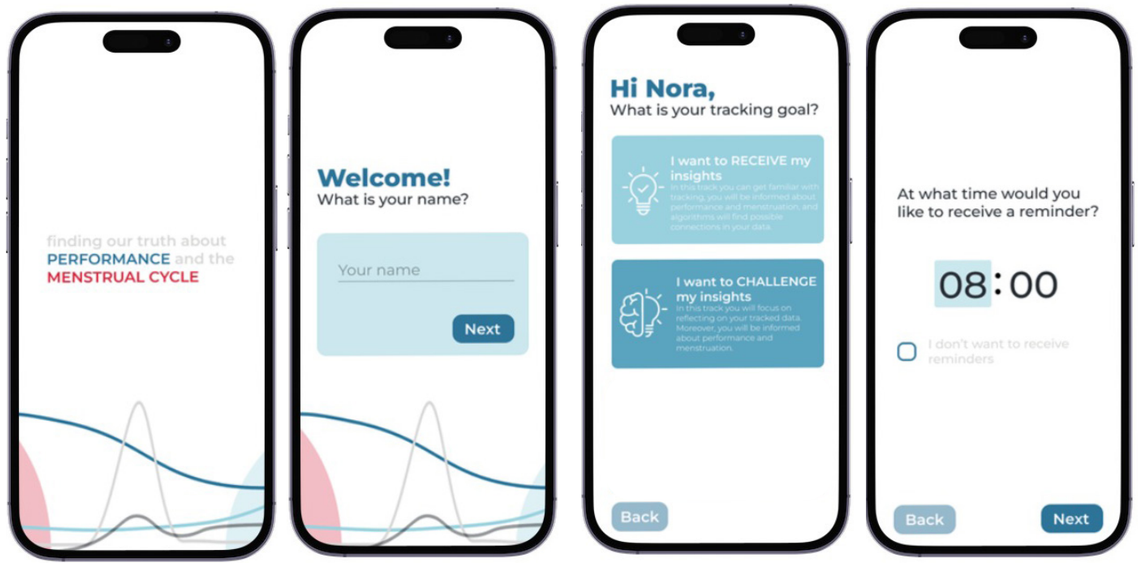
3.4 The data should allow rowers to see the **different influences on performance**.

With this decision, the specific structure within these tracks had to be established. To build this structure, inspiration was drawn from the steps described by Kim et al. (2019). In this research, the Dear Data project was studied, and they discussed how this project could be applied to the design of an application that allows for user empowerment, which fits well with the goals of this final design.

The identified steps (red) and how they were used for this project are:

1. **Preparation:** To prepare for the track, the rower should first have chosen a track, which is done through the first-time registration. This registration also allows the rower to put a reminder so that the tracking can be done consistently.
2. **Data collection:** The data is collected as simply as possible by dividing the tracking parameters into two parts. In the morning a check-in is performed. This asks for their resting heart rate, recovery, and motivation (based on the second prototype). Later on the day, the users can fill in their performance score and the context of that day.
3. **Data processing:** The data is automatically processed and the possible activities that the user can perform with this data are presented on a tab of the main screen.
4. **Visual encoding:** The data is represented on the main screen of the application, minimizing the required steps to access it. A line graph represents the data as this was well evaluated during the previous prototypes.
5. **Sharing and reflecting:** Both tracks allow the user to download their data visualization and raw data. Additionally, the users are asked to reflect on the data history to current data to reflect on personal experiences.

The design was done in Figma. This program could be used to test the designed function before programming the final application. The design of the first time registration is presented in Figure 4.3.



1 The loading page of the application, which includes a phrase about reframing our shared truth of the menstrual cycle.

2 The welcome page, which asks for the users name to personalize the application.

3 The page where the user chooses which track to use. The tracks are explained in more detail in the following figure.

4 The user can select a time at which the application will send a reminder to track.

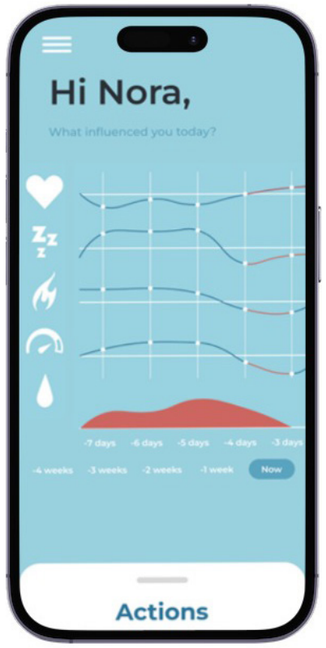
Figure 4.3: *Illustration on the first time use steps of the application*

Track 1: Receiving Insights
The first path focuses on receiving practical insights. This track includes calculated insights that may not align with the rower's experiences, but it is an easy track to start with. After completing the initial setup, the rower is reminded every morning to collect data on their resting heart rate, rest and recovery, motivation to train, and bleeding. Directly, after the morning questions the system compares the newly added data with the data history of the user data and displays similar entries. After the comparison, they will receive a daily insight. In the evening or the following morning, they can rate their performance, add context, and note anything they want to remember about that day. This is followed by a calculated insight into their data, such as their average cycle length, the parameters that have the most influence on each other, and their average values.

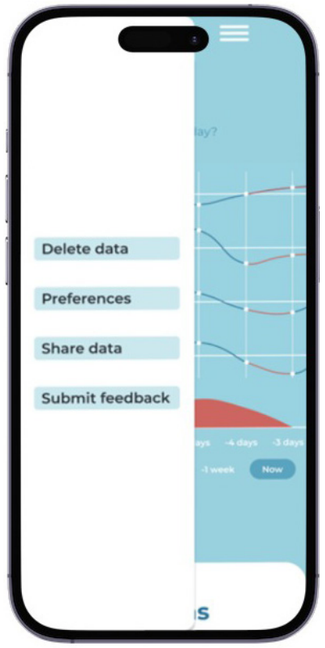
Daily Insight

Rowers build their knowledge through daily blocks of information. This knowledge supports rowers to reframe what the interaction between the menstrual cycle and performance could be. The daily insights will cover the following topics:

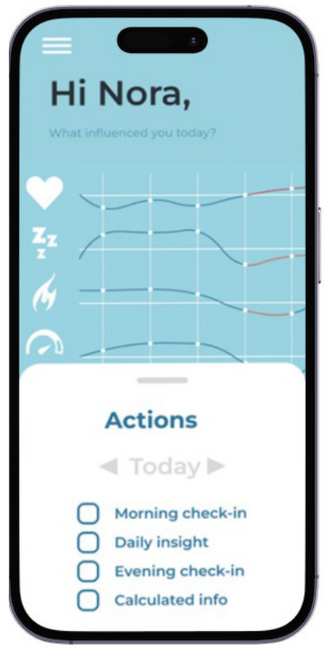
1. The 'regular' period
2. The possible influences of the hormonal cycle on performance
3. The possible influence of performance on the hormonal cycle
4. Supporting the hormonal cycle
5. When to reach out to a professional



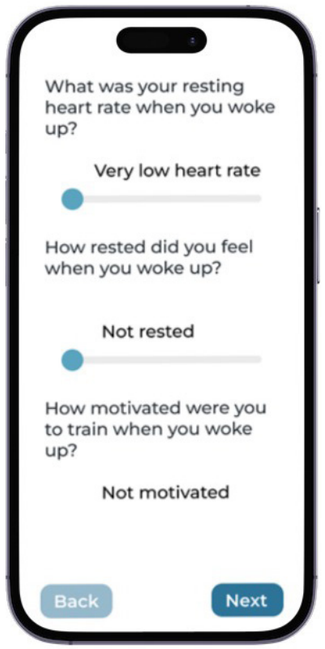
1 The home page



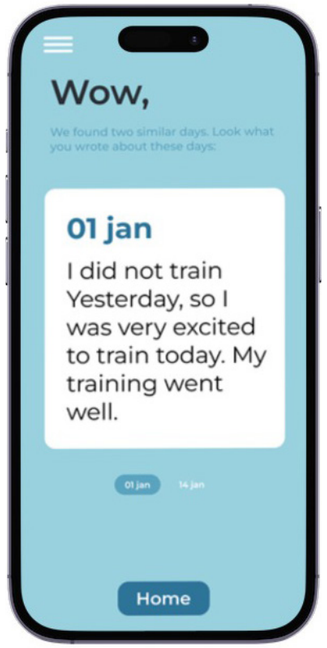
2 The settings



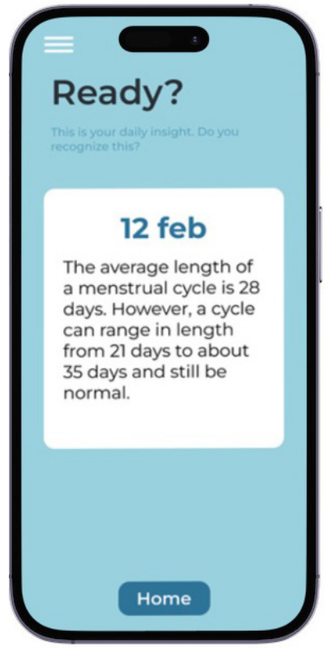
3 The actions of the day



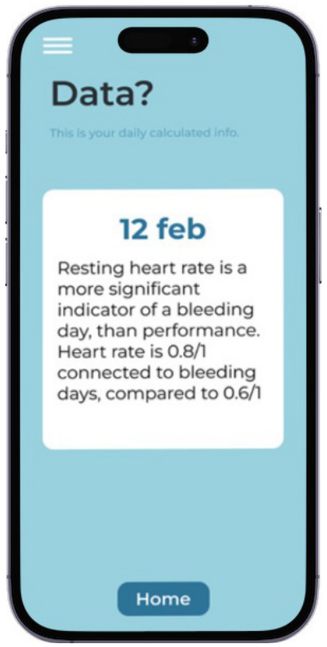
4 The morning questions



5 The comparison page



6 The daily insight

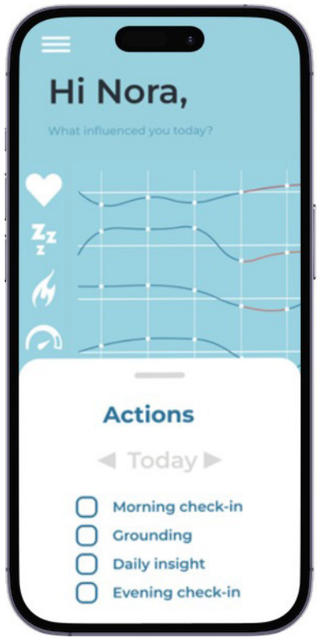


7 A calculated insight

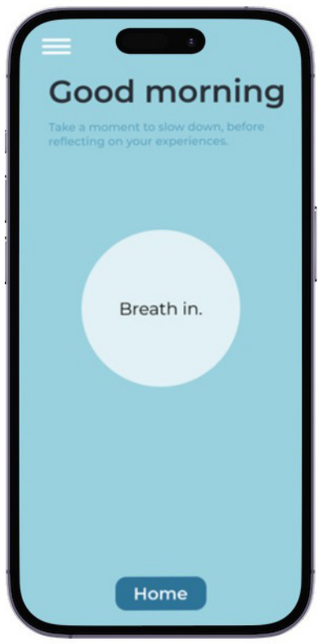
Track 2: Reflect on assumptions
Track 2: Reflect on assumptions
The second track allows for control over the data and puts more importance on the reflection done by the rowers. In addition to the described first-time registration, the participants are asked to select their assumptions about their menstrual cycle before they start to track. These assumptions will be asked again after five-week intervals, so that most rowers have completed a full hormonal cycle. The daily tracking process is similar to that of the first track. The rowers enter data in the morning, including resting heart rate, rest, motivation, and bleeding, and receive two comparison days. Before filling in this data, they are asked to take five mindful breaths to support reflection on their personal experiences. In the afternoon, they report not only their performance and the context but also what influenced them the most that day. Finally, every four weeks, participants are requested to reflect on one of the assumptions they had when they began tracking.

Final Design Reflection

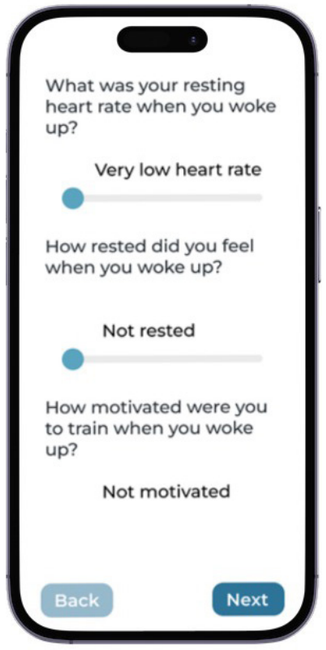
Lastly, an evaluation was performed that reflected on how the developed mobile application aims to fulfill the established goals. This result is presented in Figure 4.4.



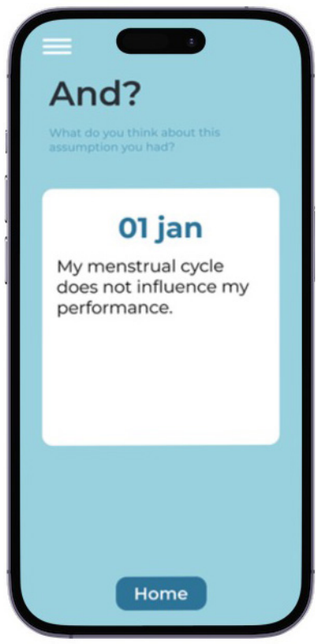
1 The home page



2 The grounding



3 The morning questions



4 The assumption check

1. Based on project goal

1.1 The design must support rowers to **track and reflect**.
The morning and evening check-in pages of the application support the rower to track their data. The reflection is performed differently across the first and second tracks. Both tracks use the comparison page to encourage rowers to think about data from their history. The insight track provides daily insights, which might cause the rower to think about if they have personally experienced this insight. The control track specifically asks to question previous assumptions, possibly starting a reflection.

1.2 The design must **integrate** menstrual cycle, health and performance.
The application includes questions concerning the menstrual cycle, health, and performance, integrating these aspects. Additionally, the insights track contains daily insights that could build knowledge on the menstrual cycle, health, and performance.

1.3 The design should fit with **rowing routines**.
During the design process rowers were constantly consulted to inform the design to ensure that the design fits the existing rowing routines. The final design reflects this through the chosen questions, which question the main aspects of the rower's day: rest and resting heart rate (physical), motivation (mental), and any other context they want to add at the end of the day. Additionally, the time required to track was tried to be minimized by the clearly defined tasks on the main screen.

2. Based on first phase

2.1 The must offer to **share** the data.
The rower can download an image of their visualization through the settings page.

2.2 The design of the tracking should be as **simple** as possible.
The tracking is simplified by having clear tasks within the main screen, this could make it easier and more motivating to perform the different tasks of the tracking. Moreover, questions are split up into two parts, to make the number of questions less overwhelming.

3. Based on second phase

3.1 The design must include **context**.
The rower is always asked about what they want to remember from their day at the end of the day. These comments will be displayed if their data is comparable to data of this day in the future.

3.2 The design must allow for **insights and control**.
The design offers two tracks, where one focuses more on insights and the other focuses more on checking their assumptions, encouraging the rowers to take more control over the story they tell about their menstrual and performance experiences.

3.3 The design must support rowers to reframe menstrual beliefs.
The reflections described in goal 1.1 aim to support rowers to reframe their menstrual beliefs.

3.4 The data should allow rowers to see the **different influences** on performance.
The mental and physical questions aim to support different insights into the performance of rowers. Additionally, the calculated insights of the insights track support more insights into the different influences and the control track specifically asks the rowers what might have influenced their performance.

Figure 4.4: *Reflection on the goals and the final design*

4.5 Prototype Deployment

Motivation

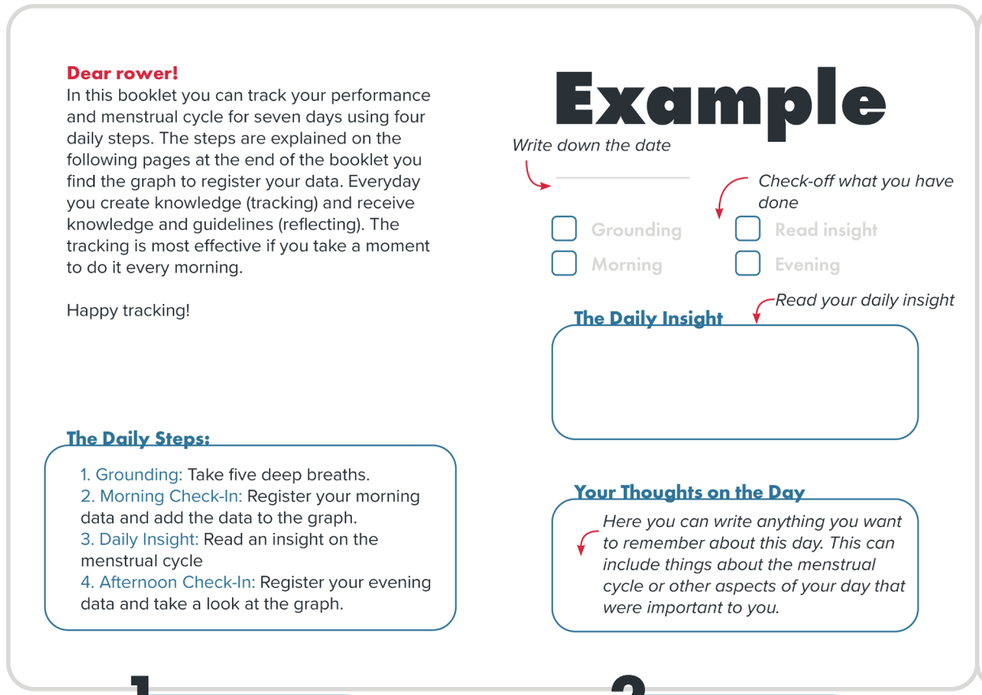
To evaluate the final design within the decided timeframe, it was decided to test a physical prototype with three new rowers. The physical prototype would allow for quick deployment and the new rowers could evaluate it with an open mind.

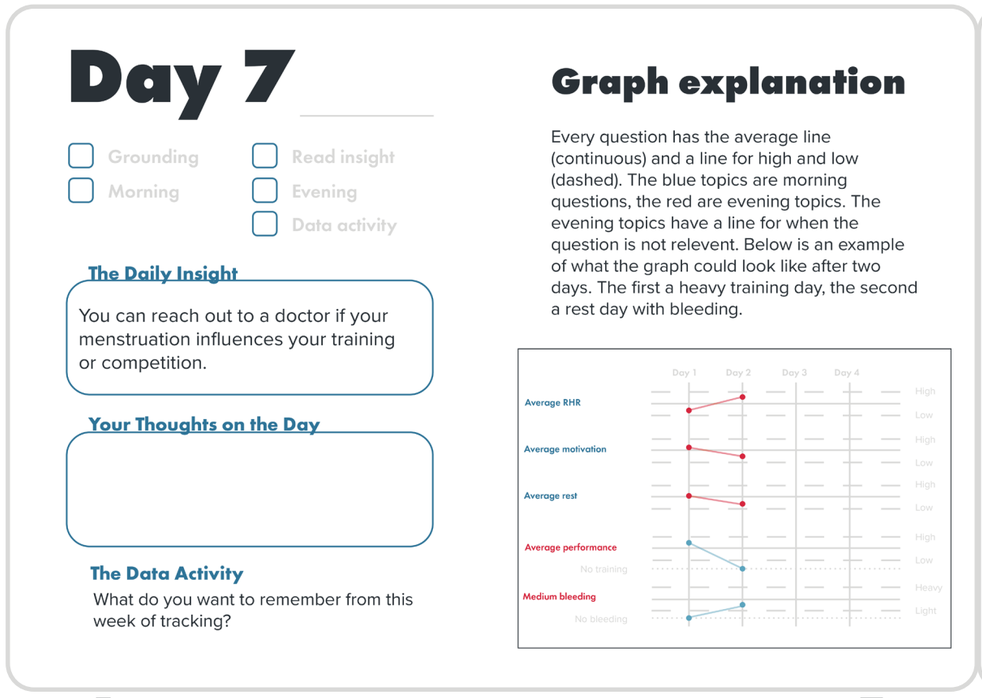
Method

First, the components of the final design to be included in the prototype were determined. The complete booklet can be found in Appendix C. It was decided that all rowers would be tracking according to the activities of both the insight and control tracks, including the morning and evening questions (both tracks), daily insights (insight track), and the grounding activity (control). In addition, they were given an activity to specifically explore their data. This could be done individually or by asking them to discuss it during the conversations that took place every other day.

The first conversation took place after the first day of tracking. Rowers were asked to discuss what questions they had about the tracker after the first day of tracking. No rowers reported having any questions. The second conversation took place after the third tracking day, during which the rowers were able to indicate what phase of the menstrual cycle they thought they were in, and all the rowers had an idea of what phase of the menstrual cycle they were in. One rower used the phrases explained in the booklet. During the interview after the fifth day, the rowers were asked if they saw any comparable data between days, which was done to get them thinking about possible connections in their data. One rower stated that most days were quite comparable, but another rower mentioned that this question had made her realize that her resting heart rate got lower as she got closer to menstruation.

Finally, after seven days of tracking, a semi-structured group evaluation was conducted in which the rowers were first asked how they experienced the tracking, then what parts of the tracker they did not understand, what they learned from the tracking, and finally what they would change about the tracking. The questions were chosen to be open-ended in order to start a conversation about the topics among the teammates. The rowers' comments were transcribed and summarized.





Value according to the Sports Gynecologist

‘What is unique about your project is that it helps athletes to find insights themselves and they can do something with these experiences. Existing projects do not have this.’

Value according to the Professional Coach

‘Every step that a coach takes should be to make the individual a better rower, but we also do not always know what we should do to achieve that. Your final design supports rowers in investigating what they experience and what they need to do to become better rowers ... I find our conversations extremely inspiring and it helps break the taboo about these topics. ’

Value according to Rower 1

‘I found it interesting to fill in the tracker and I really learned something from the daily insights. I noticed that my heart rate was dropping and then I asked if this could have something to do with the fact that I had my period. I had never known that that could be the case.’

Value according to Rower 2

‘I liked that you could directly see how things were connected. For example, one night I slept only three hours, and directly my heart rate was high and I had no motivation. I would have loved to track longer than a week.’

Value according to Rower 3

‘I thought the tracker was accessible, it did not take long, nor was it difficult. I liked that it made me more aware of the menstrual cycle. Like, someday you might do everything perfectly, sleep and food, and then still perform less. If you then think about your cycle, you might not get that frustrated. ‘

Figure 4.5: *The main remarks concerning the value of the design.*

Final Prototype Reflection

After tracking for one week, the rowers were asked about their experiences. In addition, the prototype was discussed with a sports gynecologist and a professional coach. The main remarks from the professional coach, the sports gynecologist, and the three rowers are shown in Figures 4.5 and 4.6.

Improvements according to the Sports Gynecologist

‘Something that could be added to the daily insights is information about birth control and I think it is important to think about how “the regular period” and “when to reach out” are focused on athletes, as this is information that every woman should have.

Improvements according to the Professional Coach

‘What could be added is something for coaches, how to approach the conversations, maybe a workshop or poster, or how they can start these conversations. ’

Improvements according to Rowers

‘One thing, I would love is that more would be done with the data. It was now nice to have the conversation with you, but how could this happen when it is a digital design?’

‘Can I track for longer than 1 week?’

Figure 4.6: *The main remarks concerning the improvements for the design.*

4.6 Summary & Conclusion

In the final phase of the research, the findings and goals were combined into a final design. An adaptation of this design was tested and evaluated with three rowers. In addition, the design was discussed with a sports gynecologist and a professional rowing coach. The coach and the gynecologist recognized that the main value of the design was to support individuals in recognizing their personal experiences. The rowers indicated that they found the tracker accessible and thought-provoking.

In conclusion, rowers can be active participants in menstrual health and sports optimization by allowing them to discover their menstrual cycle story. This could be supported by providing them with a combination of reflection on their data history, providing general information, and encouraging them to question their assumptions.

5.

Project Reflection

Design when research is limited

The main value of this project is the immediate solution it provides to rowers. More medical research is definitely needed when it comes to the health and performance of female athletes. However, the final design could provide rowers with insight into their performance and menstruation within months. Testing with the rowers during the process was essential to the development of this application, demonstrating that design is a way to fill a knowledge gap when medical research would not provide immediate solutions. Additionally, the collected data by the rowers could be used to further research female rowers and close the research gap.

The rowers: knowledgeable individuals

The time required to find, communicate with, and evaluate stakeholders was more demanding than expected. However, there is no doubt that these users need to be involved at different stages of the process to debunk the assumptions and beliefs of the designer. For example, the two co-creation workshops caused the most significant design shifts throughout the process. The main stakeholders in this project, the rowers, showed their passion for growing as rowers and their eagerness to improve the sport of rowing.

In addition, conversations with rowers revealed that they are individuals influenced by many circumstances and that the designs should reflect this complexity. The more practical insights they were looking for would not always reflect this complexity, further emphasizing why existing menstrual products depending on averaged calculations cannot support this complex group.

Research-through-design and taboos

When the project was started, the sub-questions and topics for the three phases of the design were already established. This choice might have influenced the design steps that were taken throughout the project. However, the design questions appeared to be in line with the suggestions and remarks provided by the data of the rowers. Additionally, the global structure served as a guide for which topics could be discussed during the conversations with stakeholders, even though these conversations were sometimes about intimate topics like changes in the menstrual cycle. It might be argued that the research-through-design, or the openness to learn with the design activities made this taboo-topic easier to discuss.

6.

Recommendations and Future Steps

6.1 Recommendations

More Control with the Application

Two tracks were included in the final design, but these tracks do not provide the level of control described in the theoretical practices in Chapter 4.2. To provide more control, a third track could be introduced in the application that provides the most control over the tracking experience. To allow for this freedom, rowers could have access to a more extensive setup that includes designing their own visualizations, as described by Kim et al. (2019). Subsequently, users could choose which questions to answer during tracking and which options from paths one and two to implement in their tracking routine. This setup would provide a unique blend of the application's capabilities for tracking health and performance.

More Inclusivity and Diversity

Throughout the process, the diversity and number of participants was still limited. A large percentage of the participants had technical backgrounds and the same level of rowing experience. To allow for a more generalized design, evaluations should be conducted with larger groups of rowers and over a longer period. In addition, it would be interesting to investigate whether the application could be applied to different sports. Finally, evaluations should be conducted with women of more diverse backgrounds to ensure that the design is also appropriate for them, for example, menstruating people who do not identify as female or women of different nationalities and cultures.

Supporting Coaches

The evaluation with the professional coach suggested that coaches should support rowers in exploring and experimenting with their personal experiences. However, not all coaches have the tools and vocabulary to do this. A workshop that combines a summary of daily insights as an information base with possible conversational phrases could help coaches guide their athletes effectively. Another option to motivate coaches to take action was suggested by the professional coach. She suggested a poster as part of the deliverable for this project, this poster is presented in Appendix C2.

6.2 Future Steps

1. Programming of the Application

During the project, a start was made with programming the application in React Native. React Native is a programming language that can be coded once and deployed on both Android and iPhone without writing in different programming languages. In App. C1 the different functions that could be used to program the pages of the defined final design.

2. Establishing More Daily Insights

A start was made with the daily insight for the prototype and the main topics that should be addressed have been discussed, but a more extensive database of insights should be established before deploying the final design.

3. Testing the Application

With these daily insights and the programmed application, the app can be deployed and evaluated for a longer period with a larger group. This could give insights into any shortcomings and the effectiveness of the two different applications.

4. Reaching out to Existing Health Apps

Existing health platforms could learn from the insights obtained during the development of this design. By reaching out, a larger group of athletes might be supported in understanding their experiences with performance and the menstrual cycle.

7.

Conclusion

This project presented the research-through-design approach to support rowers in understanding the interconnection between sports and menstruation data. Research has suggested that the performance and menstruation of athletes are linked, but the limited number of research has prevented effective guidelines for athletes. A group of athletes that is specifically impacted by this is female rowers. Due to the rapid increase of rowers in their training intensity and the novelty of the rowers when they start competitive training, they often do not communicate about their experiences with the menstrual cycle.

A mobile application has been designed to support these rowers in investigating their experiences with performance and the menstrual cycle, which could empower them to reflect on their beliefs about the menstrual cycle and performance. With daily activities in the application, they are asked to track mental, physical, menstrual, and contextual data of their day. The application contains two tracks, of which the first one offers more general insights and the second track is more focused on reflecting on assumptions the rowers have.

The application is a construct of insights gained through three cycles. Each cycle consisted of a theoretical part that was used to build knowledge of existing design practices to apply during the practical phase. Within this practical phase, the main activity was to deploy and evaluate a prototype with rowers. The evaluations of the first phase indicated simplifying the design and placing more emphasis on the visualization. The evaluations of the second phase have led to a wider view on performance.
At the end of the cycles, co-creation sessions were held, which after the first phase had caused the design to investigate the value of sharing the data. The co-creation of the second phase has placed more emphasis on having different levels of control to understand the data.

The continuous implementation of insights constructed with stakeholders has led to a design that fits with the rowing routines and could support rowers in investigating their experiences with performance and the menstrual cycle.

The following steps can be taken after the completion of this project: deploy this application by programming the application and building the knowledge base, after which the application can be tested and possibly integrated with existing health applications. In addition, more attention could be paid to the inclusivity and diversity of the application and the possibility of extending its use beyond the rowing community.

8.

Personal Reflection

I would like to close this report with a personal reflection. Even though I am very passionate about the goals of this project and raising awareness about sports and the menstrual cycle. At its core, this project is still an opportunity to learn, and I've learned so much.

Commitment as strength and pitfall

Half a year ago I almost stumbled into this project. Within three days I had asked Alejandra to be my mentor and I had written an email to Marieke. The speed with which the project started was characteristic of my process. During the project, there was never a moment when I did not know what to do and was not committed to the task. I always saw a million ways to investigate the issue and sometimes had a hard time deciding which action would best support the project. For example, I wanted to start the first tracking test quickly. As a result, within three weeks I was in contact with the first rowers and had sent out a prototype, but this also meant that I jumped head-first into the project without thinking too much about my existing assumptions.

So my first big lesson was to take moments to stop. These moments to think about what was happening felt scary at times because you do not always know what you will learn from it, but it helped me process and use the results I had worked so hard to achieve. I think what I had to realize to take those moments was that in engineering you accept the number that comes out of a difficult calculation, but in design, you have to interpret what the results mean. And when you do that, you have to realize that you are always looking at the results from your mind, full of your experience and knowledge. Stopping and looking at it from a different perspective can help to give the results a lot more value.

Having said that, I do not think I have fully mastered stopping and "relaxing," but it is a start. One thing that made it even more difficult to stop specifically for this project was my connection to the subject. Over the past few years, I have spent almost all of my free time in the rowing community. Rowers' habits and practices that are normal to me may not always be logical to other designers. I had to practice and plan to take moments to realize what I believed and how to explain it to others. Funnily enough, this feels similar to what the final design is trying to do. As a rower, you are so focused on progress and pushing forward that it is hard to stop and think about whether the way you are training is actually improving your performance. The design uses data to help you think about your experience.

In short, I think the commitment to the subject matter is what made this project so rewarding and engaging for me, but it also tested my ability to zoom out and rationalize what was happening during the project.

My goals

At the beginning of the project, I had set out to learn and practice five different topics.

First, I wanted to incorporate programming into my project. This did happen, and as always, the process of programming was a nice change from the writing or designing during the project. However, I also realized how time-consuming it can be. So even though I enjoy the process, I have to keep asking myself if this is the best activity to be doing right now.

Which leads me to another goal I had. I want to learn to change the plan when I feel that a task is no longer supporting the project, and I am sure this is the project where I have tried to apply this. Several times I adjusted the prototype to better explore the goals for this project. However, I did not deviate drastically from the original plan, but it also felt unnecessary to do so.

My third goal was to learn how to properly handle sensitive data, and except for the HREC application, this was not a big part of this project. This may have been due to the enthusiasm of the participants, which led me to believe that the way I was approaching the project was sensitive enough.

Another important goal was to consider whether I should be solving a stakeholder problem, and a moment where this became important was when the rowers said they wanted practical insights or, for example, direct changes to their training schedule. However, I felt that the rowers would have too much context to directly use calculations to include this. The professional coach specifically stated that this was one of the strongest points of my design, and I am proud to have realized that I could not cross that line and directly implement what the rowers wanted.

My final goal was to build my confidence as a designer, and despite some ups and downs, I have never been more proud of a project. I believe that by choosing my path and learning to reflect, I have truly bridged the gap between being an engineer and a designer, and I look forward to presenting myself as that hybrid.

Enjoyment in the process vs the results

An important meeting in this process was the week before Christmas break. In the last few weeks before the break, I had put a lot of emphasis on implementing the feedback on my writing and creating a good academic report on the actions I had taken so far, but in doing so, I had lost a bit of the fun in the process. During the Christmas break, I realized that I had been putting too much emphasis on the results and taking it way too seriously. In contrast, at the beginning of the project, my curiosity to learn new things brought me so much joy. By recognizing that the report was also a learning opportunity and not something to be taken too seriously, I was able to approach the task much more lightheartedly. Focusing on the small steps and practicing them makes everything more fun. I hope to carry this lesson with me and think about it when I am dreading feedback or when I am working on a particular task. Or as my boyfriend would tell me, “Everything will be fine”.

With this reflection, I officially closed off this project and will take a week to sleep in :p. I can not wait to see where my next steps will take me, but I am sure that I will use the lessons from this project along the trajectory.

Julia

Ref.

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App.
Appendix

A1. Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Rademaker
initials: J.T.E. given name: Julia
student number:
street & no.:
zipcode & city:
country: The Netherlands
phone:
email:

Your master programme (only select the options that apply to you):
IDE master(s): (★ IPD) ( ) DfI ( ) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: M. H. Sonneveld dept. / section: HCD - AED
** mentor: A. Gomez Ortega dept. / section: SDE - IoT
2nd mentor:
organisation:
city: country:
comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair M. H. Sonneveld date - - signature

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC
Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC
List of electives obtained before the third semester without approval of the BoE

( ) YES all 1st year master courses passed
( ) NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ( ) APPROVED ( ) NOT APPROVED
Procedure: ( ) APPROVED ( ) NOT APPROVED

comments

name date - - signature

TU Delft

Personal Project Brief - IDE Master Graduation

Sport and menstrual cycle tracking for health and performance of rowers — project title

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

start date 02 - 10 - 2023 — 12 - 03 - 2024 end date

INTRODUCTION **

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

Current Research
Sports research primarily examines male athletes. Only 6% of sports research between 2014 and 2020 was conducted on female athletes, compared to 31% of all-male sports research (Cowley et al., 2021). The lack of all-female research means that most exercise guidelines do not reflect the physiological differences between men and women (Sims & Heather, 2018) (Pandit et al., 2023). The lack of guidelines has two effects. First, without proper sports health education, it is more difficult for athletes to recognize the effects of training on their bodies. Second, athletic trainer education rarely includes women-specific advice (Cowley et al., 2021), and coaches who are not sufficiently informed about women-only issues can negatively impact the health of female athletes. This impact is highlighted by the specific group of this graduation project: Dutch female athletes reported that the main factor that prevented them from reporting amenorrhea (loss of menstrual cycle) was the tendency of coaches and medical professionals to normalize this condition (Verhoeven , 2021).

Current Solutions
Menstrual tracking (registration of bleeding days and/or symptoms) is fundamental to understanding personal health (Eschler et al., 2019). This may be particularly important for female athletes, as changes in the menstrual cycle are the most obvious indicator of relative energy deficiency in sport (RED-S) (Verhoeven, 2021). Women use different tools to monitor their menstrual cycle, including phone applications, digital calendars, handwritten diaries, monitoring contraceptive cues, recognizing symptoms, or relying on memory (Epstein, 2017). Female athletes incorporate various tracking systems into their routines to monitor health and performance. Measuring training or health parameters (sleep or heart rate) guides the adjustment of training load (Torres-Ronda et al., 2022).

Current Problems
1. Sports gynecologist Paternotte pointed out the limited data available on medical advice for female athletes. Without an established policy, it is difficult for athletes to appropriately interpret the data they collect.
2. Most menstrual tracking applications do not take into account training and health parameters related to athlete tracking, and performance trackers do not take menstrual symptoms into account.
3. Tracking applications focus on digitally storing data and using calculated predictions. It minimizes females' physical interactions with their bodies. Examples of digital applications and a physical sensor can be found in Figure 1.

Stakeholders
1. Female rowers: This report mainly concerns Dutch female competitive rowers aged 18 to 28 years. Most of these athletes begin rowing during their college years and typically increase their training from 4 to 14 times per week within two years. While the athletes compete at national level, they are not subject to any federation guidance. Personal experience has shown that rowers have routines to monitor their health. The athletes log their sleep, heart rate, weight and training using self-created Excel spreadsheets. In addition, they have reflective conversations with their trainers before and after training.
2. Coaches: The instruction of rowers relies on the efforts of volunteers, often students. This means that this group may lack expertise but has the flexibility to adapt to new information.
3. Sports gynecologists and sports physicians: Tracking the menstrual cycle of athletes is of interest to gynecologists and sports physicians who care for female athletes. Understanding helps discuss menstruation (Eschler et al., 2019).
4. Database coordinator: The data from tracking applications must be managed by a database coordinator.

space available for images / figures on next page

TU Delft

Personal Project Brief - IDE Master Graduation

introduction (continued): space for images

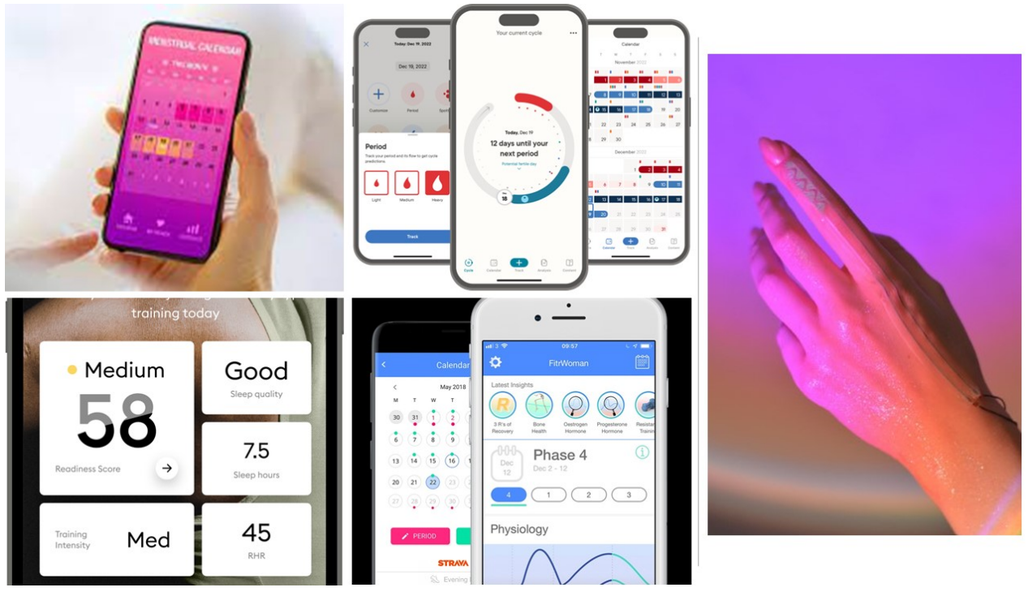


image / figure 1: Menstrual tracking applications (left) and a physical sensor (right) to monitor the menstrual cycle

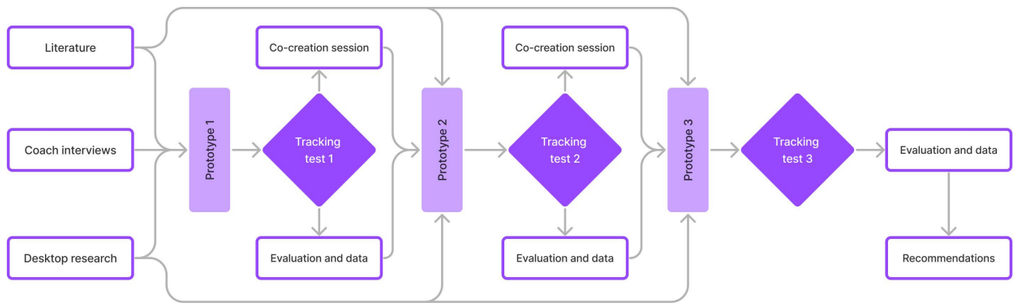


image / figure 2: Diagram of the planning structure

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30 Page 4 of 7
Initials & Name J.T.E. Rademaker Student number
Title of Project Sport and menstrual cycle tracking for health and performance of rowers

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

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

Current menstrual tracking systems consist only of computational and digital translations. To facilitate meaningful discussions about athletes' experiences, they should use multiple senses to listen to their bodies and gain insights from diverse sources of knowledge (Woytuk et al., 2023). A product-service combination can enable athletes to unveil their reality with the menstrual cycle.

It is good practice for rowers to already record data about their health and have regular moments of reflection. However, the menstrual cycle is often not integrated into this routine. A practical tool that combines this performance reflection and menstrual data can provide athletes with meaningful insights and help discuss this topic with coaches.

The limited biodata available on female athletes' menstrual cycles makes it difficult to develop a tool for this audience, but a tool could also help collect a larger data set on female athletes. The project must strike a balance between collecting the larger set of required data to design and using the data to design for the individual athlete.

In summary, the main three problems with menstrual tracking for rowers are:

1. Combination of sensing and computation --> feeling of control over your body and data
2. A practical tool that integrates with the tracking and reflective rowing routines
3. Collect group data to design, but designing for the individual

A versatile design solution that combines scientific rigor with a focus on the needs of the athlete should solve these problems. The solution is designed to enable athletes to access accurate health and performance information and stay connected to their body through touch. In addressing this challenge, I strive for a solution that values the uniqueness and privacy of each athlete while supporting them to engage in open conversations.

ASSIGNMENT **

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

The goal is to design a product-service combination that supports rowers to track and reflect on the interdependence of the menstrual cycle and their health and performance. While ensuring the athletes feel in control over and in touch with their bodies. The end result should fit current rowing routines.

The project has two primary components: a digital element (the service) and a physical aspect (the product). The aim is to develop an initial digital prototype. Using the insights of this digital prototype, I will develop a tangible product to enhance the tracking experience . For this to work, I want to work closely with a group of athletes while remaining in contact with professionals like gynaecologists and a professional coach. My intended outcomes aim to address the mentioned opportunities with three design questions and related research questions:

1. Empowering athletes: How can female rowers be active participants in menstrual health and sport optimization, not just digital data collectors? a. What does it mean for a rowers to be an active participants in health and sport optimization? b. How can a product give a rower a feeling of control over their body?
2. Motivating Insights: How can the tracking be a valuable and safe experience for female athletes? a. How do rowers currently get value out tracking? b. What is required for female athletes to get valuable insights from data? c. What does a solution require for female athletes to have a safe experience with it?
3. Data-driven design: How can collected sport and menstrual cycle data improve designs for female athletes? a. What data is currently tracked by female athletes? b. What connections can be seen between data collected by female athletes and the menstrual cycle? c. How can data be used during a design process?

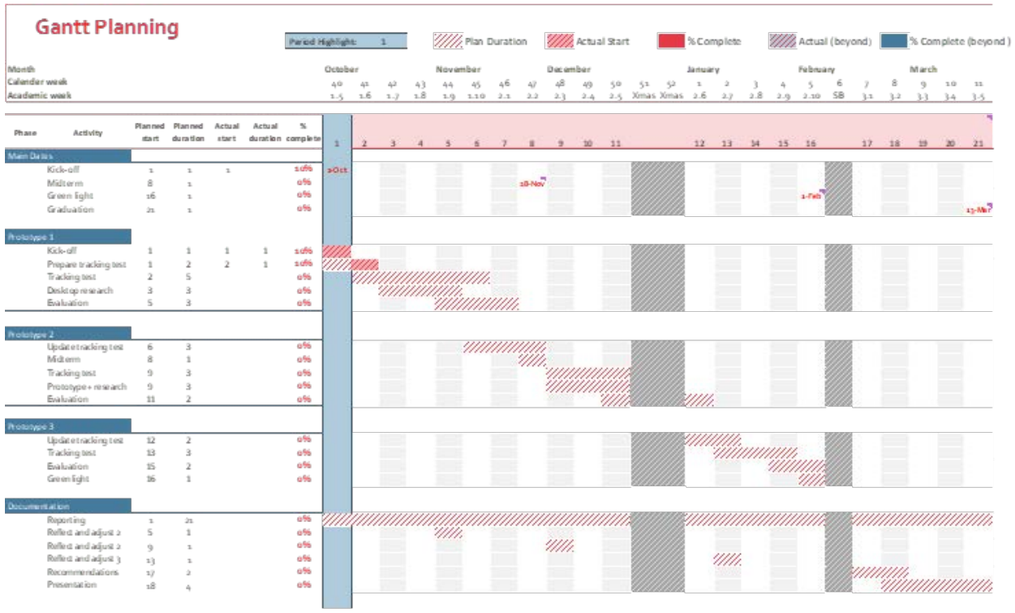
Personal Project Brief - IDE Master Graduation

TU Delft

PLANNING AND APPROACH **

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

start date 2 - 10 - 2023 12 - 3 - 2024 end date



The project planning is guided by a research-through-design method. Limited data is available on menstruating athletes, with RtD some required knowledge can be generated and the iterative methodology fits with the cyclic characteristic of menstruation.

I aim to include a minimum of 12 up to 50 rowers from at least two different rowing associations. This way I can provide the possible necessary support if any difficulties arise, while collecting a wider set of data.
I will go through three cycles, or prototypes, intentionally starting with a digital prototype to lower the threshold for participants. A digital product is closest to what the athletes currently use. The three prototypes are:

1. Quick digital prototype to build a first database (Design Question 3)
2. Digital or physical prototype to support athletes to interpret their data (DQ 2)
3. Physical prototype to incorporate different senses of rowers and make the athletes active participants (DQ 1)

During the each prototype test by the users, I will perform desktop research, and prepare for the evaluation. I aim to conclude the first two prototype test with a co-creation session. In addition, I will ask all participants to fill in an evaluation on their tracking process and collect the tracked data. The combined gained insights will guide the preparation of the next prototype. After each cycle I aim to finish the documentation for that cycle, see Figure 2.

The first cycle is concluded with the midterm report, the second two cycles are between the midterm report and the green light meeting. After the green light meeting, I will prepare the presentation, write the recommendations and re-evaluate the report.

TU Delft

Personal Project Brief - IDE Master Graduation

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

As a former rower, I have seen the effects of energy deficiency around me. From my own team four out of six rowers (age 18-21) lost their period and little was done to guide them during this time. Now that I started to learn more about the health implications of menstrual problems, I felt it was imperative that rowers learned to recognize and respond to menstrual problems.

During my studies I have always had an interest in programming and I especially enjoyed the course Machine Learning for Design. I want to make use of these python skills by collecting and analyzing the biodata of athletes.

The courses Flight Case and Creative Facilitation have helped me see what my value as a designer can be. As a designer, I am always curious and dare to ask questions. With these inquiries, I can help stakeholders reframe their problems and bring them to the core of their needs. By organizing co-creation sessions, I want to practice questioning what the stakeholders perceive as their problem and recognize what I can solve.

An important part of my project resolves around sensitive data and I want to gain a better knowledge on how to ensure the safety of this data and how to build trust with the athletes that donate their data.

As a designer with an engineering background, I am inclined to follow structured methodologies for a design. However, with a personalized project like a graduation project, I think that the standard list of methodologies might not always add value to the project. I want to be more flexible: recognize when planned tasks or methods do not fit the project anymore and change my plan accordingly.

Lastly, I have worked in a lot of group projects during my master and feel that I am a competent group player, but sometimes lack the confidence to stand my ground. As a final part of my studies I will work on building my confidence to trust my designerly instincts and present my self to the job market as an asset.

Summarized:
- Apply python programming on biodata
- Grasp the core of a stakeholder need and know what I can solve
- Understand data safety
- Understand when to adapt the methodology to the project
- Build confidence in my own skills and interests as a designer

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Sources: see separate PDF page.

A2.1. Data Management Plan

Plan Overview

A Data Management Plan created using DMPonline

Title: Sport and menstrual cycle tracking for health and performance of rowers

Creator: Julia Rademaker

Contributor: A. Gomez Ortega

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2021)

Project abstract:
The goal is to design a product-service combination that supports rowers to track and understand the effect of their menstrual cycle on their health and performance. While ensuring the athletes feel in control over and in touch with their bodies. The end result should fit with the current rowing routines.

ID: 134292

Start date: 02-10-2023

End date: 12-03-2024

Last modified: 10-10-2023

Sport and menstrual cycle tracking for health and performance of rowers

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

Question not answered.

2. Date of consultation with support staff.

Question not answered.

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Consent form, sent with the instructions of the participation.	.csv files	Qualtrics survey	Collect consent for participation	Within the Qualtrics survey portal and after collection of the data on TUD SURFdrive.	Supervisors (Alejandra Gomez Ortega, Marieke Sonneveld)
Menstrual cycle-related data (collect daily symptoms, number of bleeding days, cycle length)	.csv files	Upload within a Qualtrics survey.	Investigate relations between the health of athletes and the menstrual cycle. Limited existing data, so new data needs to be generated to enable a fitting design.	Within the Qualtrics survey portal and after collection of the data on TUD SURFdrive.	Supervisors (Alejandra Gomez Ortega, Marieke Sonneveld)
Health data tracked by smartwatch (GarminConnect) or manually (collect resting heart rate, heart rate during exercise, exercise duration, sleeping hours) any identifiers or identifiable information will be excluded from the data on the personal device of the participants before uploading.	.csv files	Upload within a Qualtrics survey.	Investigate relations between the health of athletes and the menstrual cycle. Limited existing data, so new data needs to be generated to enable a fitting design.	Within the Qualtrics survey portal and after collection of the data on TUD SURFdrive.	Supervisors (Alejandra Gomez Ortega, Marieke Sonneveld)
Evaluation on tracking prototype through form	.csv files	Qualtrics survey.	The design of the tracking will be improved based on the experience of the participants.	Within the Qualtrics survey portal and after collection of the data on TUD SURFdrive.	Supervisors (Alejandra Gomez Ortega, Marieke Sonneveld)
Audio recordings of evaluation on tracking prototype	.mp3	Recorded on a laptop connected to the TU Delft OneDrive.	The design of the tracking will be improved based on the experience of the participants.	On the TU Delft OneDrive and after transcribing, a transcript without identifiable information on the TUD SURFdrive.	Supervisors (Alejandra Gomez Ortega, Marieke Sonneveld)

4. How much data storage will you require during the project lifetime?

- 250 GB - 5 TB

II. Documentation and data quality

5. What documentation will accompany data?

- Methodology of data collection

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- SURFdrive

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, first ask your Faculty Data Steward for advice. You can also check with the privacy website . If you would like to contact the privacy team: privacy-tud@tudelft.nl, please bring your DMP.

- No

Data will be anonymously collected

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- Yes, I work with other types of confidential or classified data (or code) - please explain below
- No, I will not work with any confidential or classified data/code

Data collected is sensitive data about the perceived physical and psychological menstrual cycle symptoms, as well as health data collected by wearables. It will include a question with regard to the use of medication and birth control.

9. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question. If this is not the case, you can use the example below.

The datasets underlying the published papers will be publicly released following the TU Delft Research Data Framework Policy. During the active phase of research, the project leader from TU Delft will oversee the access rights to data (and other outputs), as well as any requests for access from external parties. They will be released publicly no later than at the time of publication of corresponding research papers.

V. Data sharing and long-term preservation

26. What data will be publicly shared?

- All data (and code) produced in the project
- All data (and code) underlying published articles / reports / theses
- All validated non-positive results

28. How will you share your research data (and code)?

- All data will be uploaded to 4TU.ResearchData
- I will share my data and code via git(lab)/subversion and also create a snapshot in a repository

Only the possible code generated will be shared via git(lab)/subversion.

30. How much of your data will be shared in a research data repository?

- < 100 GB

31. When will the data (or code) be shared?

- At the end of the research project
- As soon as corresponding results (papers, theses, reports) are published

32. Under what licence will be the data/code released?

- CC BY

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

- Yes, the only institution involved

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

Alejandra Gomez Ortega
Marieke Sonneveld

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

4TU.ResearchData is able to archive 1TB of data per researcher per year free of charge for all TU Delft researchers. We do not expect to exceed this and therefore there are no additional costs of long term preservation.

A2.2. Informed Consent

Consent form

Menstrual and sport tracking to feel in control over your health and performance

Introduction of the research

You are being invited to participate in a research study titled “Testing menstrual and sport tracking for health and performance insights”. This study is done as a part of the TU Delft Graduation Project of Julia Rademaker. The research aims to test tracking for female rowers and investigate the correlation of the different parameters tracked. By participating in this research you contribute to understanding the mental and physical indicators of the menstrual cycles of rowers. This can lead to better data collection for medical research and improved tracking possibilities for female rowers.

Commitments to the research

Participation involves tracking menstrual (e.g. daily symptoms, bleeding days, cycle length) and performance data (resting heart rate, exercise heart rate, sleeping hours) and submitting the data through an online survey. First, you will track in an Excel sheet that is located on the TU Delft Servers. As soon as the second prototype is finished, you are asked to connect the tracking to your current tracking behaviour (for example, save Garmin Connect data), 15 minutes installation time. After which, it will take you approximately 2 minutes to complete the tracking daily and the tracking aims to connect to existing tracking behaviour to minimize double work. You are asked to answer questions on menstrual symptoms and performance statistics.

Lastly, you are asked to provide feedback and submission three times after a completed cycle. You will export only non-identifiable data from the application and submit that data. You can decide to deliver the evaluation through an online questionnaire (approx. 10 minutes) or a personal discussion (approx. 15 minutes).

In return, as a researcher, I commit to providing the required technical support and acknowledging your feedback. We aim to minimise the time required for you to participate in this research and improve your current tracking experience.

Data handling

As with any online activity, the risk of a breach is always possible. To the best of our ability, your answers in this study will remain confidential. We will minimize any risks by collecting only non-identifiable tracking data and storing the data on the TU Delft servers. In case of a personal evaluation discussion, the conversation will be recorded on a laptop and temporarily stored in the TU Delft OneDrive. After the graduation project, the transcripts will be saved without identifiable information on the TU Delft servers.

Participation in this study is entirely voluntary and you can withdraw anytime. Don’t hesitate to contact us for any further questions or feedback:

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
1. I have read and understood the study information, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves: - Tracking performance and the menstrual cycle - An online questionnaire to submit the tracked data and evaluation without identifiable information - Optionally, an audio-recorded discussion (recorded on a laptop) on the tracking experience. Temporary storage of the recordings on the TU Delft OneDrive and transcriptions of the recordings without identifiable information on the TU Delft servers.	☐	☐
4. I understand that the study will end at the latest on the first of February.		
5. I understand that the following steps will be taken to minimise the threat of a data breach, and protect my identity in the event of such a breach: - Anonymous data collection	☐	☐
6. I understand that after the research study, the de-identified information I provide will be used as part of the research for a TU Delft graduation project and for potential reports.	☐	☐
7. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐

Signatures

_____ _____ _____

Name of participant [printed] Signature Date

I, as a researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands what they are freely consenting.

Julia Rademaker \ 19/10/2023

Researcher name [printed] Signature Date

Study contact details for further information:
Julia Rademaker

A2.3. HREC Checklist

Delft University of Technology
HUMAN RESEARCH ETHICS
CHECKLIST FOR HUMAN RESEARCH
(Version January 2022)

IMPORTANT NOTES ON PREPARING THIS CHECKLIST

1. An HREC application should be submitted for every research study that involves human participants (as Research Subjects) carried out by TU Delft researchers
2. Your HREC application should be submitted and approved **before** potential participants are approached to take part in your study
3. All submissions from Master's Students for their research thesis need approval from the relevant Responsible Researcher
4. The Responsible Researcher must indicate their approval of the completeness and quality of the submission by signing and dating this form OR by providing approval to the corresponding researcher via email (included as a PDF with the full HREC submission)
5. There are various aspects of human research compliance which fall outside of the remit of the HREC, but which must be in place to obtain HREC approval. These often require input from internal or external experts such as Faculty Data Stewards, Faculty HSE advisors, the TU Delft Privacy Team or external Medical research partners.
6. You can find detailed guidance on completing your HREC application here
7. Please note that incomplete submissions (whether in terms of documentation or the information provided therein) will be returned for completion **prior to any assessment**
8. If you have any feedback on any aspect of the HREC approval tools and/or process you can leave your comments here

I. Applicant Information

PROJECT TITLE:	**Empowering female rowers:** Tracking for health and performance insight
Research period: *Over what period of time will this specific part of the research take place*	From halfway October until halfway March
Faculty:	IDE
Department:	Data-Centric Design
Type of the research project: *(Bachelor's, Master's, DreamTeam, PhD, PostDoc, Senior Researcher, Organisational etc.)*	Master graduation project
Funder of research: *(EU, NWO, TUD, other – in which case please elaborate)*	-
Name of Corresponding Researcher: *(If different from the Responsible Researcher)*	Julia Trijntje Elizabeth Rademaker
E-mail Corresponding Researcher: *(If different from the Responsible Researcher)*	
Position of Corresponding Researcher: *(Masters, DreamTeam, PhD, PostDoc, Assistant/ Associate/ Full Professor)*	Master student
Name of Responsible Researcher: ***Note:** all student work must have a named Responsible Researcher to approve, sign and submit this application*	Alejandra Gomez Ortega Marieke H. Sonneveld
E-mail of Responsible Researcher: *Please ensure that an institutional email address (**no Gmail, Yahoo, etc.**) is used for all project documentation/ communications including Informed Consent materials*	
Position of Responsible Researcher : *(PhD, PostDoc, Associate/ Assistant/ Full Professor)*	PhD Assistant Professor

II. Research Overview

***NOTE:** You can find more guidance on completing this checklist here*

a) Please summarise your research very briefly (100-200 words)

What are you looking into, who is involved, how many participants there will be, how they will be recruited and what are they expected to do?

Add your text here – (please avoid jargon and abbrevations)
The project investigates the performance and menstruation tracking of female rowers. During the course of the project the participants are asked to store and collect data on their rowing activities, measured health statistics (for example collected by their smart watch) and menstrual symptoms. I aim to include a minimum of 12 and a maximum of 50 female participants, aged 18-28. I will recruit them by reaching out to coaches I have met at rowing competitions and contacting the official board members using the rowing association website. I will stimulate participants to forward the recruitment. During the research, the participants will use a performance and health tracking system and participate in evaluations (either in the form of forms or discussions).

b) **If your application is an additional project** related to an existing approved HREC submission, please provide a brief explanation including the existing relevant HREC submission number/s.

Add your text here – (please avoid jargon and abbrevations)

c) **If your application is a simple extension of, or amendment to,** an existing approved HREC submission, you can simply submit an HREC Amendment Form as a submission through LabServant.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?		**X**				
5. Will the research take place in a country or countries outside the EU?		**X**				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		**X**				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		**X**				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?		**X**				
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? *It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student's failure to participate to your satisfaction to affect your evaluation of their coursework).*	**X**		**Participants might be colleague students at the TU Delft.** **I am currently a rowing coach, the rowers I coach might feel obliged to participate to influence decisions I make as a coach.**	**All rowers are contacted via their coaches creating an official communication line and a distance between me, as a researcher, and me as a previous colleague on a project. In addition, the research will not influence their curriculum.** **The rowers I coach or possibly will coach will not be included as participants in the project.**		
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?		**X**				
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups		**X**				
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a		**X**				

III. Risk Assessment and Mitigation Plan

NOTE: *You can find more guidance on completing this checklist here*

Please complete the following table in full for all points to which your answer is "yes". Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of **Personally Identifiable Information (PII)** and/or **Personally Identifiable Research Data (PIRD)** which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alignment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It's worth noting that **you're much more likely to need to resubmit your application if you neglect to identify potential risks**, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider[1] [1] *If yes, please include the graduation agreement in this application*		**X**				
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? *If yes please provide a copy of the signed DTA/DPA*		**X**				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? *If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below*		**X**				
B: Location						

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.						
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences *If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.*		**X**				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		**X**				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		**X**				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		**X**				
27. Will the experiment involve the use of devices that are not 'CE' certified? *Only, if 'yes': continue with the following questions:*		**X**				
• Was the device built in-house?						
• Was it inspected by a safety expert at TU Delft? *If yes, please provide a signed device report*		**X**				
• If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? *If yes, please provide records of the inspection*		**X**				
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?	**X**		**During the evaluation and co-creation sessions, the participants meet face-to-face.**	The face-to-face evaluation will be optional and I will allow for a hybrid participation if preferred by the participants.		
29. Will your research involve **either:** a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants **and/or** b) artificial intelligence or algorithm training where, for example, biased datasets could lead to biased outcomes?	**X**		**The data collected by the participants will combine data from their smartwatches and personal observations. Using algorithms this data will be investigated for correlations, which might raise bias.**	The sample of the data will consist of a specific group (female competitive rowers from Dutch Student Rowing Associations) to limit bias. The limitations of the selection of this group will be discussed in the research and the importance of the individuality of the rowers will be underlined.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)						
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		**X**				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?		**X**				
E: Subject Matter *Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.*						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		**X**				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? *If yes see here to determine whether medical ethical approval is required*		**X**				
17. Will blood or tissue samples be obtained from participants? *If yes see here to determine whether medical ethical approval is required*		**X**				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		**X**				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) *Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.*		**X**				
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)	**X**		**The participants will record data on their health (specifically menstrual cycle) and performance.**	Participation in the research is voluntary and all the data collected will be stored without an identifier or stored locally.		
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? *If yes please attach the advice/ approval from the Privacy Team to this application*		**X**				
22. Does your research investigate causes or areas of conflict?		**X**				

	ISSUE	Yes	No	*If YES please complete the Risk Assessment and Mitigation Plan columns below.*	*Please provide the relevant reference #*	
					DMP	ICF
	G: Data Processing and Privacy					
	30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)		X	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	
	31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?		X			
	32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		X			
	33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	X		**The research is part of a graduation project and will be published in the education repository.**	All data will be stored without indentifier and the findings will not be linked to individual data.	
	34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?		X	**Not planned for now.**	If this would apply the participants will be asked to consent to sharing their data to the archive.	

H: More on Informed Consent and Data Management

NOTE: *You can find guidance and templates for preparing your Informed Consent materials) here*

Your research involves human participants as Research Subjects if you are recruiting them or actively involving or influencing, manipulating or directing them in any way in your research activities. This means you must seek informed consent and agree/ implement appropriate safeguards regardless of whether you are collecting any PIRD.

Where you are also collecting PIRD, and using Informed Consent as the legal basis for your research, you need to also make sure that your IC materials are clear on any related risks and the mitigating measures you will take – including through responsible data management.

Got a comment on this checklist or the HREC process? You can leave your comments here

IV. Signature/s

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Name of Corresponding Researcher (print): Julia Rademaker
Signature:

_____

Date: 10/10/2023

Name of Responsible Researcher (print)

Signature (or upload consent by mail) Responsible Researcher:

Date:

V. Completing your HREC application

Please use the following list to check that you have provided all relevant documentation

Required:

- **Always:** This completed HREC checklist
- **Always:** A data management plan (reviewed, where necessary, by a data-steward)
- **Usually:** A complete Informed Consent form (including Participant Information) and/or Opening Statement (for online consent)

Please also attach any of the following, if relevant to your research:

Document or approval	Contact/s
Full Research Ethics Application	After the assessment of your initial application **HREC will let you know if and when you need to submit additional information**
Signed, valid Device Report	Your Faculty HSE advisor
Ethics approval from an external Medical Committee	TU Delft Policy Advisor, Medical (Devices) Research
Ethics approval from an external Research Ethics Committee	Please append, if possible, with your submission
Approved Data Transfer or Data Processing Agreement	Your Faculty Data Steward and/or TU Delft Privacy Team
Approved Graduation Agreement	Your Master's thesis supervisor
Data Processing Impact Assessment (DPIA)	TU Delft Privacy Team
Other specific requirement	Please reference/explain in your checklist and append with your submission

B1.1. Prototype 1 - Communication

Message to Board

Onderzoek gezondheid en menstruatie tracking bij wedstrijdroeister

Beste XX,

Ik ben op zoek naar deelnemers voor een afstudeerproject over het tracken van gezondheid, performance en menstruatie bij wedstrijdroeisters.

Als ex-lichte dame wedstrijdroeister bij Proteus-Eretes, heb ik veel roeister hun menstruatiecyclus zien verliezen.

Afgelopen onderzoek heeft aangetoond dat veel sporters geen hulp zoeken bij zulke klachten (Verhoeven, 2021) en om dit te verbreken moet het onderwerp bespreekbaarder gemaakt worden.

Ik hoop een tool te ontwikkelen dat het bijhouden van data vergemakkelijkt en roeisters meer inzicht te geven in hun eigen lichaam. Het gaat hier om prestatie en gezondheidsdata (denk aan rusthartslag, slaap, motivatie) en de menstruatiecyclus (menstruatiedagen, klachten). Het doel is atletes niet alleen in staat brengen om beter te communiceren maar ook beter te presteren.

Als wedstrijdcommissaris, kun je me steunen door me in contact te brengen met coaches van de middengroep en ouderejaars dames wedstrijdroeisters. Dan kan ik met die coaches bespreken of dit is iets is wat binnen hun visie past en waar de roeisters aan mee kunnen doen.

Hopelijk kunnen we samen zorgen voor een gezondere roeisport! Ik hoor graag van je.

Met vriendelijke groet,
Julia Rademaker

Message to Rowers

Hey XX,

Hoe is het? Ben jij komend seizoen nog van plan wedstrijd te roeien? Ik ben momenteel aan het afstuderen en ik ga mijn onderzoek richten op het tracken van gezondheid, performance en menstruatie bij wedstrijdroeisters en wil daarvoor heel graag samenwerken met wedstrijdroeister van andere verenigingen. Ik vroeg mij af of je misschien de contacten hebt van een van de coaches van de middengroep / ouderejaars dames coaches, zodat ik het met een van hen kan bespreken. :)

Groetjes,

Julia (van Proteus)

Message to coaches

Hey XX,

Ik heb jouw contactgegevens gekregen van XX. Ik ben momenteel bezig mijn afstudeerproject over het tracken van gezondheid, performance en menstruatie bij wedstrijdroeisters en ik hoop daarmee

samen te werken met wedstrijdroeisters van zoveel mogelijk verschillende studentenroeiverenigingen.

Ik heb zelf drie jaar lichte dames wedstrijdgeroeid bij Proteus-Eretes en heb veel roeisters hun menstruatiecyclus zien verliezen. Door een tool te ontwikkelen waarmee er betere inzichten gehaald kunnen worden uit gezondheidsdata en menstruatie data, hoop ik dit onderwerp bespraakbaarder te maken en de roeisters bewuster te maken van hun cyclus. Daardoor kunnen ze beter communiceren en beter presteren.

Ik zou graag een keer met jou willen bellen om te kijken wat voor data jullie momenteel bijhouden (bijvoorbeeld rusthartslag) en waarom, en hoe jullie reflecteren door het jaar heen. Op die manier kunnen we samen kijken of dit onderzoek bij jullie past en of jij het door wil sturen naar je roeisters.

Ik hoor graag van je,

Julia Rademaker

Call to coaches

Hey XX,
Met Julia Rademaker, bel ik gelegen?
Ik had je contactegevens van X gekregen / mailcontact met je gehad. Vind je het goed als ik dit gesprek opneem, zodat ik niet notitites hoef te maken, maar het eventueel nog terug kan luisteren?
Samenvattend ben ik bezig met een afstudeerproject over het bijhouden van sport prestatie en de menstruatie cyclus bij middengroep of ouderjaars wedstrijdroeisters. Ik hoop roeister een tool te kunnen bieden waarbij ze meer inzicht in hun lichaam krijgen en daardoor beter over hun gezondheid en prestatie kunnen praten rondom de menstruatiecycles.
Ik vroeg me af jullie momenteel dagboekjes hebben, of bijvoorbeeld de rusthartslag bijhouden om inzicht te krijgen in de gezondheid van de roeisters?
Welke parameters vinden jullie hiervoor nuttig?
Hoe reageren jullie erop als jullie iets onverwachts zien?

Als jij er mee akkoord bent, dan zou ik graag je roeisters vragen om hun menstruatiecyclus (bijvoorbeeld symptomen), herstelwaarden (bijvoorbeeld rusthartslag/slaap) en trainingstijd/zones bij te houden. Dit zal allemaal anoniem verzameld worden via de TU Delft servers. Het onderzoek loopt ongeveer gedurende drie cyclussen en het kost elke ochtend een minuutje om iets in te vullen. Na elke cyclus krijgen ze een evaluatie toegestuurd, en zal het tracken upgedate worden. Hiervoor krijgen ze uiteindelijk een uitgebreide set data over hun eigen lichaam voor terug en ik zal mijn uiterste best doen om alle feedback zo goed mogelijk terug te geven.

Invitation to rowers

Hey!

Als het goed is krijg je dit bericht doorgestuurd via je coach of wedstrijdcommisaris. Ik ben namelijk op zoek naar middengroep en ouderjaarswedstrijdroeisters die mee willen werken aan een afstudeeronderzoek. Het onderzoek richt zich op menstruatie en sport tracking voor gezondheids en prestatieinzichten.

Waarom dit onderzoek?

Afgelopen drie jaar heb ik als lichte dame wedstrijd geroeid bij Proteus-Eretes en ik heb gemerkt dat er weinig gesproken word over de effecten van de menstruatie cyclus op het roeien (en het effect van wedstrijdroeien op je menstruatie). Het bizarre is dat dat hartstikke logisch is, er is namelijk heel weinig onderzoek naar (en dus weinig adviezen over) de menstruatiecyclus en sportsters. Een manier om toch beter te leren presteren met je menstruatie (en gezondheid) is door zelf verschillende symptomen te tracken en op die data te reflecteren. Hierdoor leer je jezelf beter begrijpen, kun je erover communiceren en wie weet uiteindelijk ook nog bijdragen aan betere adviezen voor menstruerende sporters.

Hoe werkt het onderzoek?
Als je deelneemt aan het onderzoek wordt je gevraagd om drie cycli je menstruatie (symptomen, bleeding days) en prestatie data (rusthartslag, slaap, trainingsduur/hartslag) bij te houden (1-2 minuten/dag). Aan het einde van elke cyclus zul je gevraagd worden om je data anoniem te exporteren en het process te evalueren (10 min). Ik zal die evaluatie meenemen en gebruik om het proces voor de volgende cyclus te verbeteren. Je mag op elk moment stoppen met het onderzoek en het is volledig vrijwillig.

Wat krijg je ervoor terug?
Je krijgt een tool om je menstruatie en prestatie te tracken. Deze tool zal twee keer verbeterd worden aan de hand van jullie feedback. Je leert inzicht krijgen in je eigen data. En tot slot draag je bij aan meer onderzoek naar sporters en de menstruatiecyclus.

En nu?
Je kan je interesse aangeven via de volgende link, en je krijgt dan binnenkort meer informatie: https://forms.office.com/e/TbCKuieuYz Ben je nu al enthousiast om hier meer over te lezen, heb ik ook een booklet bijgevoegd over de menstruatiecyclus en roeisters van een vorige afstudeerster.

Bij vragen mag je me altijd mailen op of appen/bellen via .

Groetjes,

Julia Rademaker

Ps. Ken je een andere roeister bij wie dit ook heel erg past, maar die dit niet heeft ontvangen, voel je vrij om het door te sturen!

B1.2. Prototype 1 - Evaluation

Thank you for taking the time to fill in the evaluation and submit the data of the tracking application.

This form has two parts:
1. Add background information (required to contextualize the data) and upload the data collected.
2. Evaluate your tracking experience.

If you have not uploaded your consent form, please upload it here.

Drop files or click here to upload

Data submission and background information

What contraception are you using?

- I am not using any contraception
- Pill (only progesteron)
- Pill (combined hormones)
- Hormonal ring
- Hormonal patch
- Hormonal IUD
- Cupper IUD
- Implants
- Injects
- Other

Did you experience lack of bleeding or irregular bleeding during the past six months?

- Yes, I experienced a loss of bleeding
- Yes, I had irregular bleeding (cycle length fluctuated significantly and/or was unpredictable)
- No, I had regular bleeding

How many times per week do you aim to train the following four months (until the start of the season)?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Training per week

I am a:

- Light weight rower
- Open weight rower

How did you record your data?

- Windows application
- Excel sheet
- Both (and primarily used the Excel sheet)
- Both (and primarily used the Windows application)

Paste data of Windows application

1. In the application go to settings
2. Click export data
3. Right-click in the text box to select all the text and copy this text
4. Paste the data in the text box below.

←

→

Could you describe when and how you entered your data? (e.g. at what moment of the day did you look up any information to fill in the form, did you always fill in all the questions?)

Have you used any of these application features?

	Have used	Have NOT used
Load Garmin data	○	○
Enter data	○	○
View data	○	○
Export data	○	○
Update question preferences	○	○
Update symptom preferences	○	○

How valuable is each feature to you?

	Not used	Not valuable	Slightly valuable	Valuable	Very valuable
Load Garmin data	○	○	○	○	○
Enter data	○	○	○	○	○
View data	○	○	○	○	○
Export data	○	○	○	○	○
Update question preferences	○	○	○	○	○
Update symptom preferences	○	○	○	○	○

Did you find any features confusing or hard to use? Please explain

Can you order the questions from most useful/insightful to least useful/insightful?

What is your resting heart rate?

How rested did you feel when you woke up?

How excited are you to train today?

How demanding did you perceive Yesterday's training?

What is your weight?

Do you experience bleeding Today?

Did you expect to (not) be bleeding Today?

Comments

Experiencing comments

Did you look at your data after filling it in?

Yes

No

How did you look at your data? (Etc. graph, looking at previous days)

Have you identified any correlations or patterns in your tracked data that surprised you? Please describe.

Can you think of any additional visualizations or data representations that you would find useful?

Do you have any other suggestions, feedback, or comments about the tracking application that you'd like to share?

B1.3. Workshop 1 - Preparation

Co-creation 1

General

Background

Case: Sports and menstrual cycle tracking for health and performance of rowers

Problem definition: Limited data exists on the menstrual cycle and sports performance, resulting in limited medical advice for female athletes, making it difficult for athletes to appropriately interpret menstrual and performance data.

Problem as Given (PaG): How can rowers be supported to understand their menstrual and performance data?

Ideal outcome: A tool that rowers can use to interpret tracked data

Logistics: 20th of November, 19:30 at IDE(?)

The method is based on the book ‘Road Map for Creative problem solving techniques’

General timeline

15 min	1. Introduction/briefing	19:30 - 19:45
5 min	2. Purge on PaG	19:45 - 19:50
15 min	3. Problem finding	19:50 - 20:05
10 min	4. Purge on PaP	20:05 - 20:15
10 min	5. **BREAK**	**20:15 - 20:25**
35 min	6. Idea finding	20:25 - 21:00
20 min	7. Solution finding	21:00 - 21:20
5 min	8. Wrap-up	21:20 - 21:25

Supplies

- [ ] Post-its
- [ ] Markers
- [ ] Tape
- [ ] Scissors
- [ ] Flipchart sheets
- [ ] Dots
- [ ] Paper
- [ ] Hanging place
- [ ] Table
- [ ] Chairs
- [ ] Snacks and water

Session plan

1. Briefing and introduction

1.1 General briefing

Stage/session duty	Session duty 1/2: Introduction and Briefing
Time	19:30 - 19:40, 10 min
Materials	Poster with the problem statement, poster with agenda.
Aim	Setting the tone, positive and open atmosphere and building a shared understanding of the problem
Notes	State the problem: ’It is good that you the rowers already fill in a logbook. However, the menstrual cycle is often not integrated into this routine. The limited biodata available on female athletes' menstrual cycles makes it difficult to understand what data on the menstrual cycle and performance can mean. I want to think with you together how we could make this data understandable and take the data out of the logbook.’ Allow for questions ’This session will consist of dropping all first associations, understanding

	the problem, creating ideas and developing these into solutions. I have some guidelines for this session, firstly everything that you think of is good. So, postpone judgement. Next, it is important to lift on other people's ideas and continue on those and lastly, to have fun!’
Time alternative	Park questions with post-its if too many questions are asked.
Energy alternative	N.A.

1.2 Icebreaker

Stage/session duty	Session duty 4: Icebreaker
Time	19:45 - 19:50, 5 min
Materials	-
Aim	Set a loose mood
Notes	“To understand how postponing judgment works, we are going to do a short exercise: No, because / Yes, and. - Pair up and explain no, because - Explain yes and!
Time alternative	Less time: Throw a ball and mention your favourite race.
Energy alternative	-

🧠 2. Purge on PaG

Purge with Braindump

Stage/session duty	Session duty 3: Purge with H2
Time	19:45 - 19:50, 5 min
Materials	Post-its, flip-overs to paste it on
Aim	Shed first ideas on the problem statement
Notes	‘We are going back to the problem as we have been given, using post-its and markers to write down all ways to define this problem, using the H2 structure. For example, How to make technology interesting? Keep in mind to postpone judgment. Once you have written it out, you can say it out loud and give the Post-it to me, are there any questions?’ The goal is to have 15-20. - Remind to write big and clearly - Sitting down
Time alternative	Stop earlier.
Energy alternative	In silence, or standing.

❓ 3. Problem finding

Flower association of the problem

Stage/session duty	Problem finding / Session duty 4
Time	19:50 - 20:05, 15 min
Materials	Getting into the divergent mindset, diving into the problem
Aim	Define the problem to a level that it is good to build ideas on
Notes	Take the words ‘data’ and ‘understanding and value’ every word that is associated with it pops up around it like the peddles of a flower. Start the association by asking: ‘What do you associate ‘X’ with? ‘What does ‘X’ remind you of?’ Remain standing. In the meantime create a flip-over with the problem statement for the purge.
Time alternative	Only on value
Energy alternative	-

🧠 4. Purge on PaP

Purge

Stage/session duty	Idea finding
Time	20:05 - 20:15, 10 min
Materials	Flip-over sheets, post-its
Aim	Shedding the first ideas
Notes	With the associations in mind, write all the ideas down that solve the problem statement ‘XX’. You can paste the ideas on the board and say it out loud when you put it down. It is important, that everything goes, so if in doubt, write it out.
Time alternative	-

Energy alternative	Optionally in silence

🛑 Break

Break

Stage/session duty	Session duty 7: Break
Time	20:15 - 20:25, 10 min
Materials	-
Aim	Keep the mind fresh
Notes	Write on the board at what time to be back, slightly shorter than 10 minutes. Indicate where toilets or refreshments are. Check with PO how they are doing.
Time alternative	-
Energy alternative	-

❓ 5. Idea finding

Energizer

Stage/session duty	Session duty 6: Energizer
Time	5 min
Materials	-
Aim	Bring the group to the right mood
Notes	In the case of low energy: ninja or what are you doing? In the case of high energy: the association circle, doodle drawing
Time alternative	Optional
Energy alternative	See notes.

Absurd questioning

Stage/session duty	Idea finding
Time	20:25 - 20:45, 20 min
Materials	Flip over sheets, black markers
Aim	Break free from a possible rather defined problem space and create unexpected ideas.
Notes	Write down the problem statement and underline three main phrases, have a sheet with the matrix nearby, more creative and absurd. We are going to fill up the matrix per term. We are generating solutions for the medium-absurd ones. Then ask everyone to combine two of their favorite ideas. We paste those four combinations on the board and we force-fit ideas to those combinations on the original problem.
Time alternative	- Do not do the combinations, or select more problem statements.
Energy alternative	Could be done with drawing, to challenge the group.

Clustering

Stage/session duty	Idea finding
Time	20:45 - 20:58, 13 min
Materials	-
Aim	Create a structure in all the ideas, and shift the mindset to converging.
Notes	Start grabbing ideas and place ideas that you think should belong together.
Time alternative	-
Energy alternative	-

Hits and dots

Stage/session duty	Idea finding
Time	20:58 - 21:00, 2 min
Materials	Dots.
Aim	Select ideas
Notes	Everybody has three dots, to intuitively place on ideas that they see the most potential in.
Time alternative	-
Energy alternative	-

❓ 6. Solution finding

Doodle drawing

Stage/session duty	Solution finding
Time	21:00 - 21:05, 5 min
Materials	1 Post-its pp and pens
Aim	Get into the drawing visual mindset
Notes	Ask the participants to doodle, and now make it into a bird.
Time alternative	Doodle and drawing.
Energy alternative	-

Poster making

Stage/session duty	Solution finding
Time	21:05-21:18, 13 min
Materials	Colours, papers, scissors etc.
Aim	Conceptualize the poster and identify unexplored aspects
Notes	We are dividing into groups of two and three, from the selected ideas, decide on the solution that you think is most achievable. Make a poster that contains at least a name, a sketch and an explanation.
Time alternative	Change the time to draw and sketch the poster.
Energy alternative	Pass on the concept posters.

Elevator pitch

Stage/session duty	Solution finding
Time	21:18-21:20, 2 minutes
Materials	-
Aim	Explain the solutions
Notes	Appoint a person and ask them to sell their poster in one minute to the group, the group can ask questions.
Time alternative	-
Energy alternative	-

❓ 8. Wrap-up

Restating the problem

Stage/session duty	Session duty 8: Wrap-up
Time	21:20, 21:25, 5 min
Materials	Camera
Aim	Highlight some actions still be taken and close off the session.
Notes	‘Are there any left-over remarks or actions that should be taken by the PO from the group?’ ’Thank you all for your great effort on this session and to close off I would like to ask you to give everybody a well-deserved high-five on their performance.
Time alternative	
Energy alternative	

B2.1. Prototype 2 - Communication

Dear XX,

First of all, I want to thank you again for your participation so far. Attached is a booklet with a personal reflection on your data and a more global summary of other findings. I hope you can learn something new with this overview.

Besides this information, it became apparent that tracking can be time-consuming, while the tracked numbers remain underexplored and abstract. To address these issues, I will investigate an alternative tracking system that consists of a physical data visualization set and an opportunity for anonymous sharing.

This weekend, I plan to send out packages that support you with this new tracking for approximately three weeks (this is in consultation with you). During these weeks, you are asked to take the following steps:

1. Physically track by placing three markers a day
2. Additionally, add context to your markers
3. Share anonymous observations in a Telegram group change initiated by questions

What do you get?

1. The possibility of anonymously investigating the menstrual cycle with other rowers
2. A free data toolkit
3. The opportunity to ask questions to a sports gynecologist
4. A small surprise as a token of gratitude

Could you send me the address where I can send or bring this package? It should fit through your mailbox. Additionally, I would require your phone number to allow for anonymous sharing.

I look forward to seeing what we can learn together in the next phase!

Kind regards,

Julia Rademaker

Introduction

The past month (or weeks) you have been tracking your menstrual cycle, together with four other rowers. This booklet shows a summary of the preliminary findings during your tracking.

Firstly, an introduction is given into menstrual data for sporters, which can help you to identify parameters to explore in your data. Followed by a visualization of your data.

I hope this booklet helps you get a better understanding of your menstrual cycle and motivates you to continue tracking your menstrual cycle!

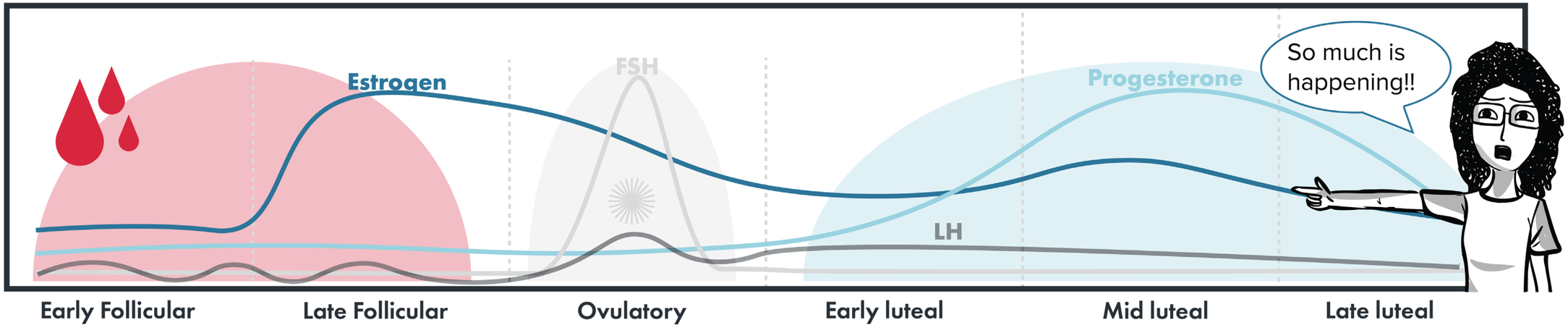
If you have any questions, you can always contact me at
Kind regards,

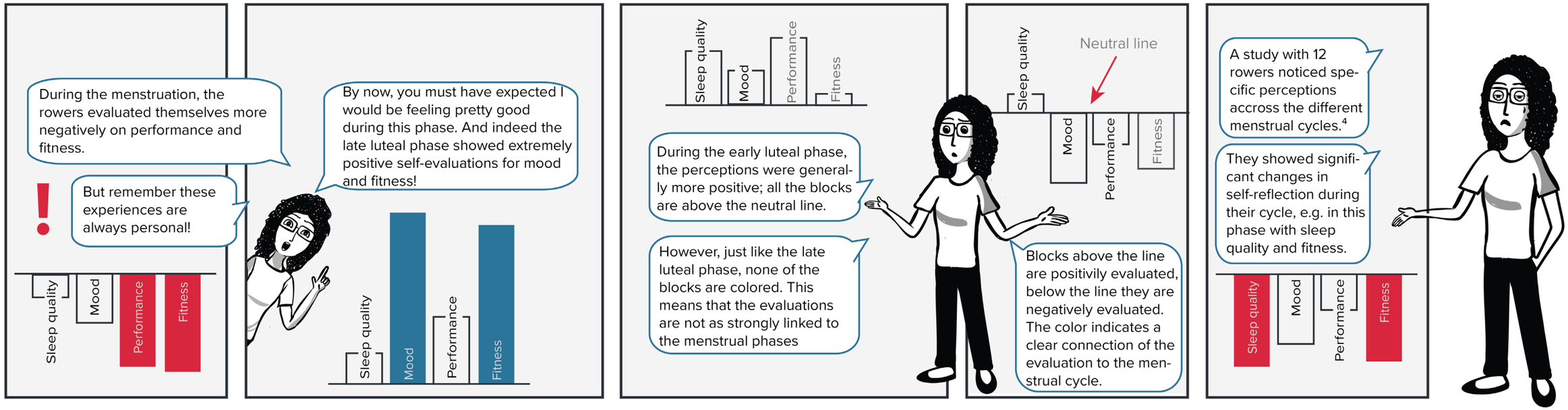
Julia Rademaker

Menstrual Data

The menstrual cycle influences your sport performance and performance data. Carmichael et al. (2021) reported that studies menstrual cycle and performance recognize the influence of fluctuation hormones on the perceived performance. However, according to Wundsam (2023) this influence can vary per individual. Nevertheless, Antero et al. (2023) have found significant changes of perceived performance during the menstrual cycle of 12 rowers. Similarly, McKinley et al. (2009) saw significant changes in the resting heart rate during different phases of the menstrual cycle.

An overview of changes which can be recognized accross different phases of the menstrual cycle is presented in Figures 1a and 1b. This figure provides an overview of the findings of the papers discussed in the first paragraph. It is crucial to understand that all observations of your menstrual cycle are valid and the patterns presented in the figure do not have to be true, but they can be used as inspiration of what you can look for in your data.


Estrogen
FSH
Progesterone
LH
So much is happening!!
Early Follicular
Late Follicular
Ovulatory
Early luteal
Mid luteal
Late luteal

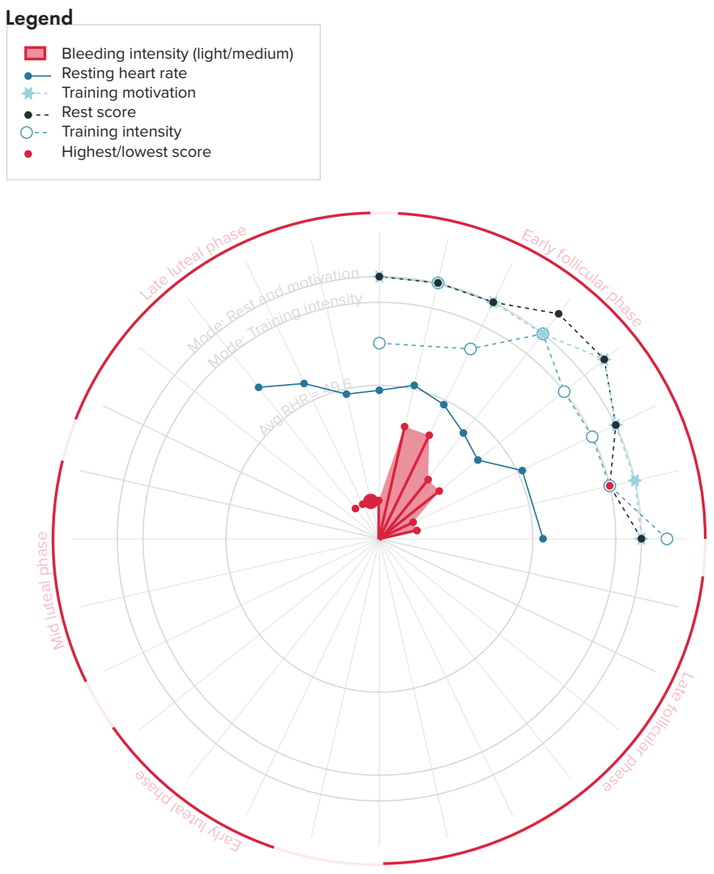

During the menstruation, the rowers evaluated themselves more negatively on performance and fitness.
But remember these experiences are always personal!
Sleep quality
Mood
Performance
Fitness
By now, you must have expected I would be feeling pretty good during this phase. And indeed the late luteal phase showed extremely positive self-evaluations for mood and fitness!
During the early luteal phase, the perceptions were generally more positive; all the blocks are above the neutral line.
However, just like the late luteal phase, none of the blocks are colored. This means that the evaluations are not as strongly linked to the menstrual phases
Neutral line
Blocks above the line are positivily evaluated, below the line they are negatively evaluated. The color indicates a clear connection of the evaluation to the menstrual cycle.
A study with 12 rowers noticed specific perceptions accross the different menstrual cycles.[4]
They showed significant changes in self-reflection during their cycle, e.g. in this phase with sleep quality and fitness.

Your Data

Figure 2 depicts a visual representation of your sports and menstrual data. This image illustrates the cyclical nature of the menstrual cycle. The outer circle represents a rough estimate of the possible phases of your menstrual cycle, as explained in the comic. The inner circle depicts the perceived intensity of bleeding, which is combined with the impact of symptoms (red circles). The larger these circles, the greater the influence of menstrual symptoms.

The single grey circle presents your average resting heart rate, while the medium dark blue line and circles depict your resting heart rate for each day.

The other two lines represent the mode of your training motivation, rest scores, and training intensity, which is the most frequently filled in value. The star-strewn line, dark blue circle, and light blue circle represent your tracked motivation, rest, and training intensity.



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B2.2. Digital Data

Rower 2

Average rest	Motivation	Performance	Heart rate	Bleeding
2	3	4	47	
3	3	4	43	
3	3	3	42	
1	1	2	56	
3	2	2.5	42	2
4	3	3	47	2
2.5	4	2	60	1
2	3		52	
4	4		50	
4.5	5		48	
3.5	5	4	53	
4	5	4	48	
4	5	4	47	
4	3		49	
3	4	4	44	
3.5	4	3	47	
3.5	3	2	50	
3	3.5	4	48	
4	3		48	1
3	3.5		50	2

Rower 3

Average rest	Motivation	Performance	Heart rate	Bleeding
2	1.5	4	4	3
	2	4	3	2.5
	3.5	4	2	2
	4	4		1.5
4	4	4.5	2	
3	4	3	3.5	
3	4	4.5	3.5	
4	3		3.5	
4	3		3.5	
4	3.5	3	4	
3.5	3	3	3	
3	4	2	2	
3	1.5	3.5	3.4	
4	2	4	3	
2.5	3	4	3	
3	3		2.5	
3.5	3	3.5	2.5	
4	4	3.5	2	
3	2	3	2.5	2.5
3	3	3	2	2

B2.3. Prototype 2 - Evaluation

Interview set-up

Usage Patterns:

How did you use the tracker during the testing period? Were there specific times or situations when you found it more or less convenient to use? How did this compare to the first prototype? Would you prefer a physical or digital tracker, what makes you say this? How often did you remember, how much did you want to track? (Asking about routine)

Hoe gebruikte je de tracker tijdens de testperiode? Waren er specifieke momenten of situaties waarin je het gebruik handiger of minder handig vond? Hoe was dit in vergelijking met het eerste prototype? Geeft u de voorkeur aan een fysieke of digitale tracker, waarom zegt u dit? Hoe vaak herinnerde u zich, hoeveel wilde u bijhouden? (Vragen over routine) Hetzelfde als de digitale. Het fysieke kan alleen thuis, digitale iets regelmatiger.

1. **Interaction with Data**
   How did you engage with the data? Did you use the questions for this? Were there any aspects of the data that stood out to you? How did this compare to the first prototype? Would you have preferred more or less support in looking at the data?

   Hoe ging je om met de gegevens? Heb je de vragen hiervoor gebruikt? Waren er aspecten van de gegevens die je opvielen? Hoe was dit in vergelijking met het eerste prototype? Had je liever meer of minder ondersteuning gehad bij het bekijken van de gegevens?

   Wat vond ik en hoe voel ik me hierdoor.

2. **Understanding of the Menstrual Cycle**
   Did using the tracker enhance your understanding of your menstrual cycle? Were there any insights gained about how your menstrual cycle relates to your performance? Did it raise new questions?

   Heeft het gebruik van de tracker je meer inzicht gegeven in je menstruatiecyclus? Zijn er inzichten verkregen over hoe je menstruatiecyclus samenhangt met je prestaties? Riep het nieuwe vragen op?

3. **Sharing and privacy**
   How comfortable were you with the idea of sharing your tracked data?
   Were there any privacy concerns, and if so, how did you manage them? Is there a way to make it more comfortable to share?

   Hoe comfortabel voelde je je bij het idee om je getraceerde gegevens te delen?
   Waren er zorgen over je privacy en zo ja, hoe heb je daarmee omgegaan? Is er een manier om het delen comfortabeler te maken?

4. **Conversation starter**
   Have you taken your tracker to others? Did it support starting other conversations?

   Heb je je tracker meegenomen naar anderen? Ondersteunde het bij het starten van andere gesprekken?

5. **Closing**
   Do you have any other suggestions for improvements, how can the tracker better support your needs as a rower? Thank you for your honesty and participation.

   Heb je nog andere suggesties voor verbeteringen, hoe kan de tracker jouw behoeften als roeier beter ondersteunen? Bedankt voor je eerlijkheid en deelname.

Interview between Julia Rademaker and rower 2

23rd of January 2024, online.
The interview has been transcribed semi-verbatim. The interview was held in Dutch, this was transcribed and both Dutch and English translations have been included in this document.
Julia Rademaker is the interviewer, indicated by J
A rower is the interviewee, indicated by R, for privacy reasons the rower's name is not included.

Start of the interview.

R: [Introduces herself and indicates she also studies Industrial Design Engineering; she discloses that she believes that Delft often has a focus on aesthetic design.]

J: Bedankt voor sturen van een foto van je tracker, het ziet er erg goed uit, erg kleurrijk.

R: [Lacht], dankjewel.

J: Ik had eerst een vraag over je gebruik. Hoe gebruikte je de tracker de afgelopen periode?

R: Ja, ongeveer eigenlijk hetzelfde als de digitale. Dus dat was voor mij eens in de vier of vijf dagen met terugwerkende kracht invullen en ik heb niet heel erg specifiek iets gedaan met die informatie. Maar ik was wel benieuwd.

J: Ja, waren er momenten dat je dacht ik had liever de digitale gehouden, of vond je het fysieke makkelijker?

R: Ja, het maakte mij niet heel erg uit. Het fysieke kan ik natuurlijk alleen doen als ik thuis ben en de digitale kon ik overal invullen. Wat dat betreft heb ik de digitale regelmatiger ingevuld, dus iets minder met terugwerkende kracht.

J: Ja.

R: Maar die fysieke was wel direct overzichtelijker wat nou invloed heeft op wat voor dingen. Al zag ik niet echt conclusies. [Schud hoofd].

J: Dat is natuurlijk ook het lastige van de data waarschijnlijk. Op wat voor momenten herinnerde je om het wel in te vullen?

R: Meestal ’s ochtends of als ik een keer terugkwam van de training. En dan dacht ik laat ik dat ook maar weer eens doen.

J: Dus niet echt een ritme, maar meer bepaalde momenten dat je dacht: Oh ja?

R: [Knikt], ja.

J: Heb je ook daarin de vragen gebruikt, die in het groepsgesprek waren gestuurd, op het moment dat je de data invulde?

R: [Kijkt twijfelachtig], niet zo veel. Ik was vooral bezig met ‘wat vond ik’ en ‘hoe voelde ik me toen’, dan echt naar die vragen kijken. Ik heb wel een beetje geprobeerd van zie ik hier verbanden in. En toen dacht ik, mwah. [Trekt moeilijk gezicht].

[Beide gniffelen]

J: Ja. In hoeverre was dat vergelijkbaar met het eerste prototype, dus de digitale?

R: Ja best wel hetzelfde.

J: Had je dan ook liever meer of minder ondersteuning gehad bij het bekijken van je gegevens?

R: [Twijfelt]. Het is eigenlijk allemaal een beetje random bij mij. Dus ik denk niet dat er heel veel uit te concluderen is. Vooral omdat mijn ongesteldheid meestal een periode is van veertig dagen.

J: Ja.

R: Dus dat is best wel lang, dus als je dan twee/drie weken trekt dan zie je dus eigenlijk net niks.

J: Ja. Had je het idee dat als je het combineert met wat je digitaal hebt getrackt, dat dat meer laat zien?

R: Nee dat denk ik niet. Want ik had wel het idee dat ik nu net zoveel data invulde als op de digitale. Met die digitale keek ik heel soms eens van ‘hey, wat heb ik voor data?’ en dan was het grafiekje meestal een beetje vaag en onduidelijk. Dus dat vond ik van de fysieke wel nice, dat je dan wel gelijk onder elkaar zag wat voor invloed het op elkaar had.

J: Ja, wat interessant. Nice. [Knikt]. Ik zal op een later moment ook nog naar je data kijken, om te zien of ik er moment uit kan pikken of ik nog iets daarin kan uitleggen voor je.

R: [Knikt bevestigend].

J: Dat is lastig om nu on the spot te zeggen, maar heb je ook nieuwe vragen gekregen over de menstruatiecyclus, nu je dit zo hebt ingevuld.

R: Nou ik heb opzich altijd mijn cyclus wel bijgehouden, wanneer ik ongesteld ben enzo. Dus ik kan ook zo nog even terugzoeken wanneer mijn ovulatie was en dat ik die er ook nog even inzet, misschien is dat handig voor jou. Maar ik heb altijd een beetje de ene keer vlak voor dat ik ongesteld ben dat ik denk nice, wat ben ik sterk. Ik kan heel veel. En de andere keer dus zo er vlak naar. En dat wisselt een beetje.

J: Ja.

R: Dus ik heb altijd iets van ja het heeft wel invloed, maar de invloed is wel onregelmatig en vaag.

J: Ja, precies. Dus de vraag is in hoeverre meer begrip je zou kunnen helpen.

R: Ja, dat ook. Want we hebben natuurlijk gewoon een trainingsschema en daar heb je je in principe aan te houden. Dus het is wel dat als je een keer een trainingsschema wat minder doet, dan kun je wel een keer zeggen. Oh maar ik moet ongesteld worden, dus het is ook kansloos vandaag. [Lacht].

J: [Lacht]. Zo vervelend als dat gebeurt.

R: Ja dan ga je langzaam en dan denk je: ‘dat heb je soms’.

J: Heb je dat ook wel eens met de coaches besproken?

R: Jawel. We hebben in principe wel allemaal mannencoaches, maar ik geef daar niet zoveel om, dus daar dealen ze maar mee.

J: [Lacht], heel goed. Anders gaan ze er nooit over praten.

R: Nee, daarom. Je moet daar gewoon over beginnen. En dan zeggen ze: ‘ja, uhu, ja, oké.’ En dan hebben ze volgens mij geen idee waar ik het over heb, maar dat is prima.

J: Dat kan ik me voorstellen. Ik vroeg me ook af hoe comfortabel je je voelde bij het delen van foto’s van bijvoorbeeld je data.

R: Dat vond ik in principe allemaal geen probleem. Maar ik had wel een beetje zoiets van er kwam verder niet echt een gesprek op gang. Dus ik dacht ik kan wel meer sturen, maar er gebeurt niet echt wat, dus toen dacht ik er gebeurt niet echt wat. En toen dacht ik, ik heb hier ook niet heel erg veel tijd voor, dus laat maar zitten.

J: Dat is heel begrijpelijk hoor. Dit was niet een aanval.

R: Nee dat snap ik, maar dat was hoe ik het heb ervaren inderdaad. Maar het delen dat vind ik geen probleem.

J: Heb je daarna ook meer gesprekken met anderen er ook over gehad? Bijvoorbeeld coaches of ploeggenoten.

R: Jawel. Opzich hebben wij het er met de damestak bij ons, hebben we het er ook wel regelmatig over dit soort dingen en over eten. Eigenlijk wel het hele gebeuren er omheen.

J: Ja. En in hoeverre kon je de tracker gebruiken in die gesprekken?

R: Ik denk niet zo heel erg. Misschien als je het wat langer en wat rigoureuzer of strakker op bent, dat je daadwerkelijk bent. Dus dagelijks tracken en drie cycli, dat het dan wel wat meer resultaten geeft.

J: Ja dat is wel een commitment.

R: Ja, inderdaad, dat duurt bij mij dan dus wel 120 dagen. [Lacht].

J: Ja, dan heb je het hele seizoen gehad.

R: Ja.

J: Als je nu iets zou moeten verbeteren aan het tracken, wat zou je dan als eerste verbeteren?

R: Ik zou hem denk ik horizontaal maken in plaats van een rondje. Want dan zie je nog iets makkelijker het lijntje verschuiven.

J: Oh ja.

R: En verder dan ook losse kolommen maken voor rest, motivation en performance. Want dat was nu allemaal in één. En dat maakt het soms ook een beetje chaotisch. Aan de andere kant ook wel weer nice, want je ziet heel duidelijk of dingen erboven of eronder zijn, of op dezelfde plek. Dus misschien daar mee spelen, kijken of dat werkt. Maar vooral horizontaal. Rondziet er leuk uit en is heel erg ontwerperig. [Lacht]. Maar ik vind het niet heel praktisch.

J: Nee, precies, dat is duidelijk. Wat ik nu ga doen is met Data Science naar de gegevens kijken en kijken of er duidelijke momenten uitkomen, of verbanden. Dan zal ik dat opsturen. Dus ik ben heel dankbaar voor de tijd die jullie tot nu toe in het tracken hebben gestopt en jullie input.

R: Nice.

J: Je zei dat je misschien nog niet de inzichten die je had willen hebt gekregen, maar dat kan ook interessant zijn.

R: Ja want meestal voel je wel aan wat je voelt. Je moet het dan haast bij je hoofdcoach leggen dat die er met het trainingsschema naar kan kijken, maar je hebt met al je roeiers ook andere cycli. Dus dat wordt wel een ingewikkelde zaak. [Lacht].

J: Ja. Tenzij je allemaal aan de pil gaat. [Lacht].

R: Ja dat is inderdaad ook kansloos. Als je skifft, kan je dat misschien nog wel doen.

J: Heb je nog iets anders wat je kwijt wilt?

R: Nee niet echt.

J: Heel erg bedankt voor je tijd dan.

ENGLISH

Start of the interview.

R: [Introduces herself and indicates she also studies Industrial Design Engineering; she discloses that she believes that Delft often has a focus on aesthetic design].

J: Thanks for sending a picture of your tracker, it looks very good, very colorful.

R: [Laughs], thank you.

J: I first had a question about your usage. How did you use the tracker during the last period?

R: Yes, pretty much the same as the digital one actually. So for me, that was retrospectively filling in once every four or five days and I didn't do anything very specifically with that information. But I was curious.

J: Yes, were there times when you thought I would have preferred to keep the digital, or did you find the physical easier?

R: Yes, it didn't matter very much to me. The physical one I can obviously only do when I'm at home and the digital one I could fill in anywhere. In that respect, I filled in the digital one more regularly, so a little less retrospectively.

J: Yes.

R: But with the physical one, it was more immediately clear what affects what things. Although I didn't really see any conclusions. [Shake head].

J: Of course, that's also the tricky thing about the data probably. At what times did you remember to fill it in?

R: Usually in the morning or once I came back from training. And then I thought let's do that again.

J: So not really a rhythm, but more certain moments when you thought, Oh yes?

R: [Nods], yes.

J: Did you also use the questions for that, which had been sent in the group discussion, at the time you filled in the data?

R: [Looks doubtful], not that much. I was mostly concerned with 'what did I think' and 'how did I feel at the time', then really looking at those questions. I did try a little bit of do I see connections in this. And then I thought, mwah. [Draws difficult face].

[Both chuckle]

J: Yes. To what extent was that similar to the first prototype, so the digital one?

R: Yes, pretty much the same.

J: So, would you have preferred more or less support in viewing your data?

R: [Doubts]. It's actually all a bit random with me. So, I don't think there's a whole lot to conclude from it. Especially because my period is usually a forty-day period.

J: Yes.

R: So that's quite long, so if you then draw two/three weeks then you actually just don't see anything.

J: Yes. Did you have the idea that if you combine it with what you tracked digitally, that that shows more?

R: No, I don't think so. Because I did feel that I was filling in as much data now as I did on the digital one. With the digital one, I very sometimes looked at it like 'hey, what data do I have?' and then the graph was usually a bit vague and unclear. So that's what I found nice about the physical one, that you could see immediately what kind of influence it had on each other.

J: Yes, how interesting. Nice. [Nods]. I will also look at your data later on, to see if I can pick out a moment or explain something else in it for you.

R: [Nods affirmatively].

J: That's hard to say on the spot now, but did you get any new questions about the menstrual cycle now that you've filled this in like this.

R: Well, I have always kept track of my cycle when I have my period etcetera. So, I can also look back to see when my ovulation was and put that in, maybe that would be useful for you. But I sometimes have the just before my period when I think, nice, how strong I am. I can do a lot. And other time right after. And that fluctuates a bit.

J: Yes.

R: So, I always have something like yes it does have an influence, but the influence is irregular and vague.

J: Yes, exactly. So, the question is to what extent more understanding could help you.

R: Yes, that too. Because of course we just have a training schedule, and you basically have to stick to that. So, it is true that if you do a training schedule a little less once, then you can say. Oh, but I have to get my period, so it's also hopeless today. [Laughs]

J: [Laughs]. So annoying when that happens.

R: Yeah, then you go slow and then you think, 'you have that sometimes'.

J: Did you ever discuss that with the coaches?

R: Yep. We do basically have all men coaches, but I don't care much about that, so they just deal with that.

J: [Laughs], very good. Otherwise, they're never going to talk about it.

R: No, that's why. You just must start talking about that. And then they say, 'yeah, uhu, yeah, okay.' And then I think they have no idea what I'm talking about, but that's fine.

J: I can imagine that. I also wondered how comfortable you felt sharing photos of, say, your data.

R: In principle, I didn't find any of that a problem. But I did feel a bit like there wasn't really any further conversation coming up. So, I thought I can send more, but nothing really happens, so then I thought nothing really happens. And then I thought, I don't have very much time for this either, so never mind.

J: That's very understandable you know. This wasn't an attack.

R: No, I understand, but that was how I experienced it. But sharing that I don't think is a problem.

J: Did you also have more conversations with others about it afterwards? For example, coaches or teammates.

R: Yes. Actually, with the women's team, we talk about this kind of thing and about food regularly. Actually, the whole thing around it.

J: Yes. And to what extent could you use the tracker in those conversations?

R: I don't think so much. Maybe if you are a bit longer and a bit more rigorous or tighter on it, that you actually are. So daily tracking and three cycles, that it does give a bit more results.

J: Yes, that does take commitment.

R: Yes, indeed, so for me that does take 120 days. [Laughs]

J: Yes, then you have had the whole season.

R: Yes.

J: If you had to improve something about the tracking now, what would you improve first?

R: I think I would make it horizontal instead of circular. Because then you can see the line move a bit more easily.

J: Oh yes.

R: And further then also make separate columns for rest, motivation, and performance. Because now that was all in one. And that sometimes makes it a bit chaotic. On the other hand, it's nice, because you can clearly see whether things are above or below, or in the same place. So maybe play with that, see if that works. But mainly horizontal. Round looks nice and is very designer-like. [Laughs] But I don't think it's very practical.

J: No, exactly, that's obvious. What I'm going to do now is look at the data with Data Science and see if any clear moments come out, or correlations. Then I will send that in. So, I'm very grateful for the time you've put into tracking so far and your input.

R: Nice.

J: You said you may not have gotten the insights you wanted yet, but that could be interesting too.

R: Yes, because usually you do feel what you feel. You then almost have to put it to your head coach that they can look at it with the training schedule, but you also have different cycles with all your rowers. So that does get complicated. [Laughs]

J: Yes. Unless you all go on the pill. [Laughs]

R: Yes, that is indeed also hopeless. If you skifft, you might still be able to do that.

J: Do you have anything else you want to say?

R: No not really.

J: Thanks very much for your time then.

Interview between Julia Rademaker and rower 3

26rd of January 2024, on campus.
The interview has been transcribed semi-verbatim. The interview was held in Dutch, this was transcribed.
Julia Rademaker is the interviewer, indicated by J
A rower is the interviewee, indicated by R, for privacy reasons the rower's name is not included.

J: Heel fijn dat je hier even heen kon komen.

[Talk about study and rowing. The rower indicated to be injured currently, but expects to be able to train again next week.]

J: Ik had wat vragen over de tracker specifiek.

R: Ja.

J: Allereerst hoe gebruikte je de tracker de afgelopen weken.

R: Meestal vulde ik ’s ochtends alles in. En dan ’s avonds nog m’n performance invullen. Ja dat eigenlijk. ’s Ochtend kort mijn hartslag checken, en hoe moe ik was en hoe ik me voelde qua motivatie.

J: Waren er specifieke momenten waarop je het tracken handig vond of de tracker is er niet echt handig voor.

R: Ik had wel heel erg dat als ik moe was, dat ik dan heel erg kon kijken of dat ook mijn performance kon belemmeren. Dus dat vond ik best handig, en ik vond het ook handig om te tracken hoe moe je bent. Of je wel minstens een paar dagen in de week goed slaapt, goed uitgerust bent. Dat soort dingen vond ik wel heel handig om te kijken.

J: Ja. Hoe was dat in vergelijking met het meer digitale prototype, dat je eerst gebruikte.

R: Ik vond dit eigenlijk chiller, het was veel overzichtelijker. Ik had voor mezelf een systeempje bedacht. Zo vul ik dit in, zo vul ik dat in. En dan is het gewoon veel makkelijker om te tracken.

J: Ja.

R: Want met het digitale is het zo'n tabel, dan moet je alles invullen. En dan moet je naar de grafiek gaan, dan is dit gewoon overzichtelijker.

J: En wat vond je er overzichtelijker aan.

R: Ja, je kon gewoon alles in een keer zien. In een digitaal bestand moet je dan swipen en dan je ze gewoon allemaal getalletjes onder elkaar en dat was voor mij niet heel overzichtelijk. En voor mij nu zag je gewoon als het een beetje fluctueert. En hoe het op en neer gaat.

J: Ja, in een oogopslag?

R: Ja.

J: Dus je zou het ook fysiek willen blijven tracken, in plaats van digitaal?

R: Ja

J: Meestal deed je het dus echt dagelijks.

R: Ja heel soms vergat ik het, maar dan deed ik het gewoon de dag erna. Maar ik het probeerde het wel echt zo dicht mogelijk op de echte dag te doen.

J: Merkte je dat het hielp als je een beetje ritme kwam dat…

R: Ja! Als je het elke dag gewoon doet, dan is het bij het ontbijt: 'Oh ja ik moet nog even de tracker invullen'.

J: Klinkt goed.

R: Ja het was ook wel een beetje vergelijkbaar met wat we vorig jaar deden. Met roeien hadden we een logboek en dan moesten we hartslag, gewicht, hoeveel uur je had geslapen, dat soort dingen invullen.

J: Ja, en dit jaar hebben jullie dat helemaal niet?

R: Nee, dit jaar is dat veel minder. Of je kan het voor jezelf doen, maar het is niet dat de coaches zeggen, het is handig als je een logboek invult en er dan ook echt in kijken.

J: En als je er naar keek. Je gaf aan dat je er naar keek als je moe was en dan keek of het klopte. Hoe ging je verder met die data om?

R: Naja, ik deed er niet heel veel mee, maar af en toe. Als ik bijvoorbeeld zag dat mijn hartslag wat hoger was, dan probeerde ik goed op tijd te slapen en wat langer. Maar als ik mij bijvoorbeeld helemaal fit voelde, dan kon ik wel gewoon 's avonds nog wat dingen doen.

J: Waren er ook dingen aan de data die je heel erg opvielen.

R: Niet heel erg, meeste dingen waren wel een logisch. Het enige wat ik wel wat moeilijker vond is naar de cycli kijken, daar weet ik gewoon niet veel van af. Dus dan was ik wel ongesteld, dus dan zag ik misschien wel een fluctuatie in data, maar dan wist ik niet dat dat gewoon toevallig was, of dat dat met de fase van de cyclus te maken had. Daar wist ik nog niet genoeg vanaf om er goeie data uit te kunnen halen.

J: In hoe verre had je daar ook meer ondersteuning bij willen hebben?

R: Misschien wel een uitleg van over hoe het in het algemeen gaat. Ik zie dan bijvoorbeeld wel op internet dat je dan als je ongesteld bent niet zoveel kan tillen, maar dan tijdens je ovulatie wel weer meer.

J: Goed dat je het aangeeft dat dat lastig was. Had je het idee dat die vragen je ook konden helpen ernaar te kijken?

R: Het was voor mij vooral een reminder om naar de data te kijken, maar niet heel specifiek dat ik die vragen gebruikte van hier ga ik opletten. Meer meer dat ik dacht: 'Oh ja, ik ga er weer even naar kijken en weer even goed op de verbanden letten.'

J: Je had ook het idee dat je meer naar de data kan kijken met de fysiek?

R: Ja, de fysieke pakte ik er zo bij en de digitale moest je dan dat ding openen en dan dat invullen.

J: Heb je ook nieuwe vragen gekregen over je menstruatie?

R: Ja mijn menstruatie is ook gewoon een beetje onregelmatig, dus dat vind ik dan ook wel moeilijk om daar iets over te zeggen. Het is niet altijd precies zoveel dagen. Dus dat vind ik lastig.

J: Heb je ooit een patroon daarin gemerkt.

R: Niet echt. Meestal is het gewoon een beetje willekeurig en soms dan sla ik het ook gewoon over. Ik vind het een beetje vaag.

J: In hoeverre beïnvloed jouw menstruatiecyclus jouw prestatie?

R: Voor alsnog heb ik niet het idee dat het een heel duidelijk invloed heeft. Ik heb ook niet heel veel last van krampen, dus het is ook wel gewoon prima. Ik heb ook het gevoel dat er heel veel andere factoren zijn die invloed hebben.

J: Er zijn heel veel andere randvoorwaarden die eerst invloed hebben?

R: Ja.

J: Hoe comfortabel voelde je bij het delen van je gegevens, bijvoorbeeld met mij of in het groepsgesprek?

R: Daar had ik in principe geen moeite mee.

J: Zou er een manier zijn om het nog comfortabeler te maken?

R: Nee, was eigenlijk prima zo.

J: Door de afgelopen periode tracken, heb je ook vaker dit onderwerp besproken met anderen?

R: Nee, dat niet. Dit is wel iets wat ik voor mijzelf deed, maar ik heb er wel veel meer over nagedacht. Dat ik dacht: 'Oh, ja, dit komt misschien hierdoor, of hierdoor.'

J: Heb je het er wel eens met coaches over gehad?

R: Ja wel heel kort even, even over het eerste onderzoek met de Excel en dat ik daarna doorging, maar we hebben het er niet echt lang over gehad.

J: Heb jij nog suggesties om het te verbeteren.

R: Eigenlijk niet echt, ik vond het eigenlijk wel fijn zo.

J: Heb je nog andere opmerkingen?

R: Nou ik vond het eigenlijk wel heel leuk om te doen, ook omdat we vorig jaar dat logboek hadden. Dat je dan gewoon even kijkt hoe het gaat.

J: Een check-in moment met jezelf?

R: Ja precies.

J: Dat waren de vragen die ik had. Heel erg bedankt voor je tijd.

R: Graag gedaan.

B2.4. Workshop 2 - Preparation

Co-creation 2

First meeting	@December 19, 2023
Organization	IDE

General

Background

Case: Sports and menstrual cycle tracking for health and performance of rowers

Problem definition: The menstrual cycle can significantly impact the (perceived) performance of rowers. Yet it is barely considered in the rowing communication. A way to address this problem is tracking the menstrual cycle, which is a way for rowers to gain an understanding of the relation between the menstrual cycle and performance and take control over their performance and well-being. But what actions do these rowers want to take with their data and how can a tracker support this?

Problem as Given (PaG): How can menstrual and sports data be used for a rower to take action?

Ideal outcome: A set of around 2/3 possible actions that rowers can do with their sports and menstruation data

Logistics: 19th of December, 16:00 at IDE (if possible, otherwise Proteus)

The method is based on the book 'Road Map for Creative problem-solving techniques'

⏰ General timeline

20 min	1. Introduction/briefing	16:00 - 16:20
10 min	2. Explaining the tool	16:20 - 16:30
15 min	3. Identifying the characteristics	16:30 - 16:45
10 min	4. **BREAK**	**16:45 - 16:55**
40 min	6. Idea finding	16:55 - 17:35
20 min	7. Solution finding	17:35 - 17:50
5 min	8. Wrap-up	17:50 - 17:55

🛠️ Supplies

- [ ] Post-its
- [ ] Markers
- [ ] Tape
- [ ] Scissors
- [ ] Flipchart sheets
- [ ] Dots
- [ ] Paper
- [ ] Hanging place
- [ ] Table
- [ ] Chairs
- [ ] Snacks and water

Session plan

🗣️ 1. Briefing and introduction

1.1 General briefing

Stage/session duty	Session duty 2: Briefing
Time	16:00 - 16:05, 5 min
Materials	Poster with the problem statement, poster with agenda.
Aim	Introducing the goal and setting the tone, positive and open atmosphere
Notes	Thank you for joining me here today. Together we are going to look at how sports and menstruation can support a rower to take action and what I mean by that I will explain shortly, but first an overview of this session. This session will consist of a first explanation of the problem, a tool I have created for this problem, and then together creating ideas about what actions can be taken with this tool and developing these into solutions. This session will end no later than six o'clock. Before diving into the problem, I want us to get to know each other a bit so that we feel comfortable sharing during this session.

1.2 Icebreaker

Stage/session duty	Session duty 4: Icebreaker
Time	16:05 - 16:10, 5 min
Materials	-
Aim	Set a loose mood
Notes	Find 10 things in common within the group

1.3 Problem introduction

Stage/session duty	Session duty 1: Briefing
Time	16:10 - 16:20, 10 min
Materials	Presentation
Aim	A shared understanding of the problem

Notes	As you might have realized, the menstrual cycle and your rowing performance might be related to each other. Recent studies also reflect this relationship. However, studies also show that this topic is not yet a common topic within the rowing community. But what could this relationship look like: explain the comic. Does anybody have questions about this?

🧠 2. Explaining the tool

Presentation and questions on the tool

Stage/session duty	-
Time	16:20-16:30, 10 min
Materials	Presentation
Aim	Create a shared understanding of the tool
Notes	As a solution, I have created a tracker that visualizes your sports and menstruation data: explain what is visible in the graph and allow for questions. Approx. explanation: This tracker depicts a visual representation of your sports and menstrual data, which illustrates the cyclical nature of the menstrual cycle. The outer circle represents a rough estimate of the possible phases of your menstrual cycle, as explained in the comic. The inner circle depicts the perceived intensity of bleeding, which is combined with the impact of symptoms (red circles). The larger these circles, the greater the influence of menstrual symptoms. The single grey circle presents your average resting heart rate, while the medium dark blue line and circles depict your resting heart rate for each day. The other two lines represent the mode of your training motivation, rest scores, and training intensity, which is the most frequently filled-in value. The star-strewn line, dark blue circle, and light blue circle represent your tracked motivation, rest, and training intensity.

❓ 3. Identifying the characteristics

Drawing of the characteristics

Stage/session duty	Problem finding / Session duty 4
Time	16:30 - 16:45, 15 min
Materials	Presentation, paper and pens
Aim	Define the tool to a level that it is good to build ideas on
Notes	Before we can look at what different actions a rower can take with this tool and what to establish a shared understanding of what this tracker means to you. In groups of two/three we are going to look at all the different characteristics and meanings we see in this tool, to do this we are going to draw a box that shows all the different aspects. For example, if you look at the brain, it has a lot of different functions and we could draw it as this container that makes us move our arms and lets us explore, write, see, hear, and do many more things. Start by drawing a shape and adding your different understandings of this tool. After a couple of minutes ask the group to share what they have drawn.

🛑 4. Break

Break

Stage/session duty	Session duty 7: Break
Time	16:45 - 16:55, 10 min
Materials	-
Aim	Keep the mind fresh
Notes	Write on the board at what time to be back, slightly shorter than 10 minutes. Indicate where toilets or refreshments are.

❓ 5. Idea finding

Energizer (Optional)

Stage/session duty	Session duty 6: Energizer
Time	16:55 - 17:00, 5 min
Materials	-
Aim	Bring the group to the right mood
Notes	In the case of low energy: ninja or what are you doing? In the case of high energy: the association circle, doodle drawing

Brainwriting

Stage/session duty	Idea finding
Time	17:00 - 17:15, 15 min
Materials	Flip over sheets, black markers, post its
Aim	Create ideas on what actions
Notes	With the associations in mind, write all the ideas on what actions do rowers want to take with their data. You can paste the ideas on the board and say it out loud when you put it down. It is important, that everything goes, so if in doubt, write it out.

	After some time, ask who else would want to take action with this data and what would they like to do.

Clustering

Stage/session duty	Idea finding
Time	17:23 - 17:33, 10 min
Materials	-
Aim	Create a structure in all the ideas, and shift the mindset to converging.
Notes	Start grabbing ideas and place ideas that you think should belong together.
Time alternative	-
Energy alternative	-

Hits and dots

Stage/session duty	Idea finding
Time	17:33 - 17:35, 2 min
Materials	Dots.
Aim	Select actions
Notes	Everybody has three dots, to intuitively place on ideas that they see the most potential in.
Time alternative	-
Energy alternative	-

❓ 6. Solution finding

Doodle drawing

Stage/session duty	Solution finding
Time	17:35 - 17:38, 3 min

Materials	1 Post-its pp and pens
Aim	Get into the drawing visual mindset
Notes	Ask the participants to doodle, and now make it into a bird.
Time alternative	Doodle and drawing.
Energy alternative	-

Poster making

Stage/session duty	Solution finding
Time	17:38-17:50, 12 min
Materials	Colours, papers, scissors etc.
Aim	Conceptualize the poster and identify unexplored aspects
Notes	We are dividing into groups of two and three, and from the selected actions, decide on a way that the tool could support that action. Make a poster that contains at least a name, a sketch and an explanation. After 10 minutes we are going to present the solutions to each other.

❓ 7. Wrap-up

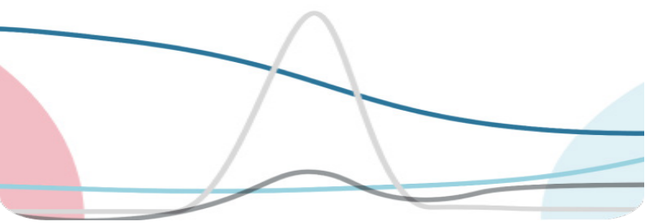
Restating the problem

Stage/session duty	Session duty 8: Wrap-up
Time	17:50-17:55, 5 min
Materials	Camera
Aim	Highlight some actions still be taken and close off the session.
Notes	Are there any left-over remarks or actions? I will combine all your ideas and see how this can be implemented in the final design of the tracker. Thank you all for your great effort during this session and to close off I would like to ask you to give everybody a well-deserved high-five on their performance.

B3. Prototype 3

Hi!

Are you ready to reflect on the interdependence of the menstrual cycle and your performance?



Dear rower!
In this booklet you can track your performance and menstrual cycle for seven days using four daily steps. The steps are explained on the following pages at the end of the booklet you find the graph to register your data. Everyday you create knowledge (tracking) and receive knowledge and guidelines (reflecting). The tracking is most effective if you take a moment to do it every morning.

Happy tracking!

The Daily Steps:

1. Grounding: Take five deep breaths.
2. Morning Check-In: Register your morning data and add the data to the graph.
3. Daily Insight: Read an insight on the menstrual cycle
4. Afternoon Check-In: Register your evening data and take a look at the graph.

Example

Write down the date

Check-off what you have done

- ☐ Grounding
- ☐ Morning
- ☐ Read insight
- ☐ Evening

The Daily Insight

Read your daily insight

Your Thoughts on the Day

Here you can write anything you want to remember about this day. This can include things about the menstrual cycle or other aspects of your day that were important to you.

The Questions

The booklet contains a graph where you can track your answer to five questions. The questions have been divided into two categories and can be placed along a low-to-high grid. The graph displays the location for your average value.

Morning

In the morning you reflect on how you woke up with three questions:
1. What is your your resting heart rate?
2. How rested did you feel when you woke up? (Low is extremely tired, and high is extremely rested)
3. How excited were you to train when you woke up? (Low is not excited at all, high is extremely motivated)

Evening

In the evening, take a moment to reflect on your day and evaluate your performance.

1. How did you perform today? (Low is very poorly, high is extremely well)
2. How was your bleeding today?

Then, jot down any important details you want to remember. This will help you review your progress and make connections about what influences you. Finally, as it is interesting to look back at the data, every day a different technique is discussed to look at your data in the graph!

Grounding

The first step of the day always includes a grounding exercise. This is as simply as sitting down and taking five deep breaths. With these breaths, you can focus on how your body feels.

Day 1

- [ ] Grounding
- [ ] Morning
- [ ] Read insight
- [ ] Evening
- [ ] Data activity

The Daily Insight

A normal menstrual cycle has a length of 21 to 35 days. The menstruation lasts between 4-7 days.

Your Thoughts on the Day

The Data Activity

Discuss with me what questions you have after the first of tracking.

Day 2

- [ ] Grounding
- [ ] Morning
- [ ] Read insight
- [ ] Evening
- [ ] Data activity

The Daily Insight

If you have not had your period for more than 6 months, it is called amenorrhea. This is not considered normal.

Your Thoughts on the Day

The Data Activity

What parameters are important for you to track and can you see that in the data?

Day 3

- [ ] Grounding
- [ ] Morning
- [ ] Read insight
- [ ] Evening
- [ ] Data activity

The Daily Insight

Your menstrual cycle consists of different phases.

Your Thoughts on the Day

The Data Activity

Discuss with me what phase of the menstrual cycle you think you are in.

Day 4

- [ ] Grounding
- [ ] Morning
- [ ] Read insight
- [ ] Evening
- [ ] Data activity

The Daily Insight

Research has suggested that the self-evaluation of athletes changes across the different phases after the menstrual cycle.

Your Thoughts on the Day

The Data Activity

Where in the graph could you see in what phase you are?

Day 5

- [ ] Grounding
- [ ] Morning
- [ ] Read insight
- [ ] Evening
- [ ] Data activity

The Daily Insight

Athletes evaluated their performance more positivily during the first week after their menstrual cycle.

Your Thoughts on the Day

The Data Activity

Discuss with me if you see any days that are compareble to each other.

Day 6

- [ ] Grounding
- [ ] Morning
- [ ] Read insight
- [ ] Evening
- [ ] Data activity

The Daily Insight

Athletes evaluated their performance more negatively the week before their menstrual cycle. However, this is personal and can be different for you.

Your Thoughts on the Day

The Data Activity

What would you want to learn more about and can you find this in your data?

Day 7

- [ ] Grounding
- [ ] Morning
- [ ] Read insight
- [ ] Evening
- [ ] Data activity

The Daily Insight

You can reach out to a doctor if your menstruation influences your training or competition.

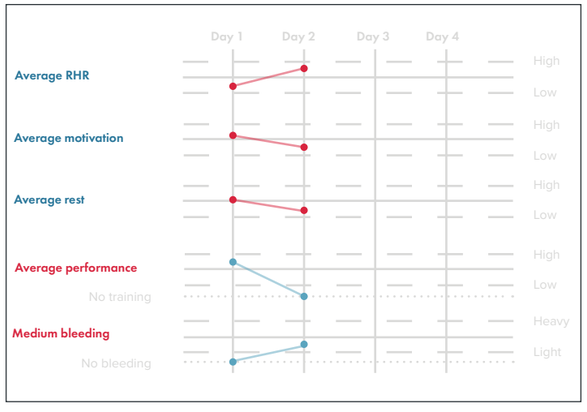
Your Thoughts on the Day

The Data Activity

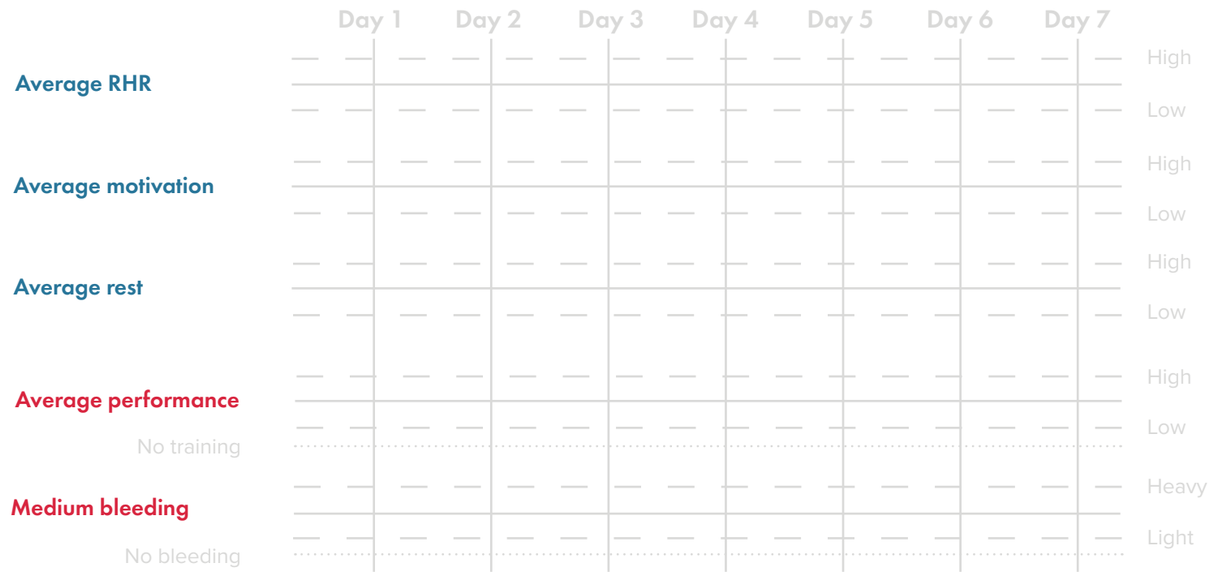
What do you want to remember from this week of tracking?

Graph explanation

Every question has the average line (continuous) and a line for high and low (dashed). The blue topics are morning questions, the red are evening topics. The evening topics have a line for when the question is not relevent. Below is an example of what the graph could look like after two days. The first a heavy training day, the second a rest day with bleeding.

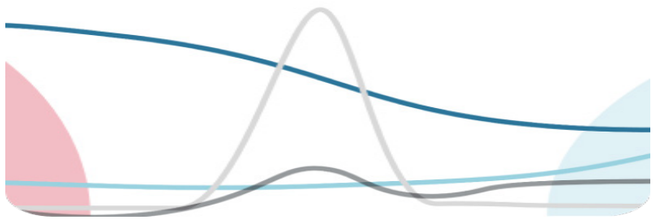


Your Graph

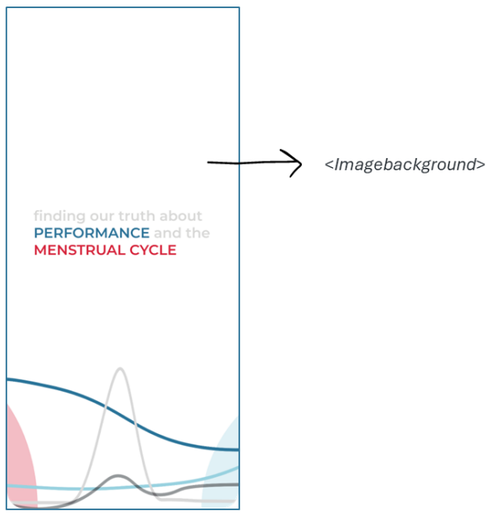


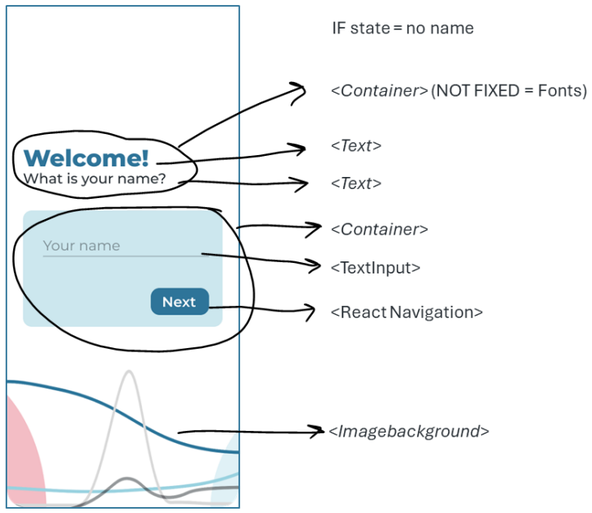
B3. Prototype 3

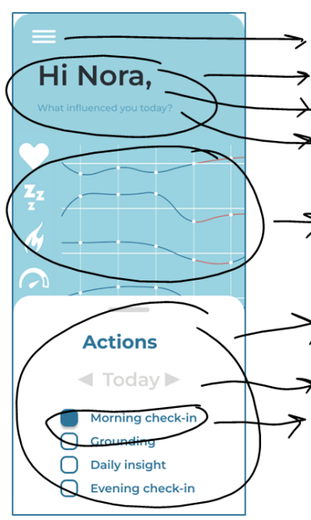
Thank you for participating!



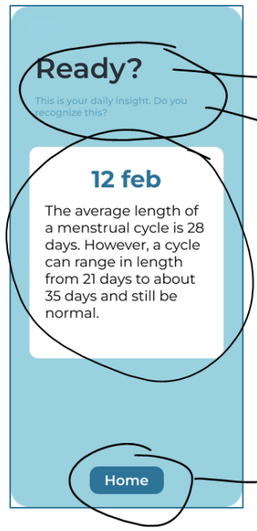
C1. Programming functions of the application



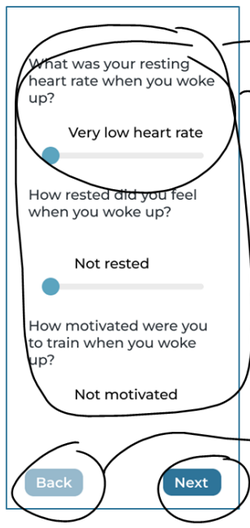




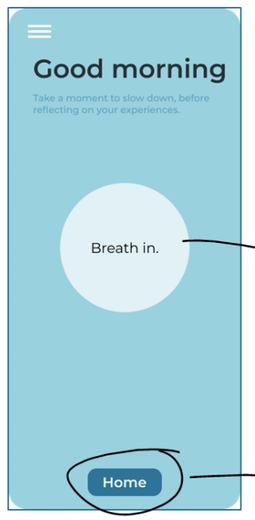
Home page
Navigation drawer with links to stacked pages -> but non-functioning
<View>
<Text>
<Text>
<graph-kit.line> stacked
Navigation drawer with links to stacked pages
<datepicker>
Component with states indicating shadow and color -> e.g. {props => props.filled ? 'white': 'medium'



<View>
<Text>
<Image>
<Navigate>

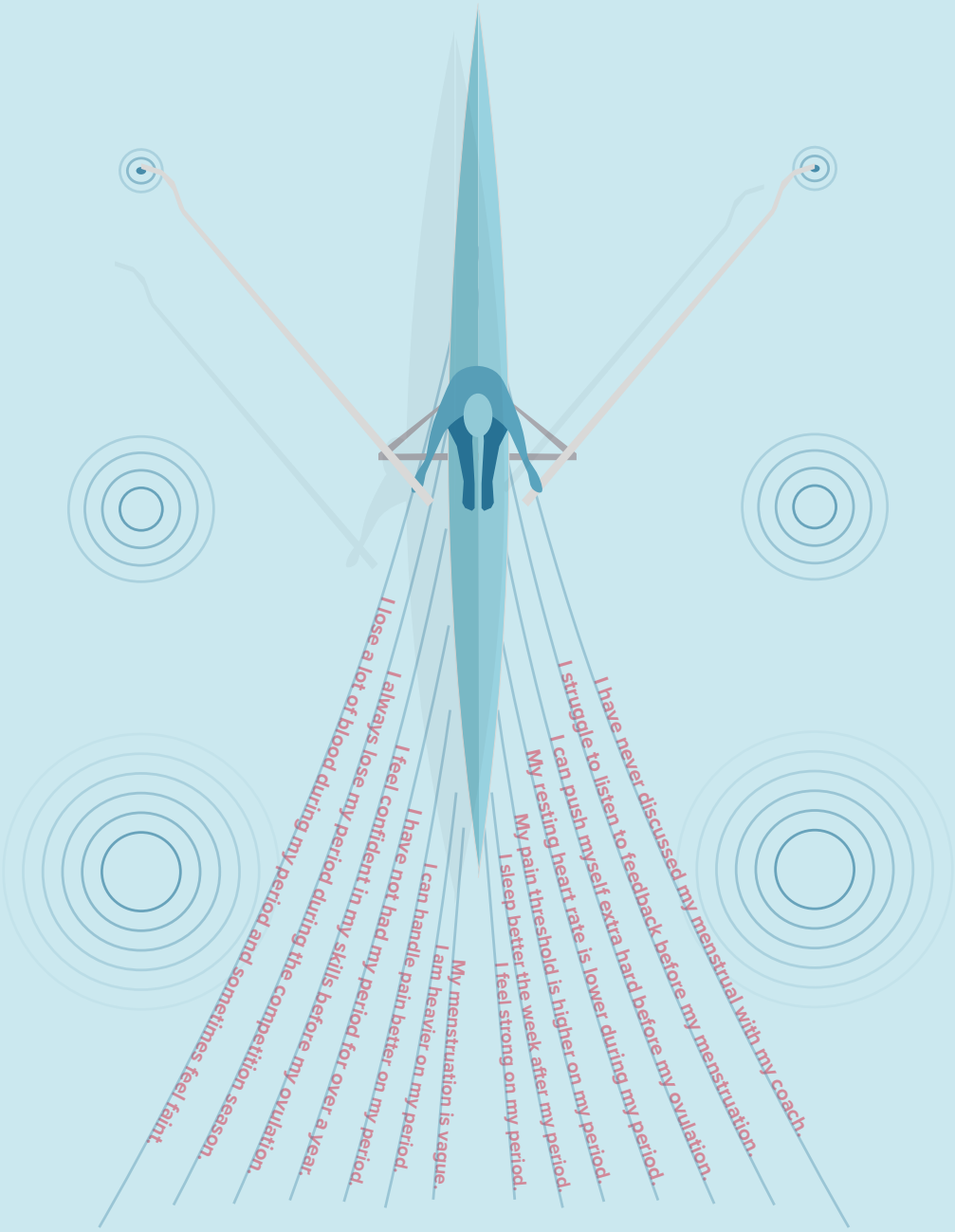


<ScrollView>
<Slider>
<Navigation>
<Async storage to store the data locally -> update states of completed activities>



<Image > (but it will be a video, but that is just what the function is called)
navigation

C2. Coach Activation Poster



Female rowers have a menstrual cycle

As a coach, you can start a conversation with a rower about this topic. The menstrual cycle can affect a rower's performance, but the rower's performance can also affect her menstrual cycle. Starting a conversation about this topic could support a rower identify how she experiences her menstrual cycle and discover how to perform healthily with her experience.