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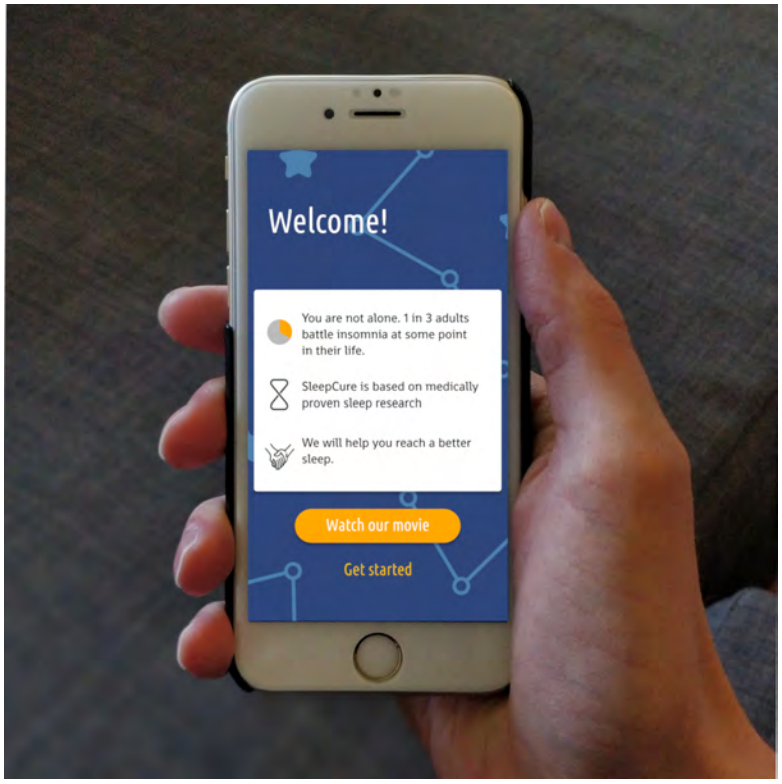

Designing for Motivation and Engagement in a Smartphone App for Insomnia

Features to consider for digital behavior change interventions for insomnia

Master's thesis in Interaction Design and Technologies

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Cover: The welcome screen of the onboarding from the created prototype.

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Abstract

Insomnia is a big problem in society and currently no long-term scalable solution to this exists. Cognitive behavioral therapy is the recommended treatment for insomnia and could potentially be delivered digitally. It can be argued that motivation and engagement is very important for a digital behavior change intervention to be successful and some concepts and guidelines has previously been proposed to design for this. This thesis aims to answer what should be considered when designing for motivation and engagement in a smartphone app for behavioral change intervention in insomnia.

The process to answer this question begun with research of literature and interviews with experts and people with insomnia. It continued with ideation where a design workshop was held together with the project initiators, the Gothenburg-based startup SleepCure. An interactive prototype was iteratively constructed and then evaluated remotely with potential users. This resulted in some promising features and themes that should be considered to be included in a smartphone app for behavior change intervention in insomnia.

Keywords: insomnia, DBCI, CBT, self-determination theory, smartphone, motivation, engagement.

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Simon Nielsen, Gothenburg, June 2020

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1
Introduction

Sleep problems are more prevalent in our society than many believe, with one in four people in Sweden suffering from it [1]. A lack of sleep has all sorts of health risks. It has been linked to increased risk of obesity, heart disease, diabetes and it's associated with lower life expectancy [2]. The traditional methods of combating this problem includes being prescribed sleep medication and/or going to cognitive behavior therapy (CBT). There is stronger empirical support for CBT than medication as a long-term effective solution however there is a lack of CBT therapists for insomnia creating waiting times to get help [3]. Considering this, the ubiquitous use of technology could potentially be a great opportunity for producing more effective and scalable behavioral change interventions. [4]
One Gothenburg-based startup called SleepCure is trying to realize this potential by developing a smartphone application that combines sleep tracking, self-assessment and sleep coaching based on cognitive behavior therapy to reduce the sleep problems of its users. One of their challenges is to design the program so that the users are sufficiently motivated and engaged to perform the necessary behavioral changes. To begin tackling this problem, SleepCure initiated an idea for a thesis which eventually developed into this master's thesis project.

1.1 Research problem and question

It is suggested that for digital behavior change interventions (DBCI) to be effective they need to be engaging [5], with [6] even saying that it is a precondition. When designing for engagement and motivation in DBCIs self-determination theory has been suggested to be relevant [7][8]. The aim of this master's thesis will be to apply these concepts and theories to an app for insomnia and investigate factors that play into the practical design of elements that support them.
In short, the thesis aims to answer the following research question:

> *What should be considered when designing for motivation and engagement in a smartphone app for behavioral change intervention in insomnia?*

1.2 Delimitations

Throughout the process persons with insomnia will be involved in both research, idea generation and evaluation. Because of limited resources to acquire these users they

will be limited to those who are already somewhat motivated to make a behavioral change. This means that the target demographic is likely to exhibit less scepticism than in the general population, but addressing that is outside the scope of this project. Furthermore the result of this project will not be implemented code, instead the focus will be on design suggestions in the form of prototypes and guidelines.

1.3 Ethical considerations

Since insomnia is a health problem it can be a sensitive subject. There are possible ethical issues when designing for care of said problem. The treatment will not involve any medical recommendations, but there will be recommendations for behavioral changes which can still have substantial consequences. For these, it will be made sure that there is always informed consent from the test users. There are also privacy concerns when regarding data surrounding an individual's health. All research will be done in compliance with Chalmers ethics policy [9].
Another potential issue is by making the sleep coach app too engaging it might introduce Orthosomnia, an unhealthy obsession with getting perfect sleep [10] [11]. Orthosomnia as a sleep disorder has been observed with a growing number of patients that are using technology to track their sleep. Considering this thesis, the technology should enable self-improvement but not take it too far as to introduce new problems.

2
Theory and Background

This chapter describes theoretical concepts relevant to this project.

2.1 Insomnia

The European guideline for the diagnosis and treatment of insomnia uses the third edition of the International Classification of Sleep Disorders (ICSD-3) as diagnostic criteria for chronic insomnia disorder [12]. These are shown in table 2.1 below. This will be the definition used for insomnia in this thesis. Sleep Cure uses the Insomnia Severity Index (ISI) [13] to screen users for their insomnia severity.

A	The patient reports, or the patient's parent or caregiver observes, one or more of the following: 1. Difficulty initiating sleep. 2. Difficulty maintaining sleep. 3. Waking up earlier than desired. 4. Resistance to going to bed on appropriate schedule. 5. Difficulty sleeping without parent or caregiver intervention.
B	The patient reports, or the patient's parent or caregiver observes, one or more of the following related to the nighttime sleep difficulty: 1. Fatigue/malaise. 2. Attention, concentration or memory impairment. 3. Impaired social, family, occupational or academic performance. 4. Mood disturbance/irritability. 5. Daytime sleepiness. 6. Behavioural problems (e.g. hyperactivity, impulsivity, aggression). 7. Reduced motivation/energy/initiative. 8. Proneness for errors/accidents. 9. Concerns about or dissatisfaction with sleep.
C	The reported sleep/wake complaints cannot be explained purely by inadequate opportunity (i.e. enough time is allotted for sleep) or inadequate circumstances (i.e. the environment is safe, dark, quiet and comfortable) for sleep.
D	The sleep disturbance and associated daytime symptoms occur at least three times per week.
E	The sleep disturbance and associated daytime symptoms have been present for at least 3 months.
F	The sleep/wake difficulty is not better explained by another sleep disorder.

Table 2.1: Diagnostic criteria for chronic insomnia disorder according to ICSD-3

There are multiple definitions used for insomnia but they are very similar, the differences mostly surround how many symptoms a patient needs to qualify and for how long they have suffered from them. For the purposes of this thesis, the differences in definitions are not relevant.

2.2 Cognitive behavioral therapy for insomnia

Cognitive behavioral therapy for insomnia (CBT-I) is the recommended treatment for chronic insomnia by the European Guideline [12]. CBT-I includes some form of cognitive therapy such as cognitive restructuring or education on sleep hygiene to correct dysfunctional beliefs and attitudes about sleep common to insomnia [14]. Cognitive restructuring means to identify and change negative thoughts about sleep. In education on sleep hygiene patients are encouraged to eliminate caffeine, alcohol and nicotine usage, to exercise daily, to eat a light snack at bedtime and to ensure that the sleep environment is quiet, dark and comfortable.

To address behavioral changes it also combines Sleep Restriction Therapy (SRT) and Stimulus Control Therapy (SCT). SRT is a way to reduce night-time disturbances by restricting the time in bed so that eventually it matches the presumed sleep requirement. SCT is based on the assumption that a patient's bedtime and bed has been conditioned for insomnia by repeated failed sleep attempts. The goal of SCT is to re-associate the bed with successful sleep attempts. This means instructing the patient to for example go to bed only when sleepy, get out of bed if they are awake for long periods of time and avoid any sleep-incompatible behaviors in the bedroom [14].

CBT-I and the techniques it encompasses has been shown to be an effective treatment for insomnia [15][16]. The common alternative of pharmacological intervention has proven short-term effectiveness but it lacks evidence as an effective long-term treatment according to a meta-analysis made by the European Sleep Research Society [12].

2.3 Behavioral theory and models

This section will talk about some relevant behavioral theories, models and constructs.

2.3.1 Self-efficacy and motivation

Self-efficacy is a concept referring to a person's perception of their competence to successfully perform a behavior [17][18]. It originates from Bandura's Social Cognitive Theory [19]. There are four sources of self-efficacy: mastery experiences, social models, social persuasion and reducing stress reactions. Mastery experiences refers to the experience of successes which builds a strong sense of self-efficacy. Although if the successes come easily people are quick to be discouraged by failure. Therefore,

some setbacks and difficulties are useful to become more resilient in their beliefs about themselves. Social model means seeing others similar to yourself succeed or fail or having models that possess the competencies you wish to hold. Another way to raise or lower self-efficacy is with social persuasion by for example verbally encouraging or discouraging someone. Lastly, someone's emotional state affects how they judge their ability to do something. By reducing stress reaction you can modify their self-beliefs.

Furthermore self-efficacy affects human functioning in four major psychological processes: cognitive, motivational, affective and selection [17][18]. In the motivational processes self-efficacy has a big contribution. It influences the goals people set for themselves, how much they work for them and how they behave when facing difficulties. In expectance-value theory motivation is described as being regulated by the expectation that a certain behavior will produce results and what value those results have [20]. Since people act on their beliefs of their ability to do something and what they think the outcomes of that will be, self-efficacy greatly contributes to the motivational aspect of this [17][18].
This implies that self-efficacy is a very relevant concept to take into account when designing for motivation.

2.3.2 Fogg's behavior model

According to Fogg's model [21], behavior is made up of three factors: motivation, ability and triggers. He explains that for an individual to perform a certain behavior he or she needs to be sufficiently motivated, able to do it and be triggered to perform the behavior. Motivation and ability are trade-offs in the sense that if someone has a low ability of doing something they need a great deal of motivation to do it while doing something that is easy might require less motivation. The implication for a designer is that in order to get more users to perform a behavior you can either make it simpler or make them more motivated. But a user also needs a well-timed trigger, something that reminds them or pushes them to do it.
The model further describes the elements and types of each factor.

Motivation: Motivation can be increased with either *pleasure/pain*, *hope/fear* or *social acceptance/rejection*. Fogg asserts that the first four are powerful but designers should think about which one is appropriate, continuing by saying that hope is probably the most ethical and empowering motivator.

Ability: How simple something is can be thought of in terms of *time, money, physical effort, cognitive ease, social deviance* and whether it is *routine* or not. Some people have more or less of these elements at different times and situations. As a designer you should focus on what resource is the scarcest for the user at the moment the behavior is triggered. In general Fogg recommends to focus on making behavior simpler instead of trying to motivate users.

Triggers: Prompts or cues to perform a behavior comes in three types according

to Fogg. When someone lacks motivation to perform a behavior they need a *spark* that inspires them to take action. The second type is called a *facilitator* which is employed when a user lacks ability. It is supposed to both trigger the behavior and make it simpler to perform. Finally when users both have the motivation and ability they just need a reminder, this type of trigger is called a *signal*.

Using Fogg's behavior model in behavior interventions has been suggested for small behavior changes in a larger intervention [22] and that it can help in the selection of short activities that will increase user engagement [23]. This could fit into a CBT-I smartphone application because of the intermittent nature of smartphone application usage.

2.3.3 Self-determination theory

Self-determination theory (SDT) is an empirically-validated approach to motivation, personality and well-being [24][25]. It sets up three constructs that are deemed essential for self-motivation: autonomy, competence and relatedness.

Autonomy: When acting with autonomy a person acts with high willingness in line with their goals and values. They act from their own agency with intrinsic motivation. Promoting this can mean giving people the freedom of choice when working with a system.

Competence: Competence means feeling effective and that one has the ability to perform something. In design it relates to usability and optimal challenge.

Relatedness: Relatedness refers to the sense of belonging and being connected to others. That means social relations that are meaningful and satisfying.

A thorough explanation for why SDT is a good theory to use to inform design for engagement, motivation and well-being can be found in [8]. One of the arguments besides it being well validated after four decades of systematic empirical research is that the constructs are safe targets to design for since they cannot be "overfilled". One cannot be made to feel too much autonomy, competence or relatedness. This seems to suggest that SDT is a safe and appropriate theory for engagement in DBCI.

2.3.4 Behavioral change techniques

It was acknowledged in [26] that the inadequate evaluation and lack of falsification of behavioral theories has led to many concepts and constructs being labeled differently depending on which theory it originates from even though many behavioral scientists see them as being practically the same. To resolve this source of confusion researchers have developed a theory agnostic taxonomy of behavior change techniques (BCT) to be used in behavior change interventions [27]. There are 93 distinct BCTs clustered into 16 groups that have been consensually agreed upon by 56 experts from seven countries from the fields psychology, behavioral medicine and health promotion. Some examples of BCTs include *goal setting*, *graded tasks*, *reframing*, *feedback on behavior* and *problem solving*.

2.4 Digital behavior change interventions

More and more health interventions are moving to the digital space and this move has the potential to improve efficacy and increase reach of healthcare [4]. There has been numerous apps developed to deliver digital behavior interventions for things like drinking, smoking and insomnia with mixed results [28][29][30]. Digital CBT (dCBT) for insomnia has been shown to be effective in a large number of studies [31]. In [32] they found that a digital change behavior intervention for insomnia was effective in reducing insomnia symptoms and increasing sleep-related quality of life. This suggests that dCBT for insomnia is worth pursuing as a scalable alternative to regular CBT. Two apps for insomnia will be discussed further in section 5.2.1.

2.4.1 Guiding principles to DBCIs

In 2015 a set of guiding principles were proposed that were common to many interventions based on self-determination theory [7]. These principles seek to promote autonomy, competence and relatedness. For example to support competence they suggest providing graded goal-setting, clear structure and guidance. With relatedness it's not only about social relatedness but also presenting a positive experience which could mean using positive language, maximizing trust and providing rewarding feedback. These guiding principles are similar to a framework that presented for massive open online courses (MOOCs) which applies SDT [33]. It too seeks to promote autonomy, competence and relatedness through different design choices. Even though the theory is not applied to an intervention many of the same principles seem to apply.
Another group applied SDT to design in a model they called Motivation, Engagement and Thriving in User Experience (METUX) [8]. It provides five spheres of analysis in which a technology can be thought about and evaluated: *adoption*, *interface*, *task*, *behavior* and *life*. The authors provide a set of questionnaires that can be used to evaluate a design in all of these spheres. In their paper they argue that the impact that a technology has on the wellbeing of a person can be better understood, evaluated and designed for by targeting the needs defined by SDT.

2.5 Persuasive system design

Based on Fogg's [21] functional triad Oinas-Kukkonen and Harjumaa developed design features that should be considered when designing persuasive systems [34]. These components were supposed to more specific software requirements and implementations. Listed below are their postulated categories with some of the design features.

Primary task support: Reducing complex behaviors into simpler ones, tunneling experience, tailoring and personalization, self-monitoring, simulation, and rehearsal.

Dialogue support: Includes positive reinforcement, reminders, and suggestions.

Credibility: For example conveying trustworthiness and expertise as well as pro-

viding verifiability to claims made by the system.

Social support: Includes social learning, normative influence and means for cooperation.

2.6 Design for engagement

Engagement with digital behavior change interventions was conceptualized in a framework of engagement based on a systematic review of 117 papers [35]. The authors proposed the following definition of engagement:

> *"Engagement with DBCIs is (1) the extent (e.g. amount, frequency, duration, depth) of usage and (2) a subjective experience characterised by attention, interest and affect."*

They continue to say that engagement should be considered to be varied both among individuals both also over time for a single person.
The proposed framework shows several concepts and their relationships affecting engagement based on direct or indirect evidence. These concepts and some of the relationships can be found below:
Content of the DBCI: The behavioral change techniques.
Delivery of the DBCI: Design elements such as aesthetics, complexity, novelty and personalisation.
Population as context: The demographic and physique. Psychological characteristics including motivation, mental health, expectations and self-efficacy.
Setting as context: The social and physical environments as well as available time.
Mechanisms of action: Things mediating the effect of engagement such as increased knowledge, skill building and increase self-efficacy.
Optimal dosage: A pre-defined level where DBCIs are effective.

To design for engagement in a DBCI it has been suggested to use a "person-based approach" which means highlighting the persons that the interventions are designed for [7]. The approach is based on self-determination theory and is therefore focusing on promoting autonomy, competence and relatedness. This includes communicating about the intervention in positive way, providing an enjoyable and interesting experience, giving users control and clear guidance.

2.7 Pitfalls when using behavior theories in HCI

There has been stated some common pitfalls when using behavioral models in HCI that researchers should be aware of [26]. They include:

> *(1) Ignoring the broader context in which a technology will be used (e.g., not taking into account a person's neighborhood environment).*
> *(2) Picking only some constructs from a theory and thus losing the potency of the full conceptual framework for designing a system.*
> *(3) Treating design guidelines generated from one empirical study as "requirements" when they should be thought of as design hypotheses.*

> *(4) Using selective constructs from a theory but making claims that are related to the full theory (e.g., stating that a system was based on the transtheoretical model but then only using the stages of change).[26]*

Also mentioned in the same paper for future research is the question: "how much knowledge does an HCI research need about behavioral theory to use and contribute to it?" These considerations are highly relevant to this thesis since the thesis author does not have a background in behavioral science or psychology.

2.8 Conclusion

In summary, insomnia is a widespread and serious problem that has potential for a scalable digital solution. This solution could be a CBT-I program as they have shown to be effective before, distributed as a smartphone application because of their ubiquitous use. There are several promising theories and concepts that can be applied to this program to help increase the engagement and motivation to use it such as self-efficacy, self-determination theory and persuasive system design.

3
Methodology

The following methods are the ones considered for this project.

3.1 Iterative design

The problem of designing something is usually what is called a wicked problem [36]. These are problems with no defined perfect solution, they can always be continuously improved and worked upon. The problems are essentially unique and the explanations of them vary greatly depending on who you ask. That's why an iterative design process is suitable for these kinds of problems [37]. This way of working consists of several design cycles where the conclusion of each cycle bringing the design closer to a releasable state. It allows each iteration to improve the design based on feedback.

3.2 Research

Research methods are all about gathering data. Most of them can be used in several stages of the project although literature review is just getting an understanding of the field in the beginning of the project.

3.2.1 Literature review

Literature review is a method intended to gather and summarize information in the relevant fields surrounding a project [38]. It is useful to execute it in an organized manner, for example structuring the sources into themes. The authors of "The Craft of Research" mentions that one should evaluate the usefulness of sources using two criteria: relevance and reliability [39]. Tips for quickly assessing an article's relevance include reading the abstract, skimming the introduction and conclusion as well as checking the bibliography for titles relevant to your topic. To assess the reliability one should check if the source was published by a reputable press, checking if it was peer-reviewed and if it is current.

3.2.2 Interviews

Interviewing is a method for collecting qualitative information from people such as opinions and experiences [38, p. 102]. They either can be structured where the interviewer asks predetermined questions, or unstructured which is more conversational

and open while still keeping to a guiding set of topics that the interviewer hopes to to address. Interviews can also be semi-structured which combines the features of structured and unstructured interviews to use both closed and open questions [40, p. 197]. Which type of interview to choose depends on context such as the purpose of the interview and the stage in the design lifecycle. In an earlier stage of ideation it might be more useful with a more open, unstructured interview. But if you want to evaluate something specific it could be better with a structured interview.

3.2.2.1 Subject matter expert interviews

According to Cooper et al. it is often invaluable to meet with subject matter experts early in the process [41]. These are people who are experts in the domain in which the product will operate. In the case of insomnia this might be cognitive behavioral therapists. Their knowledge is very valuable but Cooper et al. warns that they are not designers. When speaking with them the designer should listen to the problems that they see but perhaps not their proposed solutions. Also, if possible, you should bring them in later in the process as well to help evaluate designs.

3.2.3 Think-aloud protocol

The Think-aloud protocol is a technique where participants express their thoughts verbally about an interaction experience, including their perceptions, motives and rationales when encountering UX problems [42, 440]. This allows designers to get a glimpse of the minds of their users, how they think and reason. Nielsen states that "thinking aloud may be the single most valuable usability engineering method."[43, p. 195]. At the same time, he expresses that the technique may give false impressions of the UX problems if too much thought is given to users own theories about why they perceived something to be difficult. Instead the designer should focus on what the user was doing when they encountered the problem. Think aloud can both be used as a formative and summative evaluation method.

3.2.4 User journey maps

A user journey map is a visual representation of how users interacts with a product and the experiences they have [38, p. 196]. It's a narrative about their feelings, intentions and actions as they interact with the product over time. The map can be used to zoom out to look at how the product is used in the real world. It can also be used to find critical moments of the interactions experience that needs improvement. User journey maps should be informed by rich, qualitative data from users.

3.3 Idea generation

Following are a few methods that can be useful for idea generation.

3.3.1 Design workshop

A way to engage stakeholders in the design process and to get valuable insights from them is to hold a design workshop [38, p. 63]. It's a method of participatory design that involves co-design methods in organized sessions. Activities can include techniques like mapping, affinity diagrams, sketches and storyboards. For a session to be successful it is essential that things like timing and logistics for the participants are well-planned while also being open for things to change as you go along. Design workshops are most common in generative research.

3.3.2 Scenarios

A scenario is a narrative from a user's point of view that explores the future use of a product or service [38, p. 152]. It centers around a user's experience of using the product or service on a day-to-day basis. The goal of scenarios is to help the design team make ideas more concrete and to envision how the design is likely going to be used in the future. They are less visual and more written like a story, but are often combined with storyboards and sketches. These stories should have an event that triggers them, follow what happens and then end with the user using the product or service to assist them in a way. Thereby it shows the value of the design.

3.4 Prototyping

Prototypes are a quick and easily changed version of a design that can be used to for example convey ideas, demonstrate concepts or test design elements.

3.5 Design evaluation

Yardley et al. mentions a number of ways of measuring engagement including qualitative analysis of self-report data and self-report questionnaires that can be used to analyze individuals perceptions and experiences [6]. Qualitative methods include for example interviews, think aloud protocol and focus groups.

3.5.1 Usability testing

As stated earlier, to design for competence and engagement the interface should be easy to use. Usability testing is a common method to evaluate the ease of use of a system [38, p. 194]. The tests comprises of tasks that a user should complete with a researcher or designer taking notes. It is important to look for critical incidents, moments of "something notable" [42, p. 436]. This could be if a user understands the task but not what to do to complete it or if they express surprise or delight but also frustration or confusion. Worth noting when it comes to usability testing is that it is often not worth the time testing with more than five users when testing the same thing because the new things you learn declines with each user [44][45].

3.5.2 Questionnaires

Questionnaires are one of the primary ways to gather data besides interviews [38, p. 140]. The type of question and how it is worded as well as the design of a questionnaire plays an important role in the types of answer one will get. To gather data about the user experience of autonomy, competence and relatedness Peters et al. adapted some already existing questionnaires to create a few versions of what they call Technology-based Experience of Need Satisfaction (TENS) [8]. These versions include TENS-Interface, TENS-Task and TENS-Life which corresponds the different spheres experience from the same article.

4
Planning

Outlined in Table 4.1 below is the original time plan for the project. It contains a bigger research phase followed by a series of design sprints. Each design sprint concludes with evaluating with users. The plan is based on iterative design thinking and user centered design [46].

4.1 Changes to the original time plan

In general the time plan was followed with one big exception: evaluation with users was only performed once after the initial user interviews. One reason for this was that the Covid-19 pandemic introduced insecurities around what would happen and how to find and test with users. Further discussion can be found in section 7.1.

Weeks	Tasks	Goal
1-4	Literature review, understand SleepCure's method, writing planning report.	Understand theory and background, plan thesis.
5-6	Expert interview with therapist, 2-3 user interviews about their sleep problems and about SleepCure, workshop with SleepCure, ideation sessions, paper sketches.	Understand more about sleep problems and therapy from expert and users perspective, generate lots of ideas.
7-8	Map out scenarios and user journey. Paper prototyping. Test with 2 users.	Explore ideas, evaluate.
9-11	Expert interview with designer and researcher. Iterate on user journey and interface. Create low fidelity digital interface. Evaluate with users.	Narrow in on the solutions, decide direction.
12-13	Create high fidelity prototype. Evaluate interface with 2 users.	Goal: Get user insights about a more final looking prototype. To force decisions on designs based on the time limit.
14	Last design sprint. Fix things in interactive prototype.	Prepare for final evaluation.
15-16	User test last iteration with 3 users. Fix small things.	Evaluate the final design and gather conclusions.
17-20	Finish writing the report.	Finish the thesis.

Table 4.1: Original time plan for the thesis project.

5
Design Process

This chapter chronologically explains the design process conducted during this project.

5.1 Literature study

A literature study was conducted to get an understanding of the field of sleep research, cognitive behavioral therapy, digital behavior change interventions and designing for engagement and motivation. Publications were mainly found through Google Scholar but also through recommendations from Peter, the company project supervisor. Following are some of the most used search terms:

- Digital behavior change intervention
- Design for self-efficacy
- Design self-determination theory
- Insomnia
- Design for engagement

The result from the literature study can be found in the theory chapter.

5.2 Research

In this section it is described what research methods was performed to gather more knowledge about insomnia, CBT and the SleepCure app.

5.2.1 Domain knowledge

The design was planned to be based on the SleepCure app. Therefore it was necessary to gather knowledge about the domain of insomnia treatment apps, especially how the SleepCure app works and what is the thought behind it. Talks were had with two of the co-founders of SleepCure: Peter Kurzwelly and Patrik Aronsson. Peter has a bachelor in sociology, has acquired a lot of knowledge about insomnia and is a big entrepreneur in Gothenburg. He is also the company supervisor for the project. Patrik is a UI-designer with more than a decade of experience that has founded two successful app companies before. By talking with them during multiple sessions domain knowledge was captured. This includes the user journey, the logic behind how the behavior intervention is driven and the research that backs it up.

The main idea behind SleepCure is taking a CBT-I treatment program and breaking it down to daily tasks and information bits that could be easier to digest and be more accessible than traditional treatment. The first version of SleepCure published on app stores focuses mainly on tracking the sleep of users, teaching about sleep hygiene [14] and giving users reminders about those behavioral changes. Although this can be helpful the company has aims to expand the app to revolve around CBT-I modules used in [47].

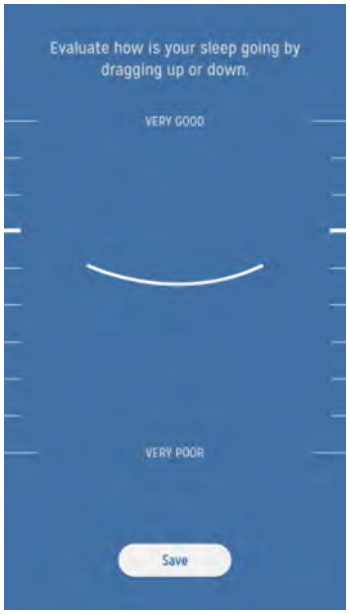

Figure 5.1: Evaluating your sleep in SleepCure.

Figure 5.2: Visualizing the sleep times in SleepCure.

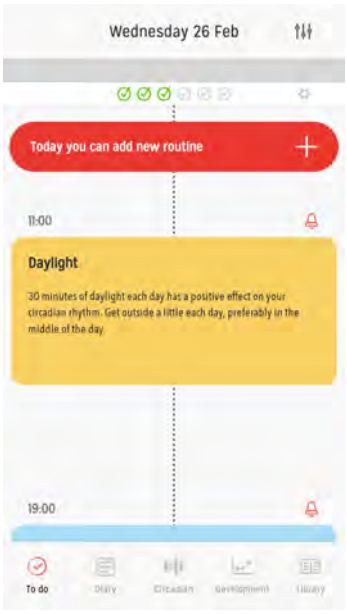

Figure 5.3: A timeline with your daily routines in the SleepCure app.

Similar apps where also looked into, such as the UK-based Sleepio program [48] and the Calm app [49]. Sleepio is based on CBT-I where a user tracks their sleep and follows a program of learning sessions. Their solution has been shown to be effective at reducing sleep problems [32]. It wasn't possible to look at the details of how Sleepio works because access to it is limited to companies that they partner with or if one applies to be a part of a research study. However their sleep situation assessment questions were available to study for inspiration. Calm is a meditation, sleep and relaxation app that creates audio content such as sleep music and nature sounds. They claim to be the leading app for sleep but the fact that it is not focused on CBT suggests that there is room for a CBT-I based app on the market.

5.2.2 Subject matter expert interview

With the help of Peter from SleepCure a meeting was arranged with Helena Wrange, a psychologist specializing in clinical psychology. She is a psychotherapist with a focus on cognitive behavioral therapy that runs her own clinic. Previously she have worked within the adult psychiatry at the hospital of Kungälv and Sophiahemmet

Rehab Center. She also works at the therapy unit at the psychology department of Gothenburg University. Working daily with CBT, Helena was considered a subject matter expert in CBT for this project. Her clients vary in the types of problems they have. Some of them only have insomnia but a lot of them are dealing with for example depression, which is often accompanied with insomnia. Therefore, she has a lot of experience in applying CBT for insomnia. Helena has also been in contact with SleepCure before regarding their app and has some knowledge of it.
The interview had to take place during her lunch break because of her busy schedule. With that in mind the interview was planned to be semi-structured with a series of questions formed beforehand to ensure that the necessary information would be obtained and the time was used efficiently. There was also room for diverting to interesting topics during the interview. Some of the most important questions were:

- What does the process of taking someone through a CBT program for insomnia look like?
- Are your clients doing what they are suppose to and do they get better?
- What makes people quit?
- What are the essential things that a sleep coach app needs to get right to be able to give value to a user with insomnia, or perhaps even replace traditional CBT?

The purpose of these questions was to gather knowledge about traditional CBT that can be applied to a digital sleep-coach. For example how the sessions are structured and why, how people respond to the treatment and what are some essential elements of insomnia treatment.
The interview went very well even though there was not enough time for getting answers to all the questions. Below is a description of the process of taking someone through a CBT program as described by Helena followed by the most important findings:

> "*You start by talking about their situation, what it looks like and what they do that affect their sleep. Do they smoke, drink, eat too much or too little? Is the bedroom environment noisy or not dark enough? Have they had sleep problems for a long time or did it arise recently? Try to find the source of the problem. There could be external triggers such as having young children that wakes up during the night in which case you need to work around that problem.*
> *The next step is to ask what they do while they are in the bed trying to sleep. Do they think a lot? What is their current coping strategy?*
> *Then they need to fill out a sleep diary to get a realistic view of what their sleeping patterns look like.*
> *At a later session when their insomnia has been established they get recommended to start sleep restriction with a warning that it will be incredibly difficult the first couple of days. The client needs to realize that it will take a lot of effort and big short-term sacrifices to get better.*
> *Generally it takes ten sessions if the client only have insomnia and the recommendation is to have one meeting per week.*"

Summary of key points:

- According to Helena's experience, everyone that does what they are supposed to do according to the program does improve their sleep. The only clients of hers who didn't get better were people who didn't follow the treatment program.
- It is very important to do a thorough assessment in the beginning to understand the client's situation and not miss any external factors that may affect their sleep.
- Helena mainly get client's with very severe insomnia. They may not be the main target group for the sleep coach app since it primarily aims to help people with moderate to severe insomnia.
- A lot of her clients know about sleep hygiene and have tried things like having a cool and dark bedroom, but few know that habits during the day such as exercise and what they eat affects their sleep.

Important things that the app needs to get right according to Helena:

- It needs to be easy to understand, not just a digitized book. Don't use too much and too academic text.
- Reminders are very important but don't be repetitive and nagging. Perhaps use random, intermittent notifications.
- Use positive language and positive reinforcement that encourages the user. Give them gold stars for their efforts and show them that they are making progress.
- The amount of data it requires the user to register should be limited, otherwise it will take too much effort.

5.2.3 Desk research

To get some understanding of how it is to live with insomnia some online research was performed. Several articles and blogs were found written by people suffering from sleep problems. For example Barbara Graham [50] said that she was reluctant to try out CBT because she felt like she should be able to conquer insomnia on her own. Lisa Congdon writes that she finds some comfort in knowing she's not alone in having sleep problems [51]. Other insights includes:

- Many do not know where their sleep problems come from and are desperate for information that can help them
- Some feel frustrated that people who do not have experience with insomnia don't understand it, belittles the problem and offer inadequate advice like "drink herbal tea" or "just drink less coffee"
- Insomnia comes and goes periodically for many
- Many experience fatigue, stress, worry and loneliness

These insights demonstrates that the user group could potentially want the intervention to empathise with them and make them feel understood.

5.2.4 User interviews

To get to know the potential users and understand insomniacs better it was decided to interview some of SleepCure's current users. The interviews were also to be used to evaluate the current version of the app to investigate some of the experienced shortcomings. Peter sent out an email to existing users and set up five phone interviews. The interviews were around 30 minutes conducted in a semi-structured way consisting of a few questions about the interviewees sleep problem and sleep situation, followed by some questions about the SleepCure app. A selection of the findings:

- Some said that they've tried the common tips for a better sleep hygiene but that they felt like the tips didn't improve their sleep enough.
- One user said she felt like the current app is not analysing her sleep situation well enough to be useful. She claimed that one of the main reasons for her sleep problems was that she had a problem with being able to stop using her phone at night, and the app never addressed that.
- Some expressed that they liked that the app is more proactive compared to other sleep apps they've tried that only measures their sleep.
- One user mentioned that she knows what she need to do to sleep better but she just doesn't do it. She felt like life would be too boring if you did everything you're supposed to do.

Furthermore, an interesting observation was that all users had very varied sleep situations, both in were they felt the problem stemmed from but also in how it was expressed. This further suggests that creating a treatment solution can be highly complex because of all the variability. After the interviews all of the findings were explored in an affinity diagram, summarized into six themes as seen in Figure 5.4.

Figure 5.4: Affinity diagram of the themes from interviews with the users.

5.3 Ideation

The ideation phase consisted of summarizing design guidelines, having a design workshop with SleepCure, sketching and creating a new user journey.

5.3.1 Extracting design guidelines from literature

The ideation process started by summarizing the literature research into applicable principles and concepts.

- Promote self-efficacy
  - Mastery experiences
  - Social models
  - Social persuasion
  - Reducing stress reactions
- Promote autonomy
  - Offer users choice where possible (e.g. of goals, tools, timing, method of implementation)
  - Offer meaningful choices
  - Control features
  - Autonomous motivation based on free-choice and interest supports more effective and lasting behavior change
- Promote competence
  - Provide clear structure and (optional) guidance
  - Provide stories modeling successfully overcoming barries
  - Goal-setting
  - Minimize conscious effort and lifestyle disruption where possible
- Promote a positive emotional experience and sense of relatedness
  - Use positive (autonomy-supportive) language
  - Warm interactions and friendly style
  - Provide opportunities to connect with others
  - Emphasis on positive and constructive feedback with unexpected rewards
  - Give rationale for advice
  - Acknowledge and address concerns
  - Reciprocate intervention usage by providing immediately rewarding feedback
  - Ensure all communications provide something interesting, enjoyable, relevant, and helpful for the user
  - Follow best practice to maximize accessibility, usability, and trust
- More things affecting engagement
  - Expectations
  - Credibility
  - Aesthetics and Design
  - Personal relevance
  - Reminders
  - Novelty

- Behavior change techniques
- Personification
- Effective features
- Optimal challenge
- Perceived sense of progression and recognition of success

Each item in the list was then reflected upon to come up with a feature or some other way to realize that principle or concept. For example regarding social models in self-efficacy the idea of providing stories of people overcoming their insomnia was written down, as seen in Figure 5.6. The next step was mapping out the user journey of the current version of the SleepCure app and explore opportunities for applying the ideas and concepts. This is displayed in Figure 5.7. Several important opportunities were found such as:

- Use warm interactions from the beginning to achieve a sense of relatedness
- Ensure and promise personal relevance early
- Show expertise and give rationale for using the sleep journal as well as socially persuade the user that they can do it by reducing the perceived effort
- Increase competence with clear guidance for how to use the sleep journal
- Have a "tip for tonight" to give users instant value for using the app
- Keep the onboarding fairly short to reduce life disruption

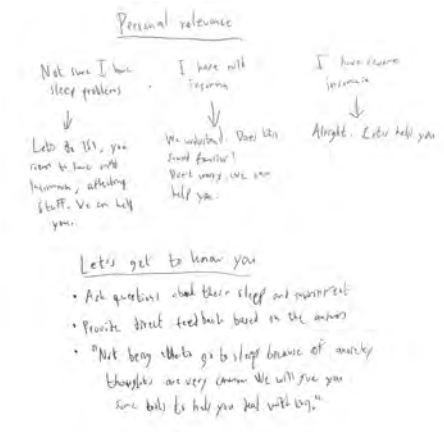

Figure 5.5: Notes from ideation on personal relevance.

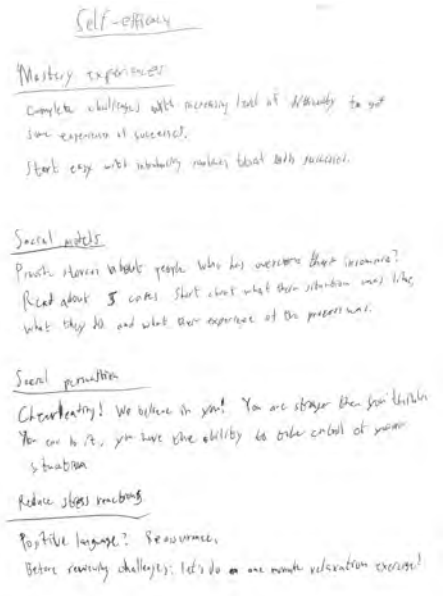

Figure 5.6: Ideas for features relating to self-efficacy.

Figure 5.7: SleepCure user journey mapped with opportunities.

5.3.2 Design workshop

A workshop was performed together with Peter and Patrik from SleepCure with the following purpose:

- Align ourselves on who the target users of SleepCure are and what we mean with a great onboarding.
- Generate ideas about how to create an engaging first week of the sleep-coaching program that keeps users motivated.

The workshop began with some theory from the literature research being presented in an attempt to establish a common understanding as well as getting some inspiration for later discussions. It was followed by a discussion on who the target users of SleepCure are. It was concluded that the target users are people who have mild to severe insomnia, are between the ages 25-55 (students in higher education or working professionals), their source of insomnia is not physiological and they are prepared to invest some time and energy to their sleep treatment. The intention is for the target group to widen in the future but for the duration of this project the aforementioned criteria will apply. During the workshop it was defined what the workshop participants believed a great onboarding in SleepCure means and what the first week of usage should contain. The following was decided:

- The onboarding should have an introduction of the app and explain how the sleep-coaching program will work.
- The onboarding is defined as from the moment when the user opens the app for the first time until they can start using it freely.
- In the first week the app should get some information about the user such as their Insomnia Severity Index score, the nature of their sleep problem and what are their goals.
- The user should understand what they can expect of the app and what is expected of them.
- The user should feel some trust for the app.
- The user should start using sleep journal during the first week.
- The app should educate about sleep and CBT.
- The app should persuade to the user to buy the coach. Show that it is worth their time and money.

Based on these results a set of "How Might We?" questions [52] was formulated to use as inspiration for sketching ideas. Sketches were created first with the Crazy 8 method [53] and then continued with free sketching, see Figure 5.9. Finally some insights and ideas from the workshop was summarized. Examples of ideas:

- Make learning sessions that are interactive with a quiz.
- Utilize challenges, in a friendly way
- Insert personal tips

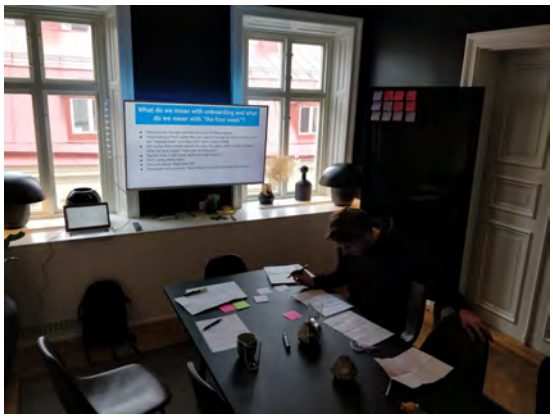

Figure 5.8: Workshop with Peter and Patrik from SleepCure.

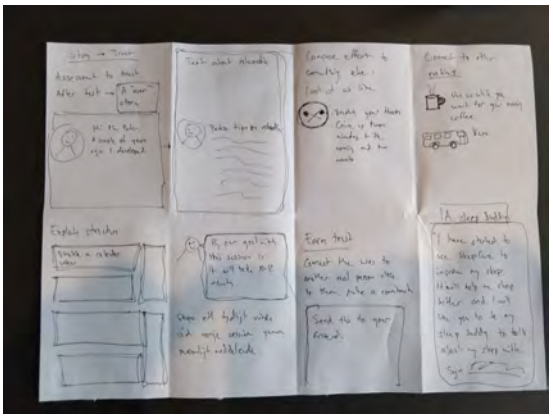

Figure 5.9: Sketches from the workshop.

5.3.3 Sketching

Based on insights and ideas from previous ideation steps some sketches of a new design for the SleepCure app was produced, see Figure 5.10. The sketching was focused on designing possible app screens for the onboarding flow and some of the main new features. They were then developed into low-fidelity digital versions in Figma, see Figure 6.7. The layout and text of the digital versions were continually assessed by viewing them on a phone in the Figma Mirror app.

Figure 5.10: Sketches of new SleepCure design.

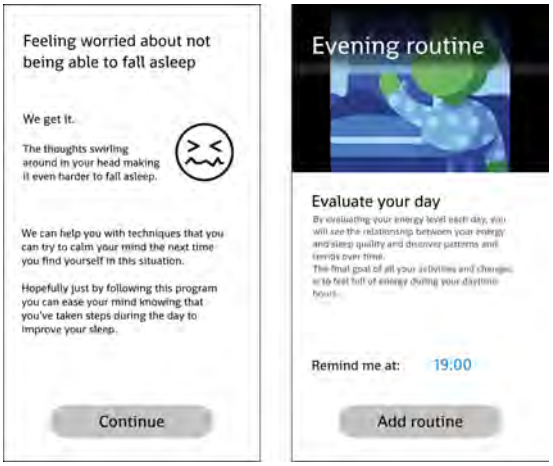

Figure 5.11: Digital low-fidelity screens.

5.3.4 User journey creation

By combining the earlier stated definition of a great onboarding and first week for SleepCure with the ideas and concepts at the time a new user journey for the first week of usage was put together. This meant thinking about what screens should come in what order in the onboarding as well as when the other features should be introduced. It resulted in a plan where each day had three times in the day that a user would receive a notification and possibly enter the app: in the morning, during the day and in the evening. The morning and evening notifications was for filling in the sleep journal and utilizing the fact that the user had opened the app to prompt them to engage further with the program. The day notification would be something different each day like a reminder about some target behavior or introducing a new feature. The first three days of the user journey that was created can be found in Appendix A.

5.4 Higher fidelity prototyping and evaluation

This section describes the process of developing a higher fidelity prototype and how it was evaluated.

5.4.1 Developing a prototype

A higher fidelity prototype was developed iteratively by creating screens based on the new user journey and the concepts, ideas and sketches and getting feedback from Peter and Michael Heron who is the academic supervisor of this thesis. Some examples of the feedback received were to include a clear overview of the sleep-coach program in the onboarding, ask users when they want to be reminded when they delay content delivery and to increase the perceived credibility of the app. To prepare for evaluation by potential users the prototype was made interactive. The prototype contained the following parts/features:

- *Onboarding:* An introduction to the app and the sleep program. Includes a set of questions about the user's sleep problem and situation. Also showing the main views of the app.
- *Morning routine*: Filling in the sleep journal with sleep times and how the sleep was.
- *Evening routine and ISI-test*: Evaluating the energy level of the day and doing the ISI-test to get a measurable score of the sleep severity that can be tracked over time.
- *Learning session*: A lesson about the basics of sleep with a quiz afterwards.
- *Challenges*: Introducing the concept of challenges and adding the first ones.
- *Morning routine with daily challenge*: Present a daily challenge after the morning routine is completed.
- *Delay learning session*: Showing the function of being able to delay prompts of completing a learning session.
- *Personal story*: A notification leading to a personal story about sleep problems.
- *Notification example*: A notification prompting the user to go outside.
- *Learning session with choice of reminders*: A shorter session about sleep hygiene with a question afterwards asking the user what habits they want help with.

Since the aim of the thesis is not to redesign the entirety of the SleepCure app it does contain some of the same features and even design as the current app. For example how the sleep journal is filled in and presented is simply screenshots from the current app in the prototype. Other elements such as learning sessions and questions about the user are more or less redesigned concepts. The program setup with modules is based on SleepCure's plans for the next version of their app. Some of the graphics is taken from heavily inspired by the videos in the SleepCure app.

5.4.2 Expert evaluation

To begin evaluating the design a meeting was arranged with an external UX-designer, Patrik Boström, who has seven years of experience working as a interaction and UX-designer. The evaluation was largely unstructured where Patrik got an explanation of the app concept, saw the prototype and discussed the implemented concepts.
His feedback:

- Generally clear screens and a good structure.
- Don't make every notification lead into an article or longer read of some sort, a user probably is more interested in getting told what to do instead of reading about it.
- Instead of telling the user how easy it is to fill in the sleep journal, show it.
- Good that the design shows that there is a long-term value in using the app. The app is not overwhelming the user and creates the feeling that there is a lot more exciting things to come.

The design was also evaluated in the same way with Mafalda Samuelsson-Gamboa, teacher and lecturer at Interaction Design, Chalmers. She stressed the importance of being extra thoughtful with the target users, considering a lack of sleep can affect people's cognitive function [54].

> *"You should be extra kind when designing for tired people. Try going through your design and imagine that you are really tired."*

To do this she suggested making the navigation clearer for example. Mafalda also said it's important to think about good default options when giving the user the choice to control something. The app could default to remind the user the next evening if they choose to delay a learning session and then make it clear that they can change it instead of asking every time when it should remind them.

The plan was that psychologist Helena Wrange would evaluate the design as well from the treatment perspective but because of Covid-19 related issues she did not have the time for it before the deadline of the project.

5.4.3 User evaluation

To evaluate how potential users would respond to the new design a set of evaluation sessions where planned and performed. Because of Covid-19 and the urge for social distancing they were planned to be performed remotely by video calls. The aim of the design evaluation was to evaluate if the feature ideas and concepts in the prototype had potential to motivate and engage users to start and stay with the behavioral change program.

Pilot test
To test the technicalities and procedure of the design evaluations a pilot test was performed. It went well and the technical solution for the video call as well as the procedure for the evaluation was kept. Therefore the feedback that was gathered from this test is included with the others.

Acquiring participants
A form was shared on social media channels to recruit people with sleep problems for design evaluations. Aside from a few practical questions the form also included the Insomnia Severity Index questions to be able to screen respondents for insomnia. The evaluation sign-up form got 18 answers and where 12 had insomnia based on their ISI score (above 10). Details for booking a design evaluation session were sent

out to 10 of the respondents with insomnia. Nine sessions were booked but two participants had to cancel because of sickness meaning that seven design evaluation sessions were performed with potential users, apart from the pilot test.

Design evaluation procedure
The evaluation started with asking the participant a couple of questions about their sleep problems to contextualize the feedback given later. Then the participant was asked to click through the interactive prototype while performing the Think-aloud protocol. The participant was informed that the prototype was divided into different parts, but not what the parts were, that was meant to be presented at different times during a first week of usage. Each design evaluation did not go through all the parts because of a lack of time. Between parts questions were asked to probe for more feedback about the feature. At the end of the design evaluation the participants were asked what they think the app could do for them to gather their final impressions.

The feedback from the design evaluations is summarized in section 6.1.

5.4.4 Result evaluation with SleepCure

The project results were presented to the three founders of SleepCure: Peter, Patrik and Martin Lindau. The results were formulated as the prototype, the results from the expert and user evaluations, promising features/themes and some comparisons with their current version of the app. In general they were happy with the results and mentioned that they wanted to incorporate some of them into the next version of SleepCure. Listed below are a few things they were especially interested in.

The onboarding
They felt this version of the onboarding had much more thought put into it. In general how the information is structured and the way it is presented. For example in empathising with sleepy users by using bigger and less text, and that the purpose of the sleep journal and how easy it is to log data with it is much clearer.

Smart reminders
Smart reminders is something they've thought a lot about, that reminders should be more personalized and customized to how and when the user wants to receive them. The project results support that in the user evaluations and from what have been gathered from literature. This means that they are even more sure that smart reminders is something they need to focus on in the next version of SleepCure. For example the ideas on how reminders can be presented to user, such as the daily challenge, is something that they will take with them in their next design iteration.

Learning sessions and challenges
SleepCure liked the concepts of learning sessions and challenges. They mentioned the way the learning sessions work in the prototype supports a more user-controlled tempo in the app. A user-controlled tempo of the intervention is something they

said they believe is important to increase engagement in the sleep program but so far one of the reason it is lacking in the SleepCure app is because of the technical complexity of implementing it.

Insights from user interview and evaluations
Peter, Patrik and Martin were also very interested in receiving more information from the user interviews and user design evaluations. They have previously not talked to many users because they've focused on talking to experts to understand what kind of solution they should build. This means that user research is very valuable information for them to understand their users better. The user research that was delivered contained no names or other details about the individuals interviewed. It consisted of summarized quotes and other notes.

6
Results

In this chapter the results from the user design evaluations and the final prototype is presented as well as promising features and themes to be considered to include in a smartphone app for behavior change intervention in insomnia to possibly increase motivation and engagement.

6.1 Final prototype and user feedback

This section includes a description of the features of the final prototype. Some features are based on the current SleepCure app, especially the sleep journal function. The prototype does not have its own name because it could be said that it is a version of the SleepCure app. See the full prototype in Appendix B.

Included with each feature is also the feedback from the design evaluations of the prototype held with potential users. After four evaluation sessions the onboarding was changed by moving the questions about the user to a separate flow that was optional. This change was done based on feedback from the first few sessions that the onboarding felt too long. The three last participants also got to see the feature *Set up notifications and engagement level* which was added based on feedback about participants different views on how much notifications they'd like.
In total there were eight participants (N = 8, M = 5, F = 3). All of them had a ISI score indicating mild or moderate insomnia (score > 10). Three participants had used the SleepCure app before. The characteristics of the participants are summed up in Table 6.1.

Number	Gender	ISI score	Used SleepCure app
1	F	12	No
2	M	14	No
3	F	13	No
4	M	15	No
5	M	11	No
6	F	12	Yes
7	M	15	Yes
8	M	14	Yes

Table 6.1: Participants characteristics in the design evaluations.

6.1.1 Onboarding

The onboarding is an introduction to the app and the sleep program. It includes a set of questions about the user's sleep problem and situation and the user is asked to set up the morning and evening routine for filling in their sleep diary. It's also showing the main views of the app which are:

- *Home*: Here a user gets messages about what to do in the program, sleep tips and a checklist of their routines.
- *Journal*: The user's sleep journal containing data inputted by the user such as sleep times and what they feel about their sleep. Taken from the SleepCure app and not a focus of this project.
- *Challenges*: See 6.1.5.
- *Learning*: See 6.1.4.
- *My journey*: A page showing the long term overview of the user's sleep journey. Taken from the SleepCure app and not a focus of this project.

Figure 6.1: A stepper with an overview of the sleep coach program.

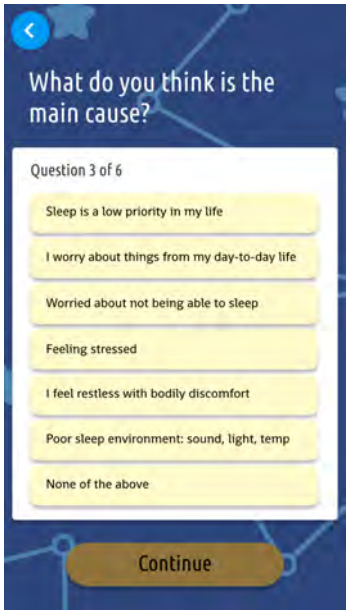

Figure 6.2: One of the questions to understand the user's sleep problem.

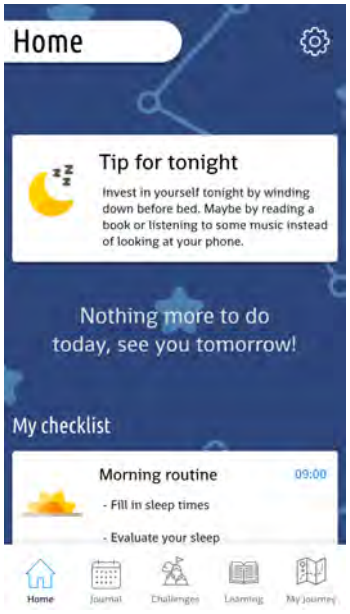

Figure 6.3: The home screen in the prototype.

The majority of the participants (5/8) mentioned that they liked the text "You're not alone. 1 in 3 adults battle insomnia at some point in their life.", saying it was reassuring and nice. They also liked the concept with weekly modules for the sleep program and the personalisation of it with participant 4 saying:

> *"It's nice that first the program goes through the basics which is the same for everyone but that it doesn't stop there, it's then personalized for what works. You get a good feeling that it is personal solution, not a one app fits all."*

Regarding the questions participant 4 thought they were very relevant while participant 2 wondered if they bring value to them as a user. 4 out of 5 participants that hadn't used SleepCure before expressed positivity regarding that the sleep journaling would only take 2 minutes each day.
All four participants that saw the longer version mentioned either that the onboarding felt long or that it was too much text to read.

6.1.2 Morning routine

The scenario in the prototype for the morning routine is that the user has received a notification to complete their new morning routine and has opened the app. The morning routine consists of filling in the sleep journal with sleep times and how the sleep was. The design for how to input the data is taken from the SleepCure app.

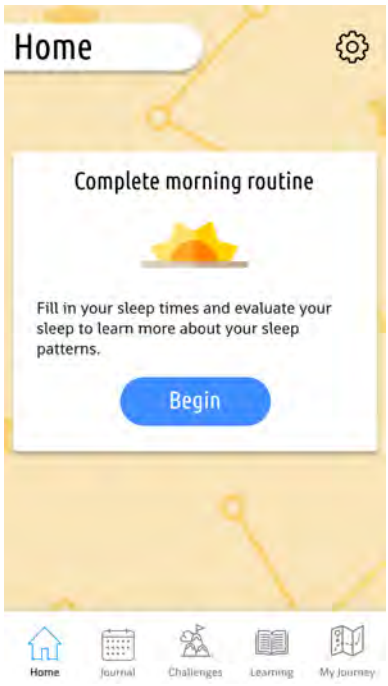

Figure 6.4: The prompt for completing the morning routine.

Figure 6.5: Filling in sleep times.

Out of the three participants (P1, P2, P3) that evaluated the morning routine participants 1 and 2 mentioned that it was quick and easy. Participant 3 said that she wished that the app could track his sleep automatically instead.

6.1.3 Evening routine and ISI-test

In this scenario the user has received a notification to complete their new evening routine and has opened the app. The evening routine is simply to evaluate how much energy you had in the day. The user is then asked to complete the Insomnia Severity Index test to get a measurable score of the sleep severity that can be tracked

over time. At the end of the test a score is presented and a projected progress.

Figure 6.6: One of the seven ISI questions.

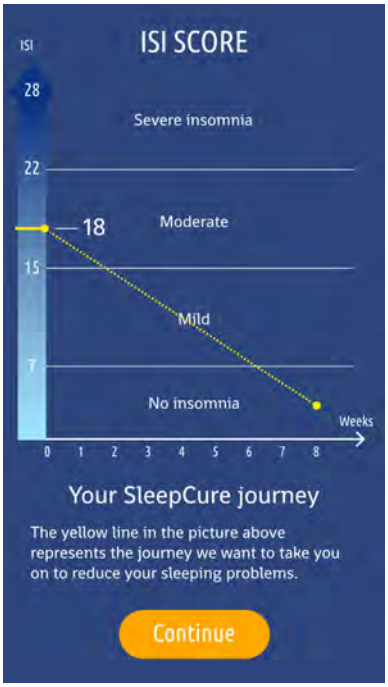

Figure 6.7: The projected sleep journey of the user.

Most participants that saw this feature (4/6) thought it was interesting to get a score of their sleep problem severity. Participant 3 said that the questions makes her reflect about their sleep. 5/6 participants also responded positively to the graph showing that their ISI-score will gradually improve if they follow the program.

6.1.4 Learning session

Learning sessions in the design prototype refers to short lessons about sleep, CBT or other relevant information. It is one of the five main views of the app. The user can see an overview of the sessions that is available and one session that will be unlocked as the user completes previous sessions. The first lesson is about the basics of sleep. Inside a session its subsections are shown in a list and the user can click on a subsection to start reading. After the session there is a quiz where the user is asked some questions about what he or she have learnt.

Participants 1, 3, 4 and 5 responded negatively to getting notifications about learning sessions during the day, saying they would not have time for it. All participants (8/8) expressed that they liked the concept of a quiz in connection with the learning session. Reasons include enjoying the competitiveness and getting feedback about what they've learned. Participants 5 and 8 said they wished it had more gamification, for example by giving you points that level up your sleep knowledge. Most (6/8) said that they wanted to learn more about sleep.

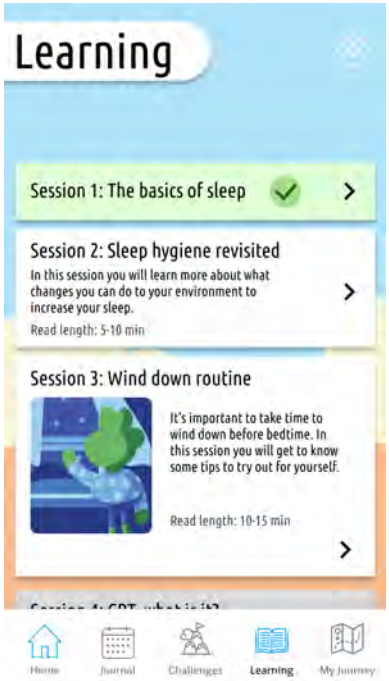

Figure 6.8: An overview of the first learning sessions.

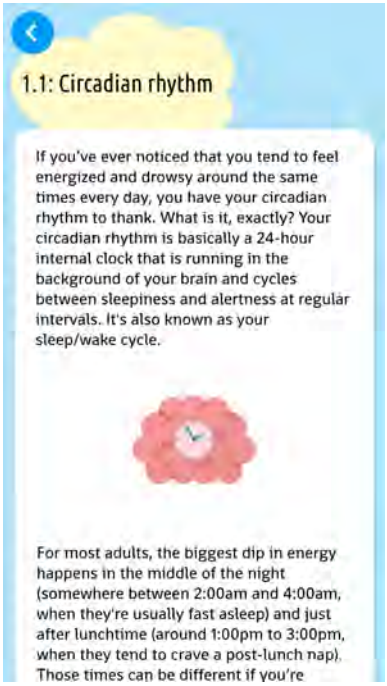

Figure 6.9: A part of the first learning session, using illustrations to break up the text.

6.1.5 Challenges

The feature of challenges means providing challenges to the user to facilitate their behavior changes. It's an effort to make the program more fun, interesting and engaging. The challenges are connected to the user's long term goals and have varying difficulty levels. For example they could revolve around helping the user achieve new sleep habits and routines in their everyday lives. In the prototype a user sets up their first challenges and sees an overview of them.

There was an interest in the concepts of challenges, especially amongst the two participants (P5 and P6) that said they were competitive. Participant 3 and said she liked that it was tied to her goals, she wants to know how well she is doing in regards them. Three participants (P4, P7, P8) suggested introducing more gamification such as points for a perfect day, counting days you've tracked your sleep and getting badges.

Figure 6.10: An overview of the challenges.

Figure 6.11: The first challenges a user is faced with.

6.1.6 Morning routine with challenge for the day

In this concept a daily challenge is presented after the morning routine is completed. The daily challenge in the prototype is to not drink coffee after lunch. An explanation is given for why the challenge is worthwhile and the user is given the opportunity to opt-in to getting a reminder during the day.

Figure 6.12: A small timely challenge.

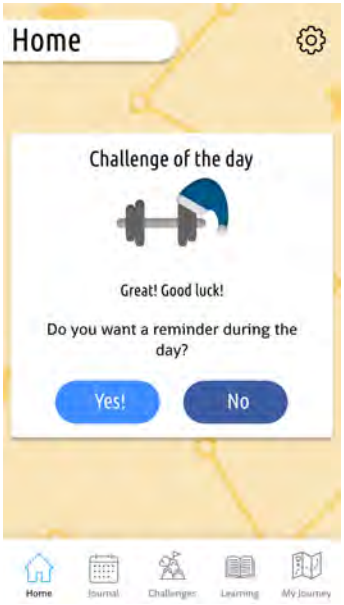

Figure 6.13: Opt-in reminder for the challenge of the day.

Participants that expressed earlier in the evaluation that they did not like notifications (P1, P3, P6) responded positively to opting in to receiving a notification to remind them about the challenge for the day they'd agreed to. 5/7 participants that saw this feature said that they would want challenges for the day, with two of them saying that they don't want it every day.

6.1.7 Delay learning session

This feature is displaying a card on the home screen asking the user if they have time with another learning session. If they press no, they are being asked when they would like to be reminded again.

The three participants (P3, P6, P8) that saw this feature said that they liked it, they thought it was good that you can control when to do the learning sessions.

6.1.8 Personal story

In the prototype this concept was a notification leading to a personal story about sleep problems and changes the storyteller suggests the reader to make to sleep better. The text is taken from an article by Mike Rice-Oxley [55].

Four participants evaluated this feature (P1, P3, P6, P7) and all of them mentioned that they felt the text was too long but that it was interesting. Participant 1 and 3 said that they thought the tips in the text were great, participant 6 said she preferred shorter tips instead of a longer story.

Figure 6.14: Offering the user a chance to delay the learning session.

Figure 6.15: A personal story.

6.1.9 Notification example

The notification example is simply a notification prompting the user to go outside that would appear during the day. The concept is that users could receive notifications about sleep hygiene or other relevant information.
Participants 3, 6 and 7 said that they were interested in notifications that reminded them about performing new habits.

6.1.10 Learning sessions with choice of reminders

This concept includes a session about sleep hygiene with a question afterwards asking the user what habits they want help with. After that the app would recommend challenges and learning sessions that is related to the choice the user made.

Two of the three participants (P7 and P8) that looked at this feature said they would personally not want reminders about the sleep hygiene topics in the prototype because they felt that they already knew all about it. Both said they thought it would be good for people with insomnia that did not have previous knowledge about good sleep hygiene. The third, participant 3, thought it was really great and said she wished she got a question about choosing reminders in the onboarding.

6.1.11 Set up notifications and engagement level

In this concept a prompt would come up after the evening routine, asking the user to set up their notifications. They are asked to set up the intensity of the program, or their engagement level, and then when they would like which notifications.
Three participants saw this feature (P6, P7, P8). Participants 6 and 7 said that they really liked to be able to choose the intensity of the sleep coach program and the amount of notifications. Participant 8 said the he thought it wasn't clear what it meant.

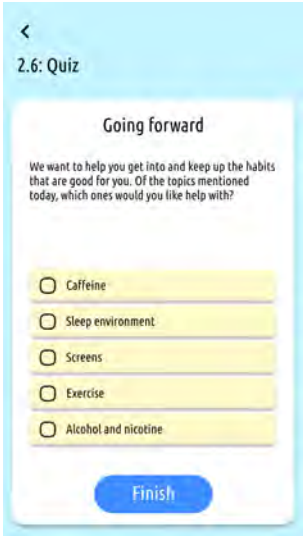

Figure 6.16: Letting the user control what they want to learn more about.

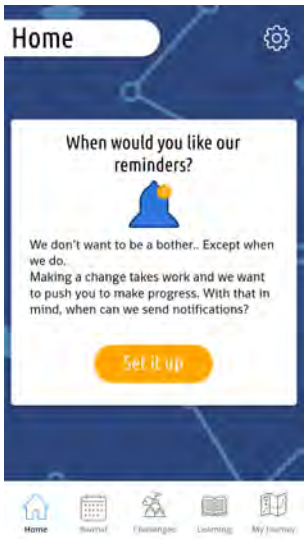

Figure 6.17: A prompt to set the notification preferences.

6.1.12 Other feedback and reported interest

Four participants (P3, P4, P6, P8) said that they usually turn off notifications on apps and expressed a general dislike for them. Participant 3 mentioned that she would turn them on for this app because they felt it was an important app. Participants 4 and 8 said they would want the notifications to be very limited.
Participant 3 had privacy concerns about the app, questioning the ownership of their sleep data.

Towards the end of each user design evaluation the participant was asked what they think an app with this design could do for them. Following are a few answers.

> *"I think I would have been more engaged with your design [compared to the current version of SleepCure]. Definitely with some challenges and checklist with what you can learn. I think it is good with functions like these to be able to stick with the logging and tracking long enough to see patterns."* (Participant 6)

> *"I think it could definitely make me change my behavior and get me to sleep more. I think it has things to teach me. In the beginning it would teach me a lot and then later be annoying, in a good way that makes me keep my own promises."* (Participant 5)

> *"Personally I would perhaps try the app but I'm skeptic to these kinds of apps. My life doesn't have much routine, I don't get along with routine. But I probably need it. I would need to see the consequences of my poor routines."* (Participant 7)

6.2 Promising features

In this section a set of features and themes will be presented that was explored in the prototype. By combining concepts and principles from theory, the research done in this project and evaluation with experts and potential users some considerations when designing for increased motivation and engagement in a DBCI for insomnia can be shown.

6.2.1 A caring onboarding

According to guiding principles of DBCI's presented in [7], an intervention should promote autonomy, competence and relatedness. It is suggested that relatedness can be promoted by using positive language and addressing concerns. Helena Wrange also said she thinks using positive language and positive reinforcement is important in a digital intervention. In the onboarding of the prototype this was applied in multiple places, for example in Figure 6.18 with the "You are not alone" message and explaining what the app can do for the user in Figure 6.19. The majority of the potential users that evaluated the prototype mentioned that they liked this text, some saying it was reassuring.
Credibility has been hypothesised to affect engagement [35] and is also a category in persuasive systems [34]. In the prototype it is used for example in Figure 6.18 and 6.1 by emphasising that the program is based on medically proven research and CBT which is the recommended treatment for insomnia. Providing clear structure to promote competence by showing an overview of the sleep coach program was also appreciated by users. Another concept that was designed for was personal relevance which seems to influence engagement in interventions [35]. By making it clear for the user what the app can do for them it could increase the sense of personal relevance to potentially increase engagement.
When designing for people with insomnia it is important that the designer empathises with the tired user, as mentioned by Mafalda. *A caring onboarding* means taking care of the user by having a clear structure and interface, using supportive language, providing the sense of personal relevance and giving rationale for advice.

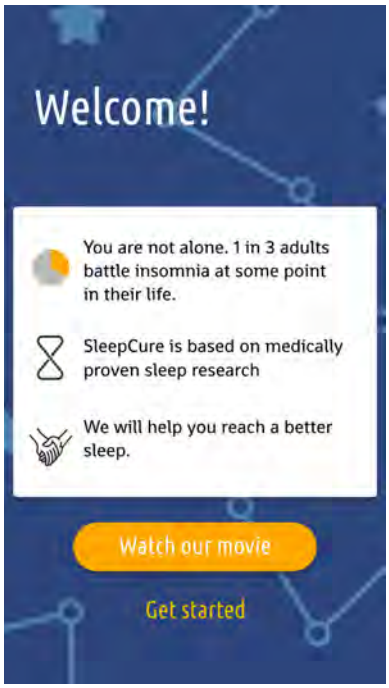

Figure 6.18: What users see when opening the app for the first time.

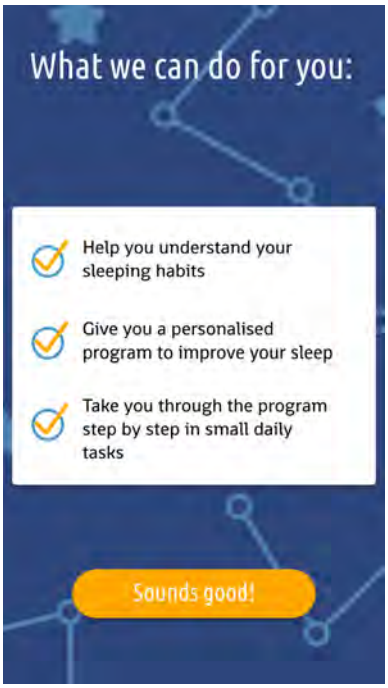

Figure 6.19: Explaining what the app can do for the user.

6.2.2 Personalisation of content and control features

The personalisation or tailoring of content as well as features that makes the user feel like they are in control of how to interact with the DBCI has been hypothesised or found to positively influence engagement [35]. Additionally offering users choice promotes autonomy. In the prototype these concepts were explored in multiple ways. In the onboarding it was explained that weekly modules of the program can be chosen based on personal relevance which was appreciated by the majority of users that evaluated the prototype. Later in the onboarding the users also answered questions about their sleep situation. The questions were prefaced by a text saying that the app asks the questions to be able to give them more relevant advice. One user mentioned that he felt that the answer alternatives hit extremely close to home, which could mean that this is a promising way to make users feel like the content will be personalised. It was tested moving the sleep situation assessment out from the onboarding to a flow reached by an optionally clickable card on the home screen, see Figure 6.20. Two of the four users that evaluated this version said they liked getting to choose if they wanted to personalise the app.
Another feature evaluating personalisation and added control was asking the users how much they wanted to be pushed by the app, essentially setting the intensity level of the intervention (Figure 6.21). This feature was really liked by users and could be a good way to introduce more control to the user. Other features include delaying learning sessions (Figure 6.14) which was liked by all users who saw it and asking after a learning session what things from the learning material that they want help with (Figure 6.16). Even though offering choices is recommended for promoting autonomy one has to be careful not to introduce decision fatigue [56].

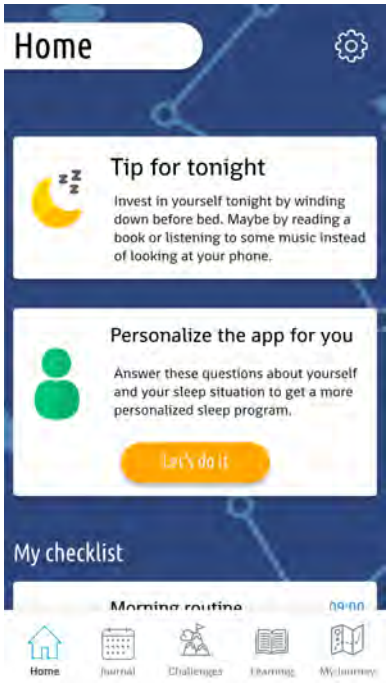

Figure 6.20: Personalising the app.

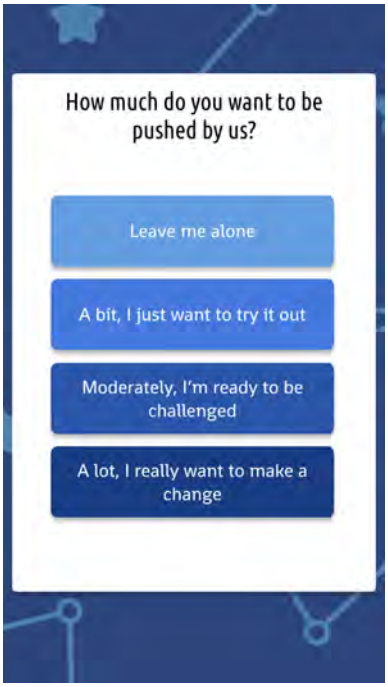

Figure 6.21: Control the intensity of the intervention.

6.2.3 Set expectations and track progress

In expectancy-value theory, motivation is regulated by the expectation that a given course of behavior will produce certain outcomes and the value of those outcomes. In a DBCI for insomnia this could be designed for by setting expectations for the outcomes of the intervention in the form of less insomnia severity. In Figure 6.22, 6.23 and 6.24 from the prototype a user is shown their current ISI score and a graph of a projected improvement over time. This has the potential to increase motivation and most participants in the design evaluation of the prototype expressed an interest in this feature. In the prototype the feature is also backed with supportive language that can increase self-efficacy as well as a sense of relatedness. The ISI value can also be used with goal-setting, an important behavioral change technique, to help users track their progress and set goals for the outcome of the program.

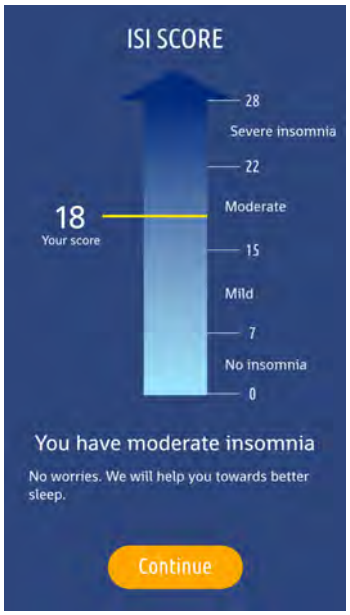

Figure 6.22: Show information clearly.

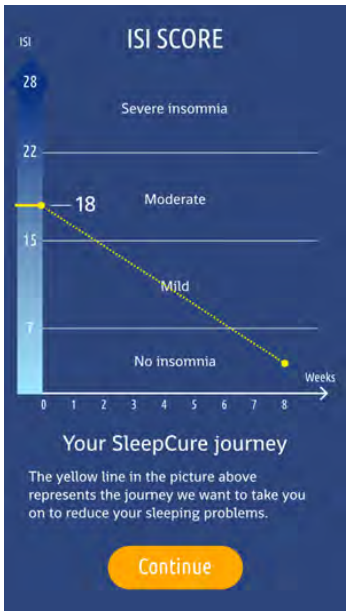

Figure 6.23: Set expectations.

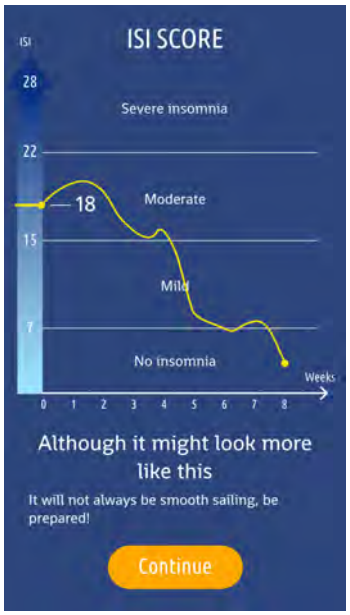

Figure 6.24: Supportive and understanding.

6.2.4 Learning sessions

Helena Wrange said that one of the first things you do with a client starting CBT is talking about how sleep works. There are a lot of things to learn about circadian rhythm, sleep hygiene etc. It is clear that a CBT-based DBCI for insomnia needs a feature that teaches the user. *Learning sessions* teaches users which promotes competence and autonomy in their behavior change. It follows the principle of giving rationale for advice and can give a perceived sense of progress. Small sessions makes it easier for the user to digest and have time for it (Figure 6.25 and 6.9), increasing ability according to Fogg's model. Quizzes can be used to make the learning more interactive (Figure 6.26), interactivity has found to positively influence engagement according to [35].
When shown the prototype users generally liked learning sessions and some said they wanted to learn more about sleep. Two users expressed that a quiz makes learning more interesting and can put some pressure on you to actually learn something, further mentioning that failing on questions can make you want to go back and get a perfect score.
Recognizing a user's progress is also something Helena mentioned is important to include. In the prototype this was showcased by green check-marks, see Figure 6.8, but it could be explored in many other ways.

Figure 6.25: Dividing learning sessions into manageable sections.

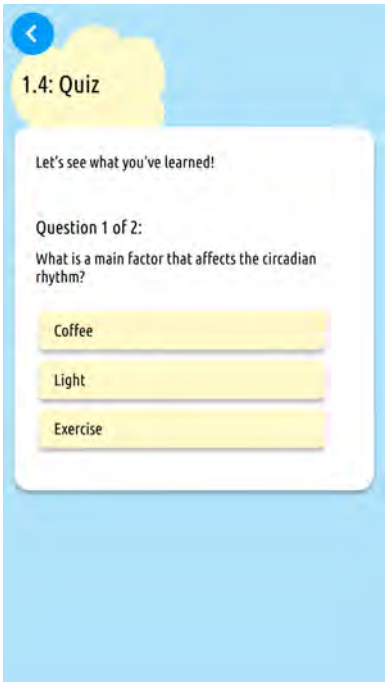

Figure 6.26: A quiz to add interactivity to the learning.

6.2.5 Challenges

One of the themes from the user research was that they wished to be pushed to change by the app. Some users knew what to do but weren't motivated to do it. One user said her life would be boring if she had to do "everything right" and another one mentioned he wasn't sure the behavioral changes would have enough of an effect to be worth it. In an effort to design for this *Challenges* was added to the prototype. Challenges are also a way to introduce the behavior change technique of goal-setting [27], increase the novelty that is hypothesised to affect engagement [35] and give users a sense of progress. In the initial user interviews and the user evaluations of the high-fidelity prototype two of the users said that they were competitive persons and liked this way of changing a behavior. They recognized it from exercising and dieting apps that they'd used. It is not clear whether this feature would actually be effective but it shows potential. When introducing the challenges the user is reminded about the goals they set earlier, as seen in Figure 6.27. By connecting the challenges, also a kind of behavior-oriented goals, to the larger outcome-oriented goals it makes it more clear to the user why they should perform them. The first challenges are easy, see Figure 6.28, using the elements of simplicity from Fogg to increase the likelihood of the user performing the desired behavior. Finally the challenges can be used as an opportunity to add a relevant reminder that can increase engagement, and help the user create a helpful new habit. A large body of evidence shows that explicit, challenging goals enhance and sustain motivation according to [17]. Goals help people give direction to their behavior and can create incentives to persist in their efforts. This was also mentioned by three of the users in the evaluations, saying that challenges and goals is what helps you go forward and is good for tracking your progress.

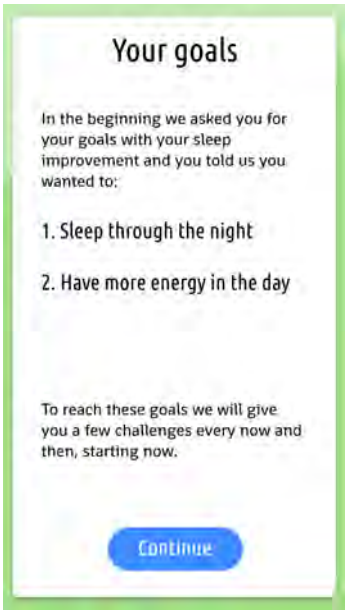

Figure 6.27: Connecting to the user's goals.

Figure 6.28: Start with easy challenges.

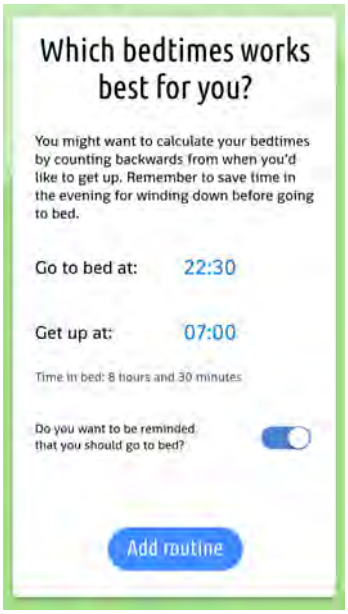

Figure 6.29: Help users create helpful habits.

6.2.6 Smart reminders

According to [35], results from a meta-analysis indicate a positive effect of reminders on engagement. They can act as triggers according to Fogg's model to make users perform behaviors to form new helpful habits. Helena Wrange also mentioned that she thinks reminders is a very important feature in an app-based CBT-I. She did warn about not being repetitive and nagging with reminders and [35] mentions having too many reminders may negatively affect engagement. One of the SleepCure users that were interviewed complained that the app had too many reminders and during the user design evaluations multiple participants said they had a big dislike for notifications. This indicates that it is essential to have *smart reminders* in a DBCI for insomnia. In the prototype this was explored in multiple way. Figure 6.17 shows a prompt for users to setup when they would like reminders where it explains that they are important for the intervention, giving rationale for the advice. Letting users decide when they like the reminders could make them smarter. Opting in to reminders right after committing to a daily challenge as shown in Figure 6.13 was liked by users in the design evaluations. This indicates that making the reminders relevant and increase user control has the potential to make notifications smarter.

6.2.7 Personal stories

Self-determination theory states that one way to promote competence is by providing stories modeling successfully overcoming barriers [25]. Additionally, one way to promote self-efficacy is by providing social models of people similar to you performing the target behavior [17]. *Personal stories* is something that users could relate to and might make them feel stronger motivation to perform their own behavior changes. See Figure 6.15.
When evaluated with potential users the feedback indicated that they were interested in the feature and liked the message but it was also a bit long to read. Personal stories is certainly a promising feature and social models could be explored further, perhaps by experimenting with the length and the timing of when to deliver it to the user.

7
Discussion

In this chapter the design process and results will be discussed as well as some thoughts on future work.

7.1 Process discussion

Quite a lot of time was spent on literature research in the beginning of the project which I believe was necessary given that the research question for this thesis revolved around applying principles and concepts from the literature. Gathering knowledge about the domain of sleep, insomnia and cognitive behavioral therapy as well as about the psychology behind motivation and engagement was essential to be able to design for the intended application. Interviewing Helena Wrange to get some first-hand information about cognitive behavioral therapy brought some highly valuable insights to the project but also left a lot of questions unanswered because the interview time ran out. There was potential to learn much more from her regarding implementing tools from traditional treatment such as goal-setting, cognitive restructuring and sleep situation assessment. The project would have benefited from an additional interview with her. It would also have been good to speak to other equivalent experts to get a wider range of perspectives.

The user interviews went well. The interviewees were very open about their sleep problems and most were easy to talk to. They contributed with a lot of information but because the sleep situations of people can be so varied it would have been valuable to talk to more people with insomnia to gain a greater understanding. Interviewing more people could result in creating personas with different kinds of problems and situations to design for. Although that work could probably be a thesis project in itself.
During the research phase there was also a plan to speak with someone from the e-psychiatry unit at Sahlgrenska who had experience with developing a DBCI for insomnia. Unfortunately the person in question was unavailable for the entirety of the project duration for various reasons. This person could probably supply some knowledge that would be useful for the project.

The design workshop with SleepCure was successful, it was very interesting to involve them in the design process. Discussing with Peter and Patrik had the effect of both reassuring me that I seemed to be going in the right direction as well as contributing a lot of new ideas. I think it would have been beneficial to have at least one

more workshop with them during the project focusing even more on developing ideas.

I believe that the sketching and user journey creation part of the ideation phase was too short. With the transition to higher fidelity designs in Figma the development of ideas slowed down significantly. The transition came quickly because I made the judgement that more concrete design suggestions needed to be developed to take the project further but it came with the cost of limiting the divergence of concept creation. It was also affected by the lack of evaluation with potential users in this phase of the project. There was a plan to talk with some people from the insomnia therapy group at Carlanderska but the Covid-19 pandemic introduced uncertainties that halted communications. The same thing happened to promising leads to find users via health centers and a sleep seminar. Instead only one iteration of user design evaluations was performed. To try to make up for it, changes were made between design evaluation and new features were tested with the last participants. Even so, the efforts did not make up for a lost iteration.

Regarding evaluation there was a plan to make use of the TENS-questionnaires [8] to gather data about the user experience of autonomy, competence and relatedness. In the end it was decided that they would not be useful for the project since the questionnaires either focus on usability or make more sense if a user has used the technology for some time. This was deemed not relevant to the project because the result and evaluation focused more on features and concepts rather than interface usability. Additionally the prototype did not allow a user to use it for a longer period of time to for the TENS-life questionnaire to be relevant.

7.2 Result discussion

The results from the user design evaluations should only be regarded as insights that can be indicative of what the target users thinks. The participants did all have insomnia according to the ISI test and were in the same age group as the earlier defined target user group but their engagement might not be the same as an average user. Most of them signed up for the evaluation via a social media post from Peter which could mean that they either have a personal connection to Peter or have an interest in his company. Furthermore, signing up for a design evaluation might define them as early-adopters, people who like to adopt new technologies early. Another limitation of the evaluation input was that much of the feedback came from users guessing if they would like those features in the future which might not translate to what they actually want. Nonetheless their input was very valuable for the project.

It seems like some of the guiding principles and concepts from literature are relatively easy to practically implement while others are harder. Positive language, facilitating learning, and tracking and showing progress is potentially easier. These concepts has been implemented many times before in different types of apps like exercising apps and online learning tools. It appears harder to implement things like personalisation, smart reminders and social models. I think this is because these features are more complex, both logically and to technically implement. Person-

alisation for example probably requires a lot more content to be produced for the program so users can choose, instead of everyone getting the same thing. To build smart reminders one might need lots of user data to build heuristics or ask the user about a lot of preferences which makes the app more complicated to use.

A slightly surprising finding was that there was a bigger resistance to notifications than I would have thought. It changed the design to be more careful with what notifications it uses. Early ideas surrounded around having a daily notification that would introduce features and prompt longer reading in an attempt to increase engagement with the program. Instead, the strategy changed to utilize the contacts points in the morning and evening when the user fills in their sleep journal. By offering the user a choice to engage with the app further it could promote a more autonomous motivation.

Some findings from the study and recommendations for features might be generalized for other types of digital interventions. Smart reminders and daily challenges could potentially be applicable in interventions to quit smoking or drinking for example. I think personal stories would probably be useful in many different interventions where people feel alone and need some support and social models.

Regarding the common pitfalls when using behaviour theories in HCI mentioned in the Theory chapter this project might have fallen for number two and three. Ideating and building features around concepts and guidelines from literature could be seen as treating design guidelines as requirements. All of the three constructs autonomy, competence and relatedness from self-determination theory was used but perhaps not equally which may have resulted in losing the potency of the full framework as stated by [26].

7.3 Ethical considerations

As mentioned in the Introduction chapter designing a digital behavior change intervention comes with a lot of ethical considerations. If the design manages to gain trust from the user it will have a big responsibility that the information it provides is correct and that the behavioral changes it recommends are safe. The intervention can have substantial consequences for a user and therefore it needs to be designed with great care. For example the learning sessions needs to be based on credible sources and carefully written to not misrepresent the facts and recommendations. Challenges is another feature that could do serious damage if it isn't implemented with care, like if the app challenges a school bus driver to start sleep restriction which causes the user to fall asleep at the wheel. When discussing risks of behavioral methods in insomnia treatments in [16] the authors mentions that clinicians should be aware of the risk that sleep restriction can affect someone's driving abilities and Sleepio also addresses it on their website [57]. It is indeed a risk that an app like this needs to consider.

The risk of inducing orthosomnia as mentioned in the introduction, section 1.3, was

not investigated in this project. However it should still be considered a risk for future work within this domain.
Additionally sleep related data can be sensitive. It is important that the data management surrounding an app like this follows local regulations and that the user is informed about how it is treated. Preferably a digital tool should not store data that can be considered sensitive.
Finally it should be noted that the information in the design in this project is not medically or psychologically guaranteed.

7.4 Future work

To evaluate if these promising features engages and motivates users a more functional prototype needs to developed and it's effects investigated for a longer time. With a functional prototype users could be interviewed or be asked to fill in questionnaires both before and after a week of usage. It would also be interesting to investigate if these features increase long-term motivation and engagement, perhaps in a study with a control group.

If the suggested features were to be implemented there is a lot more than can be learned from Helena Wrange or other experts in CBT. For example implementing tools from traditional treatment such as goal-setting, cognitive restructuring, sleep restriction and sleep situation assessment.

8

Conclusion

The purpose of this master's thesis was to apply concepts and theories from literature regarding motivation and engagement in digital behavior change interventions to an app for insomnia and investigate factors that play into the practical design of elements that support them. It aimed to answer the following research question:

> *What should be considered when designing for motivation and engagement in a smartphone app for behavioral change intervention in insomnia?*

To answer this a design process was conducted with four main phases: research, ideation, prototyping and evaluation. In the research phase both a psychologist specializing in cognitive behavioral therapy and multiple people with insomnia were interviewed to understand the problem area better. An interactive prototype was developed that was evaluated with design experts and people with insomnia.
The result was some promising features and themes that should be considered to include in a smartphone app for behavior change intervention in insomnia to possibly increase motivation and engagement. These are:

- **A caring onboarding**: Take care of the user by having a clear structure and interface, using supportive language, providing the sense of personal relevance and giving rationale for advice.
- **Personalisation of content and control features**: Increase motivation and engagement by allowing users to tailor the content and control the delivery of the intervention program.
- **Set expectations and track progress**: Use measurable targets to track the progress and set expectations for the outcomes of the intervention.
- **Learning sessions**: Teach users about insomnia in an interactive and user-controlled way to help users understand and control their sleep improvement.
- **Challenges**: Utilize challenges connected to users' long-term goals to push users to perform the necessary behavioral changes.
- **Smart reminders**: Use relevant, timely reminders to increase engagement. Show the value of the reminders and make users opt-in to promote autonomy.
- **Personal stories**: Promote self-efficacy and competence by providing social models.

These features and themes show potential for increasing motivation and engagement with users but further development and evaluation is needed. More certainty could be acquired with a functional prototype that can be used for a longer period of time.

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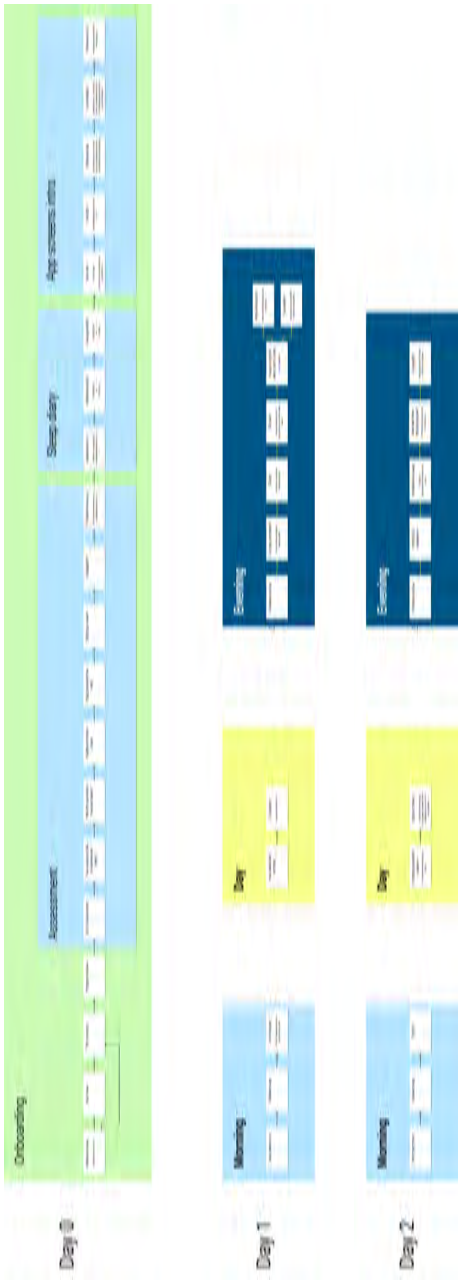
A

User journey from ideation



B

High-fidelity prototype

Link to the high-fidelity prototype created in Figma:

https://www.figma.com/file/kg6eAJMw07fnCo7uMJyvsL/Master-s-thesis-project-Insomnia-app?node-id=886%3A13