The benefits of power up the phone while wiring down the mind

Decreasing sleep onset latency through smartphone interaction

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Abstract

To be able to sleep is vital for our existence. During the process of falling asleep, many people are struggling and as an outcome, various mental health problems and sleep disorders are occurring among them. Previous studies are blaming the spreading health problems on the smartphone users for bringing their phone into their bedroom. Simultaneously, studies are showing that nocturnal smartphone usage is extremely common, with a huge spike in use during nighttime. Also, findings in studies with a different area of focus are showing that people suffering from sleep difficulties and insomnia benefits from visual stimulation and focused attention during sleep onset. This study aims to find beneficial smartphone interactions for people who are currently experiencing sleep problems. By gathering information from literature and previous studies done in the fields of insomnia, mental health problems, smartphone usage, human-computer interaction and sleep in general, the theoretical foundation of this study is laid out. To verify the previous findings and find out more about nocturnal smartphone usage, interviews and exercises with both subjective good and bad sleepers are performed. Ideas are generated and extracted through a workshop together with the collaboration partners. Visualization of the possible solution is made as a hi-fi prototype, which is later tested upon the target group of bad sleepers for three nights. In combination, the solution concept is tested together with a secondary concept through the Wizard of Oz method. The evaluation of the concepts is collected as an online form through their smartphones and the feedback from the participants is leading to a final design suggestion. This study is presenting solutions for designing for nocturnal usage, which through this study has been proven decreasing the subjective sleep onset latency among the users and in the long run will improve the user’s digital well being.
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1 Introduction

The solar cycle of light and dark provides the essential basis for all life on Earth. The rise and setting of the sun is the most reliable, repeating signal in our environment and its rhythm affects the circadian system of every living specie on our planet, including humans [1]. The circadian system helps navigate through wakefulness and sleep, telling the body and mind when it is time for each action. To sleep is a vital task, since scientists have found that inability to initiate sleep for a longer period of time can be lethal [2]. To be able to function at an optimal level, the recommended hours of sleep each night for an adult is eight hours [3]. Routinely sleeping less than six or seven hours a night demolishes the immune system, increases the risk of cancer and is a key factor of develop Alzheimer’s disease later on in life [2]. Even though these facts have been presented in various studies, sleep difficulties and depression are increasing among the population. According to the report by The National Board of Health and Welfare, the amount of females diagnosed with various mental health problems and sleep disorders has increased by 71% in Sweden from 2010 to 2015 [4]. The main reason behind sleep disruption is not yet confirmed, but the more common attitude towards sleep as an illness that needs a cure by modernity’s like caffeine or pills is discussed to be one of them [1]. Simultaneous, even symptoms of insomnia, which is a chronic sleep disorder, are increasingly being identified. Among 16-23% of young adults the insomnia diagnosis is present and for around a tenth of people these symptoms starts between age 21 to 30 [5].

During the awaken hours of the day, the world is becoming increasingly interconnected. To own a smartphone has during the last couple of years almost become a necessity to act and function in the society. A huge amount of all the communication and various errands, both economically and socially, are handled via the Internet. In Sweden (2017), 96% of the citizens in the ages 16 to 35 use their smartphone daily [6]. According to Jacob Poushter and Rhonda Stewart, technology adoption remains one of the defining factors in human progress [7]. The interconnected society opens up to an artificial rhythm with the possibility to perform with equal efficiency throughout the 24 hours of a day. Even when it is time to sleep a majority of smartphone owners bring their device into bed. In the summary of findings by the National Sleep Foundation (2011) presented that almost four in ten Americans are using their phones while in bed trying to fall asleep and 97% of the participants reported performing activities on various electronic media in the hour before bed [3]. Since getting a good night’s sleep of eight hours is crucial for the human brain’s ability to function, sleep has become a necessity to examine and study for the future health of our specie. This year a silver lining appeared. Both Google and Apple revealed the release of their new concepts of Digital Wellbeing [8][9]. The similar features involves tools that aims to help people get a better understanding of their tech usage and create healthy habits [8][9]. The new concepts is a positive step towards an increased willingness among smartphone users to think and learn more about their own health.
1 INTRODUCTION

1.1 Problem statement

In an era of expanding internet access and increasing amount of daily users world wide, the human-computer interaction do not seem to decrease in the years ahead. All previous studies found in the field of sleep difficulties and electronic media usage has concluded that smartphones should not be used in conjunction with the process of falling asleep. But looking at the statistics about smartphone usage world wide, people are using their phones before and during the procedure of initiating sleep [3][10][11]. The current stated behaviour of nocturnal electronic media use would be difficult to change or remove completely, and should instead be handled with a different approach. The wide spread decimation of sleep throughout industrialized nations is having a catastrophic impact on our health, and this epidemic needs to be handled immediately. Important to note is whether the lower quality of sleep is a result from longer average screen time or if it is the other way around is not yet confirmed [12]. Studies shows that adolescent’s use of electronic media does have a negative impact on their sleep but the precise effects and mechanisms remain unclear [13]. There exists many great benefits from using a smartphone by looking at its functionality and available interactions. This thesis will examine the smartphone as an aid for people with different sleep problems, rather than solely a gadget that is exclusively destroying the users ability to fall asleep.

1.2 Objective

Instead of trying to force people to stop using their phones during pre-sleep onset, this thesis will examine the possibility to help users that are experiencing difficulties initiating sleep by integrate a solution within their existing habitual behaviour. The target group for this study is people aged 18 to 30, who are currently using their smartphones in bed and are experiencing difficulties initiating sleep. Hence, this thesis will investigate a collection of previous studies done in the field of nocturnal phone usage and the physiology behind sleeping, as well as executing user tests and interviews through proven methodologies. The aim of the thesis is to answer the research questions:

1. What kind of nocturnal smartphone interactions are beneficial for initiating sleep and retain a healthy sleep schedule?

2. How to design an interface that can be naturally integrated into the target group’s existing nocturnal behaviour by simultaneously providing the beneficial interactions?

3. Is the target group experiencing a subjective decreased sleep onset latency through usage of the design proposal?

This thesis will use the methods for a Service Design approach [14], due to the user-centered research and holistic viewpoint for solving sleep problems through smartphone interaction.

1.3 Limitations

The time frame for this thesis is 20 weeks. The research limitations for this thesis is the absence of previous studies done in the field of beneficial nocturnal
smartphone usage. The final design proposal will be created as a high fidelity prototype with interactive elements. Due to the time limit, the user tests of the prototype will occur during a restricted time frame and the final proposal will not be implemented as a running application.

1.4 Daresay

This thesis is executed in collaboration with Daresay, an Umeå based company in Sweden founded in 2008 [15]. Daresay is developing digital strategies for organizations in need of an innovative, game-changing service or product. Daresay always have the human interests in mind and by assessing the organization’s capabilities, the needs of the customers and the extended eco-system within which the company operates they are able to achieve successful results. Daresay has developed a lot of award-winning products and in 2017 their work with Länsförsäkringar was honoured with a Red Dot in the Red Dot Award: Communication Design 2017 [15].
2 Theoretical Framework

We sleep for around a third of our lives, yet many people have little idea why. At the same time, there exist numerous studies done in the field one could read to get a deeper understanding. This study will go through some of the most relevant research done according to various aspects of sleep. In the vast field, expanding from medical sleep disorders like insomnia to subjective difficulties initiating sleep, this study takes the approach towards young adults and the existing culture of nocturnal smartphone usage. By looking into the human-smartphone interaction with regards to the exchange between the screen and the brain, possibilities for a continued media usage during pre-sleep onset will be investigated through both biological and philosophical approaches.

2.1 The physiology behind sleeping

The sleep itself is a complex state were alternating patterns of neurological activity can be seen, classified into sleep stages of rapid eye movement (REM) and non-REM [1][2][16]. When falling asleep the person will slowly pass through one to four stages of non-REM sleep, then ascend rapidly into REM sleep [1][17]. The REM sleep stage has been studied and appears to be the stage where most of the dreaming occurs [1][16][17]. New technology such as magnetic resonance imaging (MRI) has enabled researchers to scan the sleeping brain with higher precision, to look more closely at what is going on inside. The brain waves during REM sleep is very similar to an awake brain, indicating a sharp increase in activity compared to deeper non-REM sleep where the brain waves are much slower [2]. Also during REM sleep, a spike in activity in the deep emotional centers of the brain occurs. These emotional regions of the brain are up to 30% more active in REM sleep compared to the awake state, packing dreams with palpable emotions [2]. Studies have shown that students with increased REM sleep followed by an intense learning period performed significantly better on examinations, compared to students with less REM sleep [2][16]. The REM sleep has also shown to be extremely important for the human development, since it increases our ability to recognize and navigate through socioemotional signals, such as facial expressions, body gestures and group behaviour [2]. Related, the REM sleep facilitating accurate recognition and comprehension allows us to make more intelligent decisions and actions as a consequence, our ability to regulate our emotions each day [2]. According to the neuroscientist Matthew Walker (2017), the enhanced ability to regulate our emotions from sufficient REM-sleep is one of the most valuable commodities ensuring the survival and dominance of our species as a collective [2].

During the non-REM stage the brain waves appears slower and molecular gates opens, a stage that according to Sejnowski and Alain (2000) is when the brain recalls and stores information [17]. A strong and unambiguous associations between sleep and memory consolidation can be stated through various studies [1][17][18]. During one night a person goes through the cycle of sleep stages several times and usually wakes up naturally from the REM stage of sleep unless disturbed [1], see figure 1. To align the biological time to the environmental time, humans circadian system uses a dusk-dawn transition to anticipate the demands of the 24-hour day.
2 THEORETICAL FRAMEWORK

Figure 1: Sleep stages and cycles [19].

The circadian system makes sure that our behaviour and physiology is in synchronization by decreasing blood pressure and body temperature in anticipation of sleep [1][2]. This is an intuitive process that helps the body and mind prepare to go to sleep, the longer time an individual has been awake the stronger the urge to go to sleep becomes [1][2]. To help the circadian system, melatonin is released at night to make the process of falling asleep easier, see figure 2. The level of released melatonin also uses the dusk-dawn transition, being activated by darkness and acutely inhibited by light [1][20]. A study made by Arendt and Skene (2005) showed an increased need to sleep by giving melatonin in drug form to participants, and stated that melatonin could be used as a chronobiotic [20]. This suggests that the rising phase of melatonin release and the falling phase of core body temperature is essential in individuals to be able to fall asleep.

Figure 2: The cycle of melatonin, Matthew Walker (2017) [2].

In a previous study by Strogatz et al. (1987) the circadian rhythm of body
temperature was examined [21]. They report that the circadian pacemaker modu-
lates our desire and ability to initiate sleep at various times of day. Strogatz et al. reveals findings of two consistent zones of the circadian cycle in which
sleep rarely begins spontaneously, and these zones occur around 8 hours be-
fore and around 5 hours after the body temperature minimum [21]. In other
words, the subjects all avoided bedtime at those phases in the circadian cycle.
Sleep episodes that had begun prior to the zones however were able to continue
through the zones. Hence, they state that there exists wake-maintenance zones
in our circadian cycle. The subjects who was already awake tended to maintain
their wakefulness through the zones. For the college students participating in
the study, a morning wake-maintenance zone was centered near noon and an
evening zone was centered around 10:30-11:00pm [21]. Hence, the distribution
of sleep onset was selected at different phases of the body temperature cycle.

Studies has also shown that a delay in the circadian rhythm occurs during
adolescent and early adulthood, a change that is common across all adolescents,
irrespective of culture or geography. During puberty, the timing of rising mel-
atonin and the instruction of darkness and sleep is shifted progressively forward
[2]. Teenagers’ wakefulness peaks around nine p.m. and it takes many more
hours before the circadian rhythm of a teenage brain begins to shut down alert-
ness and allow for sleep to begin [2]. When entering adulthood, the circadian
rhythm shifts back to an earlier sleep phase again [2]. The late night wake-
fulness among teenagers might lead to a frustration among all parties, with
parents getting annoyed in the morning when the teen is too tired to get up.
The teenager on the other hand, having only been capable of initiating sleep
very late might still be in the circadian downswing, feeling tired and not well
rested [2]. Among college and university students, the late shifted circadian
rhythm might still be present, another possible reason why students has been
recognized as particularly group of population affected by sleep difficulties [16].
During adolescent, the brain also gets a last round of refinement after child-
hood. The brain starts to get individualized based on the personalized use of
the owner and a downscaling of connectivity occurs to refine the brains capac-
ity. The operation of downscaling takes place during non-REM sleep in the
adolescent brain, a crucial sleep stage for a teenager. As deep non-REM sleep
performs its final overhaul and refinement of the brain, cognitive skills, reason-
ing and critical thinking improves to prepare the individual for adulthood [2].
Many of the major psychiatric disorders, such as bipolar disorder, major de-
pression and ADHD are through studies now considered disorders of abnormal
development, stating the importance of deep non-REM sleep in teenagers [2].

2.1.1 What is insomnia

According to the International Classification of Sleep Disorders (ICSD-3) the
criteria for chronic insomnia disorder includes a report of sleep initiation or
maintenance problems, adequate opportunity and circumstances to sleep, and
daytime consequences [22]. The ICSD-3 duration criterion for chronic insomnia
disorder is three months and a frequency criterion at least three times per week
[22]. In the Diagnostic and Statistical Manual of Mental Disorders (DSM-5),
insomnia disorder is specified by a variety of criterion [23]. Insomnia may occur
as an independent condition or together with another mental disorder, condition
or sleep disorder. The essential feature of insomnia disorder specified in DSM-5
is dissatisfaction with sleep quality or quantity with complains of difficulties initiating or maintaining sleep. The dissatisfaction with sleep is accompanied by clinical significant impairment or distress in social, occupational or other important areas of functioning [23]. Insomnia can manifest itself in various ways. 

Sleep-onset insomnia involves difficulty initiating sleep. Sleep maintenance insomnia involves frequently or prolonged awakenings throughout the night. Late insomnia involves early-wakening in the morning with an inability to fall back asleep. A combination of all three types is the most common presentation of insomnia disorder [23]. The sleep difficulties should also occur at least 3 nights per week and be present for at least 3 months. Important to note is that if these symptoms are presenting themselves as a result from drug abuse or medication, it is not classified as insomnia according to the DSM-5 [23].

The prevalence of insomnia can be viewed as insomnia symptoms with or without daytime consequences, dissatisfaction with sleep quality or quantity or as insomnia diagnoses [24]. According to several studies, women are more likely than men to report these kinds of prevalence [25][26][27][28]. Recent reports have shown that insomnia is almost twice as common in women than men, and approximately one out of nine people suffers from chronic insomnia, which translates to more than 40 million Americans [2]. From a study by Leger et al. (1999), 12 778 persons participated in a survey about prevalence of insomnia. Their collected results showed a majority (73%) of the participants indicated the presence of a nocturnal sleep problem during the preceding month [26]. Among these results, 29% had a sleep problem at least three nights per week and 57% complained about difficulties initiating sleep [26]. In a survey by Olson (1996), 20% of the male subjects with sleep difficulty and 29% of the women with sleep difficulty reported having taken prescription medication to help them sleep [25]. The results of a survey by Maurice M. Ohayon (2002) clearly shows that dissatisfaction with sleep with quantity or quality, insomnia symptoms and diagnoses are common in the general population [24]. Unfortunately, genetics plays a role with an estimated 28 to 45 percent transmission rate of insomnia from parent to child [2]. However, this still leaves the majority of insomniac being associated with non-genetic causes, the two most common triggers being psychological like emotional concerns or distress [2].

2.2 Students’ sleep and health effects

According to Foster and Wulff (2005), the society we live in today has little regard for sleep [1]. They state that since the introduction of artificial lighting and the re-structuring of working hours, people only tolerate the need to sleep. Wakefulness seems to be a new goal to the beat of an artificial rhythm and to perform with equal efficiency throughout the 24 hours of a day [1]. Foster and Wulff highlights the problems behind this new attitude towards sleep, since it is a highly crucial act to be able to function.

Studies shows that college students has been recognized as particularly group of population affected by sleep difficulties, a result that has been argued is in relation to stress and demands in college environments that may interfere with sleep habits [16]. A strong correlation between sleep difficulties and mental health problems among students have also been found in studies [5][29][30][31]. Symptoms of insomnia has been identified among 16-23% of young adults and for around a tenth of people these symptoms starts between age 21 to 30 [5]. It is
difficult to pinpoint the exact reason behind these sleep disruptions, but the fact that the outcome from lack of sleep is mental illness is certified from previous studies. Even students who shift their sleep-wake cycle only by two hours, which might occur during weekends, reports increased feelings of depression and difficulty in concentrating [16][31]. In America 2011, the National Sleep Foundation reported that the bed time for people aged 19 to 29 is the latest among all respondents, with an average at 11:58pm. Among that age group, around one-fourth got less sleep than recommended [3].

Disrupted or reduced sleep has also been found in studies to impair the immune system, and immune responses triggered by infection can alter sleep patterns [1]. Loss of sleep also impairs many other aspects of the immune system, including circulating immune complexes, secondary antibody responses and antigen uptake [32]. To cope with sleep loss, people in the age group 19 to 29 tend to nap on weekdays and sleep two hours longer on weekends with the goal to catch up [3]. In a large scale study by Lund et al. (2009), the college students shifted their mean bedtime from 12:17am during weekdays to 1:44am during weekends [31]. Of the students participating in their study, 25% received six and a half hours of sleep (or less) every night, 20% reported staying up all night at least once a month and 35% stayed up until 3:00am at least once a week [31]. Also, males had significantly later bedtimes and rise times during weekdays compared to females. The female participants on the other hand were significantly more likely to report stress-related sleep troubles. Of the total respondents, two-fifths had a poor sleep quality and almost all of them were unable to fall asleep within 30 minutes at least once a week. The main reasons for inability to fall asleep or sleep disturbance was stress or environmental noises, 68% stated that stress is the factor that most interferes with initiating sleep [31].

The academic results also gets affected by the sleep cycle, sleep deprived students have been reported preforming significantly worse compared to students with a good nights sleep [16][33][34][35]. It has been argued that environmen-
nal demands can interfere with sleep habits [16], like the feeling of sleep being chronically restricted [31], and in turn lead to sleep problems. In a study by Adriansen et al. (2017) a survey was handed out to examine sleeping habits and perception of its health effects of college students [36]. Of the 116 participants, 61% reported an average of seven hours of sleep per night. When asking about the students sleeping habits, the top three most agreed-upon were having a relaxing sleep environment, feeling groggy within 30 minutes of waking up and using an electronic device while lying in bed to go to sleep. During the day a majority of the students reported taking naps, similar to previous studies [3][36]. When asking the college students if they perceived their health habits affecting their sleep, two of the most agreed-upon answers were that academics are affected because of lack of sleep and that lack of sleep makes an individual emotionally unstable [36].

It seems like students have a hard time realizing the health effects of their own sleep. In a previous study by Orzech et al. (2011), survey data about sleep habits from over four thousand college students were collected [35]. The result of the sleep measures shows a mean value of the students usual bedtime at around 12:40am and falling asleep usually took around 25 minutes. In their study they found a correlation between poor sleep, academic performance and mental health. In the results from interviews by Orzech et al. the students stated that they felt like doing quite well balancing their sleep and other demands [35]. This statement is argued by Orzech et al. to be a consequence from the students tendency to rate their sleep quality better by comparing themselves to individuals with serious sleep deficiencies [35]. In another study by Pilcher and Walters (2010), forty-four students were investigated on sleep deprivation and performance [34]. The students were divided into two groups where one got to sleep for a normal eight hours while the other group stayed awake all night under supervision. The following morning they all got tested on a complex cognitive task. The sleep-deprived group performed significantly worse than the non-deprived, but still they rated their estimated performance and concentration significantly higher [34]. In the study by Lund et al. (2009), 15% of the college students reported falling asleep during class at least once a week and 12% had missed a class at least three times during the last month [31].

2.3 Night time routines and sleep schedule
A person’s twenty-four-hour tempo helps to determine when one wants to be awake and when to be asleep. It can be difficult to create and maintain a healthy nocturnal routine. Several students reports of sleep onset latency being caused by stress, making it the most frequent mentioned factor that interferes with initiating sleep [31]. Other disturbances mentioned are excess environmental noise or sharing bed. It is important to be consistent with routines, keeping the body’s internal clock fine-tuned. To go to sleep two-three hours later during weekends has proven through studies to be very disruptive for the circadian rhythm [3], a very common sleep pattern specially among young adults [16][31].

To get a preferred rhythm to one’s body clock, one should keep to a precise time for going to bed and waking up in the morning, regardless of it being a weekday or weekend. It might feel strange forcing oneself up at 7 a.m. on a Saturday morning, but according to studies one should not alter the circadian rhythm, not even on the weekends [2][16][31]. To keep a strict sleep schedule
especially important for people suffering from sleep difficulties [2]. If one instead
started to rise at the same time every morning, the body would naturally start
to feel tired at a healthy time in the evening, giving one the necessary 7-8
hours of sleep. The goal is to be able to wake up naturally without needing
an alarm clock, and definitely without hitting the snooze button several times
before getting out of bed [2]. So how do one get a functional and consistent
sleep schedule? There exists various ways of priming the body to go to sleep,
since the brain is a habitual organ that you can "trick" into activate a specific emotion or though.

Studies have shown that dimming the lights in the evening can help the
circadian rhythm to release melatonin [37]. During the day, try to get as much
natural light as possible, since daylight is key to regulating daily sleep patterns
[2]. Drinking or eating too close to bedtime is disruptive for sleep onset, since
the body then have to start process the new input. Especially, caffeine which
is causing troubles initiating sleep, and alcohol which might have an relaxing
effect but is disruptive of the important REM sleep [2]. The last cup of coffee
of the day should be ingested no later than six hours prior to planned bedtime,
and for some individuals this time span is still to short [2]. To help decreasing
the body’s temperature, the surrounding temperature should be decreased by
cooling down the room. A hot shower an hour before bed could also help
decreasing the body temperature quickly when getting out of it [2]. Since the
brain is habitual, one should be very careful to start associate the bedroom
with difficulties initiating sleep, feelings of stress or bad thoughts. If one is still
experiencing troubles to relax or fall asleep after twenty minutes of laying in
bed, it is important to get up and do something completely different for a while.
Otherwise the brain will quickly start to associate the bed with sleep difficulties
and one’s problems might rapidly increase or be harder to get rid off [2]. To
practice deep breathing and relaxation also decreases pre-sleep onset latency,
since it helps with lowering blood pressure and heart rate. This includes to
wire down and avoiding nocturnal stimulation, such as not exercising too late
in the day. Exercising increases heart rate and body temperature, which makes
it harder to wire down afterwards. The last exercise of the day should be no
later than two to three hours before bedtime [2].

2.4 Internet and smartphone usage world wide

The world is becoming more digitized each year simultaneously as new technol-
ogy is released onto the market. A worldwide survey made by Poushter and
Stewart in 2015 states that two-thirds of adults used the Internet and that the
smartphone ownership raised quickly from a median of 21% in 2013 to 37% in
2015 in developing nations [7]. In advanced economies, surveyed in 2015, showed
a smartphone ownership median of 68% [7]. See figure 4. The increased Internet
access also affects the amount of Internet users with around three-quarters of
people across 40 countries stated a daily Internet usage, surveyed in 2015 [7]. A
majority of them stated access several times a day and 76% of the people online
use social networks. In the same survey, a correlation between education and
Internet usage was found. The most likely user of the Internet and ownership
of a smartphone is people with higher education and incomes [7]. On the other
hand, a significant age gap was found with younger people in the ages 18-34 as a
much more likely Internet and smartphone user compared to those ages 35 and
older [7][38]. The younger users also tend to visit social networks with greater frequency [7].

Figure 4: Smartphone ownership world wide, Pew Research Center (2015) [7].

A research made by iiS, investigating the use of electronic media in Sweden 2017, showed an almost hundred percentage usage of the Internet among the citizens [6]. In the ages 16 to 35 in Sweden, 96% use a smart phone daily. The superior service for communication via the Internet in their research is sending e-mails. Second is direct messages with close to every other person sending direct messages daily, a usage that has doubled in three years. Video chats has also increased in popularity as a communication form during the last year. The most common social media platforms in Sweden 2017 are Facebook and Instagram. Facebook is used by people in all ages with the most active users in the ages 36 to 55. The least active Facebook users are people aged 16 to 25. People under the age of 25 holds the leading roll and activity on the platforms Snapchat and Youtube. Similar to Poushter and Stewart’s survey, iiS also found a correlation between the degree of education and Internet usage during work days [7][6]. Students at university level has a higher daily Internet usage than people with a lower degree. Among people who has graduated with a university exam, 89% uses the Internet in their work. The usage appears most frequently in the line of business of IT and communication [6].

Southeast Asia is home to one of the world’s largest populations of young people, who tend to adopt new technologies more readily than older age groups [39]. Smartphone uptake in Southeast Asia is set to enjoy significant growth over the next few years, with subscriptions set to grow approximately five-fold by 2019. This growth is being driven by more affordable prices, as well as by the large and increasingly tech-savvy youth population [39]. According to Pew Research Center (2016), 92% of American teens report going online daily aided
by the convenience and constant access provided by mobile devices, especially smartphones [40]. A majority of teens (71%) report using more than one social network site, with Facebook remaining the most used social media site among American teens ages 13 to 17 [40]. The social network sites Instagram and Snapchat have risen into a prominent role in teens’ online lives and comes close behind Facebook in popularity. Texting is an especially important mode of communication for many teens with a median value of sending and receiving 30 texts per day [40].

2.5 Students’ smartphone habits

In the past few years, the flat rates for text messages and pervasive mobile Internet access combined with Internet-based mobile messaging applications have reduced the cost of a message to zero. This has led to an increased usage of applications that are providing mobile instant messaging [41]. These kinds of apps often goes along with an expectation of high attentiveness, that the receiver will notice and read the message within a few minutes. Hence, existing instant messaging services for mobile phones share indicators of availability, such as the last time the user has been online. However, in a study by Pielot et al. (2014) shows evidence that these cues create social pressure even though they are weak predictors of attentiveness [41]. Instant messenger applications are using different models of displaying attentiveness to the user. The instant message application WhatsApp is sharing the last-seen time from the receiver to the sender [41]. In the study by Pielot et al. the receiver appreciated this information for being an easy and implicit way of showing that one is active and reads messages. The biggest concerns was that it creates social pressure and that people feel observed and patronized [41]. In their data collection, the median delay between receiving and attending to a message was 6.15 minutes [41].

In 2014 to 2015, Donna Freitas visited thirteen colleges and universities to conduct interviews and surveys [42]. Freitas found out that the social media culture shapes the students’ identities, relationships and the ways in which they makes meaning. One of the most central concerns among the college students struggles with is the feeling of being constantly monitored on social media. They were wary of parents, teachers and future employees. The result is that students create carefully crafted, fantasy versions of themselves online. But on the platforms that allow for anonymous posts, things got really dark. Many online sites and apps that come with the promise of anonymity are used by students to be able to vent, confess and load off [42]. These types of forums serve as a cathartic forums which highly pressured and highly monitored young adults can finally be themselves. Sometimes they are playful and silly, sometimes vicious and nasty. A "work hard, play hard" mentality often prevails on campuses. Extremely stressed, high-pressured college students work extraordinarily hard at their studies, sports and activities during the week but party like crazy and drinks heavily during weekend, believing they "deserve" to engage in such behaviour because they are so over bounded the rest of the time. This mentality seems to be transferred online. Students feel they must maintain a perfect, happy veneer on online profiles attached to their names where they appear to be high-achieving, successful and whom everyone would want to hire. Many students have begun to see what they post online in their name as a chore, a
homework assignment to build a happy facade. Then they enter anonymous sites to unleash and let go, even if people gets hurt in the process. They believe that they deserve to let loose, after all, since it is tiring to be perfect all the time [42].

Even though the universities Freitas visited during her studies were incredibly diverse in all aspect, across them all one unifying and central theme emerged as the most pressing social media issue students face is the importance of appearing happy. In her survey, 73% of the 884 students answered yes to the question *I try always to appear positive/happy with anything attached to my real name*. Freitas calls this "the happy effect" and her data shows that young people feels pressured to only post happy content on social media. As a result they often feel inferior because they are not actually happy all the time. This leads to various mental health effects, by constantly comparing themselves to others a kind of sickness is rising among young people. Only 16% claimed that they had never compared themselves to others or felt left out and 3% answered that they did not have any social media accounts [42].

The underlying factor behind the heavy usage of smartphones have been discussed as a result from the environment in the modern world, which brings questions towards new mental disorders connected to phone usage. An extensive study about smartphone habit and behaviour was performed by Anshari et al. in Burnei, 2015 [39]. Brunei is a member of ASEAN and located in Southeast Asia, home to one of the world’s largest populations of young people [39]. In their survey they received 589 answers with a majority of them being students. Among the respondents, 63% spent more than six hours connected to Internet every day and 75% used their smartphones for this purpose. The most popular applications where instant messenger apps and social networks, with a higher user frequency among females. Anshari et al. also found the daunting fact that almost half of the respondents indicated that they could not live without their smartphones, which poses that the new terms *nomophobia* and *phubbing* could be developing or already present in the population.

The term nomophobia is considered a disorder of the modern world and has recently been used to describe the discomfort or anxiety caused by the non-availability of a smartphone, PC or any other virtual communication device in individuals who use them habitually [43][44]. Nomophobia has been suggested to be included in the Diagnostic and Statistical Manual of Mental Disorders, since the victims are experiencing anxious and phobia like feelingstowards losing one’s handset and are typically avoiding places and situations in which the use of the device is banned [44].

The term phubbing represents the act of ignoring (snubbing) someone in a social setting by concentrating on one’s phone instead of talking to the person directly [45]. In a study by Chotpitayasunondh and Douglas (2016) they found out that Internet addiction, fear of missing out and self-control predicted smartphone addiction in turn predicted phubbing behavior and the extent to which people are phubbed. Further, phubbing behavior and the experience of being phubbed predicted the extent to which phubbing was perceived to be normative [45]. Finally, gender moderated the effect of being phubbed on the perceived social norms of phubbing [45]. From a study in the book by Sherry Turkle (2012), 89% of Americans say they have interrupted their last social interaction to turn to their phones, and 82% say that the last conversation suffered from it [46].

The research suggests that males see smartphones as empowering devices
with instrumental functions, while females use smartphones as facilitators of social interaction [45]. Similar findings in study by Thompson S.H. Teo (2001) with gender correlated behaviour on computers [47] and from Pew Research Center (2016) reporting that teenage girls use social media sites, particularly visually-oriented ones, for sharing more than their male counterparts do. For their part, boys are more likely than girls to own gaming consoles and play video games [40]. This assumption could be an underlying factor to findings in previous studies showing that female students more frequently used mobile phones after lights out and more often experienced poor mental health [30][16].

But not all studies states that smartphone usage is destructive. In an analytic study of the results from the World Internet Project by Amichai-Hamburger and Hayat (2011) shows findings that Internet usage is associated with several beneficial social activities, including interacting with friends and colleagues [48]. These findings are based on representative international data collected from 13 countries, providing a generalization of different lingual, cultural, and ethnic settings. Their study claims that heavy Internet users both has larger and more diverse social networks and interacts with them more frequently [48]. Amichai-Hamburger and Hayat states that Internet usage does not have a negative impact on the social lives of users. It might even in some aspects have positive effects [48].

2.6 Nocturnal media usage

A study made by Lepp, Barkley and Karpinski (2013) states that a high number of college students feels an obligation towards social media, which in many cases have similarities to an addiction-like behaviour and leads to higher anxiety [33]. The same study states that the most crucial factor to anxiety is not the amount of time spent, but what the students does on their phone. The highest level of anxiety was connected to exclusion from Facebook, messages and calls [33].

In a large scale study by Böhmer et al (2011), data was collected from over four thousand participants about their mobile app usage during all hours of the day for six months [10]. What they found out from their study was that during late evening (from 9pm to 1am) mostly games and social apps where used. Communication apps like calls and messages where used every hour of the day, especially in the afternoon and in the evening. Specific apps that where most used during evening was Facebook, Angry Birds and Kindle [10]. When their participants were not sleeping at night, they tended to spend more time within each app and the use of non-communication functionality increased. Interviews with Swedish high school students made by Boeke and Skottestad (2005) showed a habit among the participants of staying up all night long, chatting and playing online games on their phones [49]. Same nocturnal phone habits was found among students in the Flemish Community of Belgium in a study by Van den Bulck (2007). Of 2449 participants, only 38% reported that they never used a mobile phone after lights out [11]. After lights out, 28.9% made calls at least monthly, while about 8% made or received more than three calls per night. When sending or receiving text messages, 15.2% of the respondents sent or received more than 10 messages in one night [11], see table 1.

Similar to prior studies, the National Sleep Foundation reported in 2011 that 67% of Americans between the ages 19 to 29 are using their phones while in bed
2 THEORETICAL FRAMEWORK

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<th>Nocturnal phone usage</th>
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<th>Nocturnal phone activity</th>
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<td>calls (weekly)</td>
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<td>&gt;3 calls/night</td>
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<td>&gt;10 texts/night</td>
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trying to fall asleep [3]. The most popular task to do in the hour before going to bed is texting. In their research they found that those who text before trying to sleep are less likely to get a good night’s sleep [3]. Nearly all of their respondents (97%) reported performing activities like sending e-mails, use social networking sites or surf the Internet in the hour before bed. Almost eight in ten watch TV at least a few times a week before bed and two-thirds of students do homework on their computer [3]. A recent study of Americans’ smartphone screen-time, measuring 653 participants spanned over one year’s time by Christensen et al. (2016), states that those with an average screen-time above the population median tended to be younger, female and have a higher depression score [12]. They also found that poor sleep was statistically significantly associated with longer average screen time during the reported sleeping period and during the hour after bedtime [12]. Christensen et al. discuss that screen-time was not associated with mood, physical activity level or any of the medical conditions evaluated after multivariate adjustment. Screen-time exposure on the other hand, particularly around bedtime, was found associated with a lower quality of sleep [12].

In a study by Eggermont and Van den Bulck (2006), 2546 students were sampled upon their media entertainment usage and sleep [50]. The mean age of the two study groups were 13 years old and 16 years old. Their findings shows that 36.7% of the adolescent participants reported watching television to help them fall asleep. Second, 22.1% use computer games as a sleep aid, 60.2% use music and 54.5% use books to help them fall asleep. Eggermont and Van den Bulck found a small relationship between using television, playing computer games, listening to music and average hours of sleep, but a significant relation to a higher level of tiredness throughout the day [50]. Using books as a sleep aid was significantly related to longer average hours of sleep and lower level of tiredness. Hence, media can be explained as a form of unstructured activity with no predefined starting and stopping point, compared to a book. This explanation leads to the displacement hypothesis: the time adolescents spend with media may replace time that otherwise would have been spent with more dynamic activities or sleeping [50].

In Japan 2012, Oshima et al. examined 17,920 adolescent students to see if there was an association between nocturnal mobile phone use and poor mental health [30]. They found that for both the early adolescents (grades 7 to 9) and late adolescents (grades 10 to 12), female students more frequently used mobile phones after lights out every day compared to male students. Male students
also slept longer. Suicidal feelings and self-injuries were higher among females than males, similar to the findings in the survey made by Buboltz, Brown and Soper (2010) [16]. According to the study made by Oshima et al there is an association between poor mental health and nocturnal phone use [30]. The only distinct difference found between the two age groups was the correlation between nocturnal mobile phone use and sleep length. For early adolescents the students sleep length was significantly shorter when they frequently used mobile phone after lights out. For late adolescents (age 16 and over), no significant relationship was found [30].

2.7 Existing sleep related applications

There already exist a numerous amount of applications related to sleep on the App Store (for smartphones with iOS operating system) and Google Play Store (for smartphones with Android operating system). In recent years, wearables have also made their way onto the market. Like the Fitbit Ionic, the Oura Ring, Jawbone UP3 and Garmin vivosmart® HR which all are gadgets that can be worn during night time to track one’s sleep [51][52][53][54]. Also, new interventions for monitoring sleep is starting to appear like the Neuroon Intelligent Sleep Mask and Beddit 3 Sleep Monitor [55][56]. The vast rise of new services are speaking for an increased popularity of knowing and caring about sleep. The common trend among the existing sleep related applications and gadgets on the
market today is three overall categories that most of them can be placed into, which are sleep trackers that monitors and records the user’s activity during nighttime, sounds that aims to help the user fall asleep and guided meditation and relaxation exercises through text or pre-recorded speech. These services are giving the user the option to be guided during sleep onset by voice or sound, and get more knowledge about how the night’s sleep has been. One popular application is Sleep Cycle alarm clock, who has been downloaded more than a million times on Google Play Store [57]. Sleep Cycle uses sound analysis to identify sleep states by tracking movements in bed. In the morning, graphs are presenting the sleep patterns of the night [57]. Hence, Sleep Cycle can be categorized as a sleep tracker.

From the study by Eggermont and Van den Bulck, a significant share of the adolescent participants (under age 18) showed a habit of listening to music during pre-sleep [50], which might lead to a natural transaction into guided meditation and sound applications. But through a majority of studies the most prevalent smartphone activity during night time has shown to be texting, visit social media platforms and play games [3][10][11][39][49], valid for both adolescents and adults. Neither of these activities are directly related to using headphones, listening to sounds or speech. When looking through the various application stores and gadgets available for purchase, there exists a gap in the market of sleep aids for the users that prefer a muted or soundless alternative during pre-sleep. From previous research, it has been stated that getting knowledge about one’s sleep quality and quantity is beneficial for sculpturing a healthy sleep schedule [1][2]. For the sleep-onset insomniacs and the sleep deprived on the other hand, the problem has been shown through studies to arise during sleep onset [23], commonly caused by a high mental load and difficulties redirecting thoughts [58][59][60]. Hence, the issue is during the process of initiating sleep, which should be the main stage to target for integrating a sleep aid. In the most common nocturnal smartphone behaviour of interacting with the screen through sight and gestures, the current market is lacking in providing suitable services.

The current lack of services might be something the employees at Google has detected. At this year’s Google I/O developer festival and conference (2018) [61], their new concept Digital Wellbeing was presented [8]. Google’s said goal is to enable users to understand their own habits, control the demands technology places on their attention and focus on what matters, which according to Google is time well spent. The most comprehensive update included in Digital Wellbeing is a feature called Dashboard, which monitors how and how often the user use their device [8]. According to Google it displays information about the amount of time spent as a whole as well as within specific apps, the frequency of unlocking the phone and the amount of notifications received on a daily basis. Another specific feature included in the update is the opportunity to schedule reminders to take breaks from watching videos on YouTube, and all notifications will be disabled between 10pm and 8am by default [8]. Included in Google’s new update, sleep and nocturnal technology usage are two areas well taken into account. A feature called Wind Down will give the opportunity to schedule changes to the display in the form of reducing the blue light, or even removing all the colors turning the interface into grey scale [8]. According to Google’s press release, the Grayscale filter will help the user to disconnect at night [8]. Also, the user will be able to turn on the "Do Not Disturb" functionality (where
sound and vibrations are muted) only by turning the phone face down [8].

Apple have also taken Digital Wellbeing into account in their press release for the new update of iOS 12 [9]. It was during Apple’s annual developer conference WWDC (2018), that the staff announced the upcoming features included in the new update. One of them, called Screen Time, will help the user to keep track of the time spent on their iOS device, as well as send notifications as reminders to turn applications off [9]. Much like Google’s announced new features [8], Apple’s Screen Time will include a dashboard monitoring and presenting an overview of the screen time of the last seven days. The upcoming iOS 12 also provides new management of notifications and the ability to set the Do Not Disturb functionality on a scheduled timer, making it turn on and off automatically [9]. The planned release date of Apple’s iOS 12 is during the fall of 2018 [9].

2.8 Cognitive performance and activity during night time

Sleep is a complex and highly organized series of behavioural and physiological states. It affects our cognitive performance and shifted circadian rhythm or sleep disruption leads to impairment in our cognitive functions [1]. Evidence also shows that the amount of cognitive activity during pre-sleep can affect the sleep onset latency. In a study by Ansfield et al. (1996), participants’ sleep onset latency were tested during different levels of mental load [62]. They identified conditions in which people’s purposeful attempts at falling asleep ironically led to paradoxical wakefulness. The participants that was trying to fall asleep quickly under a low mental load (relaxing music) fell asleep faster on average, whereas participants trying to fall asleep quickly under a high mental load (music from a marching band) took longer time compared to a normal weekday [62]. Ansfield et al. states that the results interacted with the instructions given such that those who were told to fall asleep quickly under a high load reported greater difficulty falling asleep than those who were not trying, giving support for an ironic process model of sleep onset control [62].

How stress affects sleep among people with insomnia has been studied by Haynes et al. (1981). They collected twenty-one participants, either with or without insomnia symptoms and tested how they responded to stress during five nights in a controlled environment [59]. The participants got to fall asleep uninterrupted the first three nights, before being presented with cognitive stressful problems the fourth and fifth night. The results from Haynes et al. study shows that the insomniac and non-insomniac group responded significantly different to the stress problems on subjective measures, but not on objective measures of sleep onset latency [59]. The mean heart rate between the groups where very similar, still the insomniacs evidenced a significant decrease of sleep onset latency during stress nights compared to no-stress nights. Haynes et al. states that insomniacs benefits from late night cognitive activity that shifts their focus away from trying to fall asleep. The cognitive stressful problems tended to disrupt other sleep-related thoughts or attributions of internal causality for sleeping difficulties, which resulted in reduced sleep onset latency [59].

In a more recent study by Harvey and Payne (2002), different types of distractions during sleep onset were tested on 41 university students [58]. They found that imagery distraction gave the best results for lower cognitive activity during pre-sleep and the participants in that test group estimated their sleep onset latency shorter that the other groups. The test group which rated
their thoughts to be significantly more uncomfortable and distressing compared to the other groups were the participants who was not told to use any particular technique during pre-sleep. That group also estimated their sleep onset latency the longest and felt like the test night was longer than normal [58]. From these results, Harvey and Payne states that given a very specific cognitive task the process of falling asleep gained positive outcomes by shorter duration [58].

The solar cycle of light and dark provides the essential basis for life on Earth, which also affects the humans circadian system [1]. Today there exists several types of light-emitting screens who has the power to artificially override the natural cycle of light and dark [37]. How the different lights from screens affects the humans circadian rhythm and cognitive performance have been researched in various studies. In a study by Changa et al. (2015) the light-emitting screens reduced the amount and timing of REM sleep [63]. When comparing LED screens to non-LED screens, a suppression and delay of the melatonin levels during evening exposure was found, stating that the human circadian physiology and alertness levels are particularly sensitive to short-wave length light [63][64]. Typical LED-back lit screens emits 3.32 times more light in the blue range (between 440 to 470 nm) than non-LED screens [64], see figure 6. The human eye and visual system is more sensitive to some wavelengths than others and even low levels of illuminance in the blue or white fluorescent spectrum has been confirmed to disrupt the rise of melatonin [37]. Exposure to red light on the other hand has been confirmed not to be disruptive [37].

Figure 6: Difference in color temperature on screen lighting. Left: non-LED computer screen (HP LP2475w, CCFL). Right: LED computer screen (HP LP2480zxx LED). Christian Cajochen et al., 2011 [64].

Based on the proven effects from different colors of artificial lightning on the human circadian rhythm, some filter functions for screens have been developed during recent years. Apple’s screen filter called **Night Shift** became available for users with the macOS Sierra 10.12.4 update in 2016 [65]. Night Shift automatically shifts the colors of the display to the warmer end of the color spectrum after dark. Another software program that has been around for a longer time is **f.lux**, which is a filter function that adapts the color of the computer’s display to the time of day and the lightning in the environment around it [66]. These kinds of functions also currently exists for most types of smartphones. While research shows that using light-emitted screens before bedtime prolongs the time it takes to fall asleep by increasing alertness, an easy solution might be applied by using a screen filter function in the warm end of the color spectrum since that light is proven not to be disruptive [37].
In a study by Allison G. Harvey (2000) the cognitive activity during pre-sleep was compared between insomniacs and non-insomniacs [60]. The insomniacs rated their sleep quality lower and the interference from cognitive activity keeping them awake more compared to the group of non-insomniacs. The insomniacs also estimated their sleep onset latency longer (mean value 58.2 minutes) compared to the good sleepers (mean value 15.3 minutes) [60]. The insomniacs were more likely to focus their attention on trying to detect the sensation to fall asleep and attend to worries, concerns, trying to solve life problems and listen to environmental noises [60]. There was no significant difference between the groups whether the thoughts related to the past, present or future but the insomniacs reported more likely to start thinking unintentionally [60]. When the participants were asked about the content of imagery during pre-sleep cognitive activity, there was no significant difference between groups of the overall ratio between thoughts and images, the duration, vividness or perspective of the images. Both groups experienced equally amount and recurring of images during pre-sleep [60]. The difference found in Harvey’s study was that the insomniacs rated their images as more distressing and that physical sensations accompanied the images more. When describing their sleep patterns, 77% of the insomniacs stated interference from cognitive activity as the most relevant factor. Of these interference’s, 40% cited *My mind keeps turning things over*, 27% cited *I am unable to empty my mind* and 10% cited *My thinking takes a long time to unwind* as the item that best described the reason for their sleep difficulties [60].

**2.9 Visual perception and the social brain**

Humans are inherently social beings, which displays itself in the increasing popularity of the use of social network sites [6][7]. A large proportion of the human brain is involved in social interaction and understanding other people. The brain regions that are involved in social cognition are collectively referred to as the *social brain* [67]. The social brain is used for understanding of others’ emotions, intentions and beliefs. The development occurs during adolescence and is probably influenced by multiple factors such as changes in the social environment and in hormone levels. In addition, significant neuroanatomical changes occur in parts of the social brain that are likely to affect cognition and behaviour [67].

One of the areas in the brain that are involved in social cognitive processes is the medial prefrontal cortex (mPFC) [67]. Research shows that the brain enables a diverse set of functions that allow humans to understand and interact with each other by evaluating thoughts, emotions and predicting the counterpart’s actions [67]. Social cognition enables the ability to sense a specific mental state, including intentions, desires and beliefs [67]. Sarah-Jayne Blakemore explains in her study from 2008 that activation in the mPFC happens even during low demanding tasks and conditions. This allowed the participants to spontaneous and naturally start thinking about mental states, like what they want to eat for lunch or whether they enjoy the experience [67]. Blakemore states that the study of neural development during adolescence is likely to have important implications for society in relation to education, as well as for various mental illnesses that often have their onset in adolescence [67].

It is not only the mental stages that the human brain is processing. Another crucial source of sensory input is the visual perception of motion, which seems
to be hard-wired into the brain [68]. Even implied motion from static images activates the region in the brain specialized for processing visual motion. A prior study by Blakemore and Decety (2001) states that the brain can store representations of motions internally [68]. Even from very partial visual information the brain can anticipate future movements by recalling past movements. This functionality is helping humans to act and function in the visual world. It is also very important to be able to sort out visual information in the everyday dynamic environment. The brain has a system for selecting relevant information through neural processing [69]. If one is in a context with a high mental load, for example a busy intersection, the brain can sort out relevant stimuli from irrelevant stimuli. This capacity helps us process the most important information by filtering out irrelevant signals [69][70]. This filter function is what is called our attention. In the study by Ordikhani-Seyedlar et al. (2016), they found that selective attention is a key function that enables the brain to effectively process information when confronted with numerous inputs from the environment, and it is particularly controlled by the areas of the frontal cortex [70].

Attention is a fundamental brain mechanism for selection of relevant and essential information while suppressing irrelevant signals. Disorders of this mechanism result in dysfunctions, such as ADHD [70]. The cognitive processes in the brain is also highly relevant when looking into the sleep onset latency among insomniacs, who tend to experience a high sleep-related mental load and difficulties in redirecting their attention [59][60]. Previous studies have shown that a cognitive stressful problem during pre-sleep could help insomniacs with these problems by shifting their attention away from the pressure of falling asleep, which resulted in reduced sleep onset latency [59]. Also, imagery distraction has been proven to be helpful for non-insomniacs by lowering their cognitive activity during pre-sleep, which was beneficial for reducing their sleep onset latency [58]. Depending on the activity, smartphones could provide some of these cognitive inputs and help steering the user’s perception in the right direction towards a more beneficial and healthy bedtime routine.

There exist various ways of presenting stimuli. If the goal is to reach higher attention, recent studies shows that people process information more deeply when they experience some kind of cognitive disfluency [71]. For example, when a class of students were told to learn the material from a given worksheet, the ones who had received the disfluent version with harder-to-read format achieved significantly higher scores on the exam later on. Similar findings about memorizing has been proven to give more accurately results when the information is presented disfluently [71]. Questions about if smartphones are eliminating our brain’s ability to think for itself has been raised, fearing that today’s electronic gadgets perform every single simple mental tasks for us [71]. Adam L. Alter discusses in his study from 2013 that over time, without an occasional dose of cognitive disfluency, people might not think, remember or decide for themselves at all [71]. Since the brain’s ability to sort out relevant information from various stimuli is crucial to understand and interact with the outer world, these types of cognitive tasks might be even more vital in the technology era of today.

2.10 Emotion and perception

Through studies, the enhanced ability to regulate emotions have been shown coming from sufficient REM-sleep [2]. Apart from sleeping, using media enter-
tainment have also been found as a management of emotions. Using television have been shown through study by Anderson et al. (1996) to counter anxiety for people dealing with stress [72]. Similar, in a study by Carpentier et al. (2008), 51 adolescent participants with and without depression reported their media usage and its affective attributes for five weekends [73]. Their findings shows that media use had an improvement in the mood of their participants, both with and without depression, with television as the most consumed media during the test [73]. Fun media quality and content increases positive feelings of having fun in the user. Hence, similar with sad, calm or excited feelings. Choice of media quality should be made according to which emotion one wants to enhance or reach as goal. Per se, mood management through media entertainment could be applicable on all medias, including smartphones.

Looking at mood from a perceptual perspective, studies have shown that graphical elements and colors stimulates different emotions. Colors are for many people an important source of information by influencing us in the decisions we make, based on what we see and how we interpret them [74]. The use of colors can stimulate a certain feeling by making us feel calm, aggressive, energetic or happy. In a study of 98 college students, Kaya and Epps (2004) tested how they interpreted different colors and their spontaneous emotions towards them [75]. The mean age of the students was 21 years and the colors tested were both principle hues, intermediate hues and achromatic colors. What they found was that about 80% of the responses to the principle hues (red, yellow, green, blue and purple) were positive compared with only 29.2% for the achromatic colors (white, gray and black) [75]. The color that attained the highest number of positive responses was green, since the students related that color to feelings of relaxation and calmness, happiness and comfort. Green was associated with nature and trees and thus created soothing emotions.

The color blue was instead associated with both positive and negative emotions, like relaxation and calmness followed by sadness, depression and loneliness [75]. Furthermore, the color red was seen to be positive because it was associated with love and romance, while the negative aspects of red included having associations with fight, blood and evil [75]. The three intermediate colors that got most positive responses was blue-green, red-purple and yellow-red [75]. For the achromatic colors, white attained most positive responses [75], see figure 7.

In a study by Valdez and Mehrabian (1994), brighter and more saturated colors were shown to be more pleasant among their participants [76]. Also, their results indicates that brightness had a considerably stronger pleasant effect than saturation. One generalization that Valdez and Mehrabian makes from their findings is that darker colors are more likely to elicit feelings that are similar to anger, hostility, or aggression [76]. In the results from a study by Sanocki and Sulman (2011), the use of similar colors makes integration and retaining information much easier for people [77]. The color palettes in their tests with high color-similarity led to significantly higher performance in estimated memory capacity, up to 45% among the participants. Sanocki and Sulman states the advantages of similar-color palettes for graphic design and suggest further that similarity in hues is more important than the harmony of the hues [77].

When designing an interface for people with sleep difficulties, the selection of the graphical elements is important since it has a significant impact upon people’s perception and emotion. The sleep onset for poor-quality sleepers is according to previous studies related to difficulties in redirection of attention
Figure 7: The colors used from the Munsell Color System in Kaya and Epps study [75]. The numbers beneath each color circle represent the percentages of positive emotions towards the color. The percentages of negative emotions are listed in parentheses.

[59][60], attend to worries, concerns, trying to solve life problems and listen to environmental noises [60]. Maybe, the high sleep-related mental load could be controlled or reduced by color stimulation as a mood management, insinuating a preferred emotional effect into insomniacs. Important to remember, the human eye and visual system is more sensitive to some wavelengths than others. Hues in the blue fluorescent spectrum has been confirmed to disrupt the rise of melatonin [37], while exposure to red light has been confirmed not to be disruptive [37]. From the study by Kaya and Epps (2004), college students associated the color blue with emotions like sadness, depression and loneliness [75]. Hence, insomniacs should avoid being exposed to the color blue during sleep onset for more than one reason. The color green, which elicited the highest number of positive emotions [75], has a tendency of appearing in the blue spectrum. Since colors in the red spectrum is not disruptive, those hues should be preferred. The primary color red has been associated with emotions like blood and evil [75], and maybe the principle hue of red should also be avoided. To conclude from previous studies, the most suitable hue to expose people to during sleep onset could be a bright and saturated tint of the intermediate color yellow-red, commonly called orange, or a warm tint of the color green, due to its positive effect on emotions without causing too much excitement [75][76].
3 Method

This thesis has been carried out by co-creating a solution through academic research together with the collaboration partner and potential end users. The methods of choice for this study is inspired by the books *This is Service Design Doing* by Stickdorn et al. (2017) [14] and *Sprint* by Knapp et al. (2016) [78], including user interviews, workshop with employees at Daresay and prototype iteration. The specified approaches are also extracted from previous research in the field.

3.1 Questionnaire and interview

An initial interview was conducted to gather information for creation of behavioural groups. Suitable participants was collected through a questionnaire sent out on Facebook for one week during April, 2018. The questionnaire consisted of various questions about demographics, sleep and nocturnal smartphone usage, collecting statistics about sleep problems through the three variants of insomnia symptoms defined by the DSM-5 [23]. The questions about their subjective sleep quality was set within the time frame of the last three months, the same as the duration criterion for chronic insomnia disorder according to the ICSD-3 [22]. The requirement for being selected for the interview was that the participant had filled in the questionnaire, as well as current stated use of their smartphone while in bed during sleep onset. Similar to previous studies [34][59][60], the participants were chosen suitable for being divided into two groups; good sleepers and bad sleepers. To be placed in the group of bad sleepers, the participant had to have two or more subjective stated value that corresponds with sleep difficulties or insomnia [23], while the good sleepers had at most one stated value. In total, six participants were chosen, with three people corresponding to each group of sleep experiences.

The following interviews was conducted through a qualitative approach, similar to Donna Freitas study about students’ smartphone and social media culture [42], by consisting of a selection of questions to get a deeper understanding of the participants night time routines and nocturnal smartphone habits. The qualitative approach means investigating specific touch-points through the stages of falling asleep, by performing in-depth interviews with a restricted amount of chosen people. First, the six participants were asked to talk about their night time routines, nocturnal habits and explain their electronic media usage in detail throughout the evening. Also, semi-structured questions about past (or current) experience of sleep related applications or screen filter were asked. The Service Design approach includes evaluating the participants specific steps and emotional journey [14], through-out the defined stages of *the hour before bed* and *laying in bed*. The participants’ self-stated main activity during the two stages were evaluated through a printed form, representing the emotional journey. The form included four emotional values:

- Overall feeling (scale -2 to +2)
- Tiredness (scale -2 to +2)
- Stress (scale 1 to 5)
- Engagement (scale 1 to 5)
The form was filled in twice by the participants themselves, once for each main activity during the two stages. The forms are visualizing the participant’s level of satisfaction at each step [14]. Similar to the study by Eggermont and Van den Bulck, the participants got to rate their overall feeling and tiredness on a scale from negative to positive with a neutral option in between [50].

Also, a trigger exercise was included in the initial interviews to investigate how the participants reacted to images of various emotional quality [58][73], to collect data about their emotional reactions towards imagery content as mood management [73]. The trigger consisted in total of 12 different pictures. Ten of them with two doublet’s of a specific tagged emotion. The emotions tagged to the images were:

- Relaxed
- Sad
- Tired
- Scary
- Happy

As a complement, there was two pictures included without any predefined emotions tagged upon them. One was a picture of a computer, and the other of a smartphone screen. These were included to get more information about the participants feelings towards the two most commonly used electronic medias [40]. The total 12 pictures were displayed to all the participants in the same structured order, with no succession of a tagged emotion.

Figure 8: The twelve pictures included in the interviews as trigger, in the order presented from top left to bottom right. The tagged emotion to each picture is written above each image, including the two electronic medias: computer and smartphone. All pictures are downloaded from Unsplash [79].
The interviews took place in a secluded room both at Umeå University and at Daresay’s office in Umeå during two weeks of May, 2018. The hypotheses for the initial interview was:

1. \((H1)\): Social media and chatting is the two most common activities during nocturnal smartphone usage.

2. \((H2)\): Social media and chatting is an infinite activity that makes it more difficult for the participants to initiate sleep.

3. \((H3)\): Stress and anxiety is increasing sleep onset latency.

4. \((H4)\): Imagery can be used as a mood management to enhance specific feelings.

### 3.2 Workshop

After the initial interviews, a workshop was held together with the collaboration partners at Daresay to funnel down the findings towards possible solutions. The background material for the workshop was a journey map, which is a compiled document of the participants’ individual actions (see figure 9) and emotions during sleep onset (see figure 10). Extracted quotes from the initial interviews were included as well. The journey map was created to make the experiences visible and facilitate a common understanding between the workshop leader and the experts from Daresay participating in the workshop [14]. The layout of the workshop consisted of four steps, well-suited for workshops according to Knapp et al. from Google Ventures (2011) [78]:

1. **Notes**: Each participant gathers key information and pain points (20 minutes).

2. **Ideas**: Each participant sketches rough solutions (20 minutes).

3. **Crazy 8s**: Each participant chooses their best idea and sketch eight rapid variations (8 minutes).

4. **Decide**: All of the participants solution sketches are presented, decision is made by placing dot stickers. Once finished, the sketch with the most stickers is the decided preferred solution.

During the decision making step, called the heat map exercise [78], each participant got an infinite amount of green dot stickers, representing good ideas. For final decision, each participant got two orange dot stickers, representing their two favourite ideas. The main goal with the workshop was to generate possible solutions for the previous stated objective:

- What kind of nocturnal smartphone interactions are beneficial for initiating sleep and retain a healthy sleep schedule?

The workshop took place at Daresay’s office in Umeå during June (2018), together with three employees at Daresay. Other materials for the workshop was pen and papers, sticky notes and dot stickers.
3.3 Concept generation

The main goal of the concept generation was to find possible solutions for the previous stated objective:

- How to design an interface that can be naturally integrated into the target group’s existing nocturnal behaviour by simultaneously providing the beneficial interactions?

3.3.1 Solution sketches

The ideas that received the orange votes in the heat map exercise during the workshop was iterated through various stages of solution sketches [78]. Due to the time frame, the solution sketches were not included in the workshop but instead executed as a separate task afterwards. The solution sketches were created via pen and paper, since sketching refers to visualization of design ideas that support fast and flexible exploration [14]. Each sketch was drawn as a storyboard, visualizing the users potential interactions throughout the solution [78]. The focus of the sketches were both single parts of the users experience, as well as full-page sketches of the overall solution [78].

3.3.2 Wire frames

The solution sketch best suited for the objective was refined into exploratory wire frames, enabling the concept to be more tangible through visual information. Wire frames uses non-graphical schematics of digital interfaces and their structure [14]. They usually consists of "boxes" representing the prospective placement of each element, without being too detailed. The wire frames were created in an online vector design tool for computers called Figma 1. The tool of choice were settled by its availability and relevance to the stage of the study. Due to the time limit of the study, the wire frames were not tested by users. Instead, they were iterated thoroughly and later verified by the collaboration partners at Daresay.

3.3.3 Hi-fi prototype

The chosen concept was designed as a high fidelity (hi-fi) prototype to be well suited for final testing [14]. A hi-fi prototype consists of graphic elements designed in a high fidelity, namely in their prospective colors, placement and interactive functionality. The prototype contained frames from starting up the application to shutting it down, throughout various frames stages of scrolling and interacting with the feed. The color scheme was chosen from the results of previous studies, to prevent the disruption of the rise of melatonin and be harmonious to the user [37][2][75]. The imagery in the simulated social media feed were chosen according to the results of the trigger exercise during the initial interviews, as well as ideas generated during the workshop. The graphical views for the interface of the hi-fi prototype was created in the online tool Figma. The interactivity was then applied in the online tool InVision due to its high capacity and fast loading time, making the prototype behave as close to a fully developed application as possible.

1https://www.figma.com/
3.4 Usability test of the hi-fi prototype

Final testing of the prototype has been executed as an usability test in real life situation together with participants chosen according to a behavioural group. The behavioural group for the test included only self-reported bad sleepers, namely participants with two or more subjective values that corresponds with sleep difficulties or insomnia [23]. The participants were divided into two groups; group A who got to test the prototype by itself, simultaneously as group B tested the prototype in combination with a secondary concept. The usability test was performed on the prototype through a semi-structured method throughout the process of falling asleep. The semi-structured method included the given instructions before performing the usability test, whilst still giving room for the participants own interpretations and personal sleep schedule. Similar to the study by Haynes et al. (1981), the participants first fell asleep in their regular way for a few nights, before being presented with the prototype the following nights [59]. The instructions given to each participant prior to executing the test was:

1. Go to sleep in a regular way, without using the prototype, for the first 2 nights.

2. For the next 3 nights, open the prototype each night when lying in bed trying to fall asleep.

3. Each morning for 5 days, fill in the sleep diary.

The participants were collected through social media during two weeks of June, 2018, by the request for people who recognized themselves based on the description of the "bad sleepers" criterion. The other criterion was current nocturnal smartphone usage. The tests took place in the participants natural environment, their own bedroom. Similar to previous studies, the results were collected by self-reported sleep diaries in which the participants filled in their subjective sleep quality and quantity [5][58], both in relation with and without use of the prototype. The structure of the diary followed the same structure as the emotional journey during the initial interviews. Two of the values from the questionnaire about bedtime and approximate sleep onset latency was also included. The similarity was chosen to get a better comparison of the data between "regular" nights, and nights when using the prototype. Each participant filled in their subjective values (from the corresponding night) of:

- Bedtime and sleep onset latency (in minutes)
- Time spent with smartphone (in minutes, during "regular" nights)
- Time spent with prototype (in minutes, during prototype nights)
- Overall feeling (scale -2 to +2)
- Feelings of tiredness (scale -2 to +2)
- Feelings of stress (scale 1 to 5)
- Feelings of engagement (scale 1 to 5)
- General thoughts and feelings (free text)
The secondary concept tested upon group B was executed through the Wizard of Oz method. The Wizard of Oz method involves invisible operators ("wizards") who are manually creating responses from people, devices or apps behind the scenes [14]. The user is given specific tasks while the wizards simulates the operation of backstage processes without the user’s knowledge, making the responses appear fully functional.

The sleep diary was filled in as an online form, making them easily accessible to update each morning via a smartphone. To keep up the participants’ motivation to complete the usability test, a half-time check-in was executed after the first two regular nights. Also, the participants were told in advance they would receive a gift if they fulfilled the whole test. The main goal with the usability tests was to find possible solutions for the previous stated objective:

- Is the target group experiencing a subjective decreased sleep onset latency through usage of the design proposal?

After completion, all the participants’ sleep diaries were collected and their corresponding values was compared. Also, an evaluation form were sent out to all the participants the day after completion as an online questionnaire to collect feedback and critique towards the concepts. The usability tests was executed during one week of July, 2018. See the form for the sleep diary in appendix A and the evaluation form in appendix B.

### 3.5 Final design proposal

The last and final step of this study was to create a final design proposal of the prototype, with regards to the results from the usability test of the hi-fi prototype. The collected feedback from the sleep diaries and the evaluation forms were the foundation to the refinery of the prototype. Any parts in the hi-fi prototype which received negative critique from a majority of the participants got edited or removed, especially those who mentioned an increase in stress or sleep onset latency. Same as with the hi-fi prototype, the final design proposal was refined in the online tool Figma [2].

---

4 Results

The results from the different stages executed during this study.

4.1 Questionnaire and interview

The questionnaire generated in total 102 responses. It was predominantly more female respondents compared to males and the largest group of sleep onset latency was 10-20 minutes, which is a healthy time span. On the other hand, almost half stated feeling tired during the day and 22.8% respectively 30.7% stated experiences of sleep maintenance insomnia and late insomnia [23]. Also, a habit of shifting the sleep schedule from weekdays to a later bedtime during weekends can be seen in table 2.

<table>
<thead>
<tr>
<th>Age</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-18</td>
<td>3%</td>
</tr>
<tr>
<td>18-30</td>
<td>62.4%</td>
</tr>
<tr>
<td>30+</td>
<td>34.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bedtime (weekdays)</th>
<th>Bedtime (weekends)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;9:00pm 1%</td>
<td>&lt;9:00pm 1%</td>
</tr>
<tr>
<td>9-10:00pm 14.9%</td>
<td>9-10:00pm 3%</td>
</tr>
<tr>
<td>10-11:00pm 47.5%</td>
<td>10-11:00pm 12.9%</td>
</tr>
<tr>
<td>11-12:00pm 22.8%</td>
<td>11-12:00pm 36.6%</td>
</tr>
<tr>
<td>12-1:00am 10.9%</td>
<td>12-1:00am 27.7%</td>
</tr>
<tr>
<td>&gt;1:00am 3%</td>
<td>&gt;1:00am 18.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sleep onset latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 min 22.8%</td>
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<tr>
<td>10-20 min 31.7%</td>
</tr>
<tr>
<td>20-30 min 20.8%</td>
</tr>
<tr>
<td>30-40 min 12.9%</td>
</tr>
<tr>
<td>40-50 min 4%</td>
</tr>
<tr>
<td>&gt;50 min 7.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satisfied with sleep</th>
<th>Tired during day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes 61.4%</td>
<td>Yes 55.4%</td>
</tr>
<tr>
<td>No 38.6%</td>
<td>No 44.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sleep maintenance insomnia</th>
<th>Late insomnia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes 22.8%</td>
<td>Yes 30.7%</td>
</tr>
<tr>
<td>No 77.2%</td>
<td>No 69.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smartphone usage in bed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes 80.2%</td>
</tr>
<tr>
<td>No 19.8%</td>
</tr>
</tbody>
</table>

Table 2: Summarized results. Percentage of total 102 respondents.

From the following interview, the six participant’s stated steps are presented in figure 9. The two most common electronic medias during the hour before bed was using the computer and watching TV. While in bed, the most common
activity on their smartphone was to visit various social media sites. To listen to a podcast during sleep onset was mentioned by half of the participants.

Figure 9: The specific steps during the evening stages. The main activity during each stage is highlighted in color. Each participant is tagged with a number according to the order of the interviews. The good sleepers (number 2, 3 and 6) are presented in green hues and the bad sleepers (number 1, 4 and 5) in red hues.

The results of the emotional journeys during the two stages is visualized in figure 10. The mean values for the group of bad sleepers in figure 10 are higher for both overall feeling, stress and engagement during the stage of lying in bed. The mean value of tiredness are higher for the good sleepers while in bed, and have a larger increase from the previous stage of the hour before bed. Due to the small scale of the test and the qualitative approach, the most valuable information is found in the participants’ emotions and explanations to the corresponding stages.

Some quotes from the interviews:

“This is the feeling I try to suppress by watching TV” - P1: Stress

“I have a hard time falling asleep without my phone. It makes me fall asleep faster, when I don’t have to just stare at the ceiling. It’s mainly to have something to do” - P2: Phone in bed

“It was an extra step in my routine. Changing an evening routine requires actively doing so and I was not dedicated enough for that, since I did not see the direct benefits” - P3: White noise app

“I really just want to sleep, but it feels like I have to check the stuff since it’s a routine. Feels strange to go to sleep without checking” - P4: Social media

“I can scroll through so much content, just to realize after 1-1.5 hours that it’s late. But even then when I put my phone aside, I can’t sleep” - P5: Social media

“You got an alarm that told you to go to bed. But that didn’t work at all. I just turned it off, thinking now I can keep on watching TV” - P6: iPhone’s sleep app

3Quotes are translated from Swedish to English
Figure 10: The emotional journeys. The good sleepers (number 2, 3 and 6) are presented in green hues and the bad sleepers (number 1, 4 and 5) in red hues. On the left side is the participant’s stated emotions (level of overall feeling, tiredness, stress and engagement) during the hour before bed. On the right side is their stated emotions while lying in bed. The lines between them are visualizing the change in emotions between the two stages. The mean value of each group is presented below the associated graph.

A common trend among all the participants in relation to their nocturnal smartphone usage was found through the interviews. When explaining why they used their smartphone, all stated that it was a habit and it felt strange not to use their phone. The participants in both groups stated discomfort with falling asleep without something to do and felt uneasy if they did not check their social media channels one last time. Two of the participants in the group of good sleepers stated having turned off the screen filter and alarm to go to sleep, in regards to be able to stay up later. All three of the participants in the group of bad sleepers stated having downloaded some kind of sleep related
application to help them sleep better during periods of higher experienced stress or discomfort. None of them had kept on using the applications, with the explanation of them not being beneficial enough or being too disruptive of their current nocturnal habits.

Figure 11: The triggers. The good sleepers (number 2, 3 and 6) are presented in green hues and the bad sleepers (number 1, 4 and 5) in red hues. Each participant’s answer to each trigger picture is presented next to their number. The expected answer (the tagged emotion) to each picture is written above the corresponding set of answers. The participant’s stated emotions who were not in line with the expected emotion are presented in bold text. The number of "correct" corresponding answers are represented in the outlined circles in black.

In total, 53 out of 60 responses to the triggers corresponded to the tagged emotion, giving it an accuracy of 88.33%. The participants were most positive to the pictures with nature motifs, due to the warm light of the sunset and the vegetation. The two pictures tagged with the emotion tired got the biggest difference between the respective responses. All of the participants found the picture of the sleeping cat cozy and relaxing, whilst the picture of the bed was associated to negative emotions by half of the participants due to the perceived darkness in the image. The responses to the image of the computer generated one positive, three negative and two neutral stated emotions. The main reason behind the negative responses were explained as the image being too dark and the content on the screen being e-mails, a stated stressful task. The image of
the smartphone generated one positive, two negative and three neutral stated emotions. The negative emotions were mainly content bounded, depending on the nature of the notifications. In conclusion, the darker pictures was generally higher associated with negative emotions, whilst the brighter pictures was associated with positive emotions.

After compiling the responses from the interviews, all the stated hypotheses in the method section can be verified as being in line with the perceived reality. To visit social media sites (H1) was the most mentioned activity during nocturnal smartphone usage. That social media is an infinite activity making it difficult to initiate sleep (H2) was mentioned by all the bad sleepers, stating a bigger impact upon people in that group. Stated feelings of stress or anxiety (H3) was associated with increased sleep onset latency for all the participants. Furthermore, the results of the trigger test states that imagery can be used as a mood management to enhance specific feelings (H4).

4.2 Workshop

The workshop generated four main concepts with various features during the step of Crazy 8s. The heat map exercise ended up in a total of eight orange dot stickers, representing the workshop participants’ favourite ideas, see figure 12.

![Figure 12: Parts of the result from the heat map exercise.](image)

The ideas which got an orange sticker was:

- A smart "sleep coach" that keeps track of the user’s sleep schedule by learning and interacting with the user (2 votes).
- A score system that gives points whenever the user dares to miss out (2 votes).
- "Go to sleep"-filtered feed without exciting content.
4 RESULTS

- Dashboard available in the morning, presenting missed updates during night time.
- Splash screen telling the user that no new content has been posted since last time visiting.
- Built-in warm screen filter, unable to turn off.

4.3 Concept generation

The solution sketches included features and functionality corresponding to the ideas from the workshop and the initial interviews. After iteration, they were narrowed down into one primary concept. Also, a secondary concept of notification interaction was created, see figure 13.

Figure 13: The solution sketches for the concepts.

The primary concept was based upon the results from the initial interviews with imagery as a mood management, as well as ideas generated during the heat map exercise. The focus was an internal "go to sleep"-filtered feed in Instagram’s application, one of the most frequently used social media platforms. Due to the confirmed effects of imagery as a mood management, all posts with disrupting content is omitted, as well as images with motifs in excessive blue hues. The user would still receive friends posts in the feed, but the concept made sure that the content of the pictures was suitable during nighttime. To help refine the functionality, the user would be able to tell the application which types of motifs is causing stress or anxiety, by removing them from the feed by
pushing a "delete" button. Also, the concept aimed to restrict nocturnal interactions with other users by removing the icon for sending Direct messages within the application. To help the user achieve a healthy routine and limit the usage, the concept was interacting via fixed placed buttons and dialogue areas. After a finite number of posts the user were forced to make an active decision about their usage. Either they quit the application and go to sleep, or made the choice to keep scrolling through older posts. This functionality provided a clear start and stopping point of the usage, a necessity for retaining a healthy nocturnal smartphone routine. The filtered feed got activated automatically each night at a set time, forcing the user to actively turn it off. Also, the concept included a built-in warm screen filter and a darker mode of Instagram’s current interface. The chosen social media platform for the concept was Instagram, due to its current popularity among the target group. To be noted, the same kind of functionality with an internal filter functionality for the feed could be applied onto other social media applications as well.

The secondary concept was based on the smart "sleep coach" idea from the heat map exercise. It worked as an external feature in the background, keeping track of the user’s smartphone usage and sleep schedule without being connected to a specific application. The sleep coach interacted with the user by sending out notifications in relation to late night usage or excessive time spent inside a specific application. The sleep coach had information about the time set for the alarm the next morning, and could thereby notify the user when to turn off the smartphone to retain a healthy routine. The secondary concept was an extension to the primary concept, to get variation of interactivity and information about the user’s preferences.

4.3.1 Wire frames

The solution sketch of the primary concept was refined into wire frames. The stages included was from start of the application, the new feed and the menu. The icon for Direct messages is removed from both the top menu and beneath each post, and replaced with a new placeholder for the "Go to sleep"-filtered feed. At the bottom of the feed a dialogue area was included, see figure 14.

Figure 14: The wire frames of the primary concept.
The secondary concept were not refined as wire frames since it was a solely informative concept without an interface, using an existing chat forum to interact with the participants. Instead, the secondary concept contained a defined manuscript of phrases to each user, see appendix C.

4.3.2 Hi-fi prototype

The hi-fi prototype of the primary concept is designed according to Instagram’s layout and interface for smartphones using Android’s operating system. The concept has been given the name **Sleep Mode** to be explanatory to the user. The Sleep Mode functionality has been given an icon of a half moon. A new icon in the shape of a thumb’s down has been incorporated for filtering out images with subjective disruptive content and placed next to the current icon for saving images, see figure 16. From the wire frames, two hi-fi frames are designed to give the user information about the new functions, working as onboarding. The imagery in the feed are pictures of nature and animals in a warm light, the type of motifs which received suitable feedback during the trigger exercise.

The color scheme consisted of an overall darker interface to mimic the nocturnal surroundings, overlaid with beneficial colors in warm hues working as a permanent filter, see figure 15. All images in the feed has the same warm filter applied to them as well.

![Figure 15: The color scheme of the prototype. Made of dark mode colors with applied warm filter on top, consisting of the yellow-red hue from the Munsell Color System used in Kaya and Epps study [75]. Color to the left is used on interactive areas, color to the right is used for background.](image-url)
The views includes a menu containing information about the filtered feed and the option to turn off the Sleep Mode. This gives the user the ability to view Instagram’s current interface, which provides a better comparison between the two feeds. For imagery in the “real” feed, all types of pictures are included, see figure 17. Activating the Sleep Mode again is achieved by navigating through the icon of the half moon at the top menu. Also, two copies of the hi-fi prototype were created, containing different images in the feed. In total, three versions of the hi-fi prototype were created to be able to test a unique feed each of the three test nights, and each version of the hi-fi prototype consisted of 43 frames.

To be able to send text messages to the participants during the test, the secondary concept was created as a Facebook page. The page did not contain any specific information but provided the ability to send messages through a pseudonym named Sleep coach. The pseudonym separated the sender’s personal account from the messages, which made them appear closer to a real external functionality. The page was named Sömncoach (Sleep coach in swedish) and had a subtle profile picture in the same colors as the hi-fi prototype to tie the two concepts together. The messages were sent through the chat forum included in the functionality for Facebook pages.
4.4 Usability test of hi-fi prototype

In total, the usability test included eight participants. They were divided into the two test groups, with four people in group A who solely tested the prototype, and four people in group B who tested the prototype in combination with the secondary concept (the Sleep coach). Due to the method of choice of gathering the participants, the gender division was six females and two males (75% respectively 25%). The two males were equally distributed, with one in each participant group. Each participant got their own unique link to a sleep diary every day of the test. Also, the participants in group B got a link to the Sleep coach page on Facebook to be able to start chatting.

After collecting all the sleep diaries, some data can be extracted. The mean values of the stated sleep onset latency during the test nights of the participant is presented in table 3.

<table>
<thead>
<tr>
<th>Sleep onset latency (all nights)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
</tr>
<tr>
<td>Participant 2</td>
</tr>
<tr>
<td>Participant 3</td>
</tr>
<tr>
<td>Participant 4</td>
</tr>
<tr>
<td>Participant 5</td>
</tr>
<tr>
<td>Participant 6</td>
</tr>
<tr>
<td>Participant 7</td>
</tr>
<tr>
<td>Participant 8</td>
</tr>
<tr>
<td>Sleep onset latency (all participants)</td>
</tr>
<tr>
<td>First night</td>
</tr>
<tr>
<td>Second night</td>
</tr>
<tr>
<td>Third night</td>
</tr>
<tr>
<td>Fourth night</td>
</tr>
<tr>
<td>Fifth night</td>
</tr>
</tbody>
</table>

Table 3: Mean values of the stated sleep onset latency from the participants’ sleep diaries.

What can be seen in table 3 is that the total mean sleep onset latency of all the participants is decreasing throughout the nights. It is a small increase during the third night of the test, which is the first night of trying out the prototype. During the following nights, the sleep onset latency is reduced to a mean value of 27.143 minutes the fifth night after using the prototype for three nights.

The results of the emotional journeys in the sleep diaries are visualized in figure 18 (for the first two "regular" nights) and in figure 19 (for the three nights of using the prototype).
Figure 18: The emotional journey of the participants during the first two "regular" nights. Group A in green dots, group B in purple dots. Each participant was given a unique number, which is written inside the dots. The scaled feelings are their subjective overall feeling, tiredness, stress and engagement.

What can be seen in figure 18 is that the values of the participants’ stated emotions during the first two nights has an apparent variation between them. The values are well spread out, except for the feeling of tiredness during the second night where all the participants has stated the value +1 or +2 (which refers to tired or very tired). Still, the mean value of the sleep onset latency for the second night was 63.75 minutes. The values of subjective stress among the participants are located in between the values 2 up to 4, which refers to palpable stress during the first two nights.
Results

Figure 19: The emotional journey of the participants during the three nights when using the prototype. Group A in green dots, group B in purple dots. Each participant was given a unique number, which is written inside the dots. The scaled feelings are their subjective overall feeling, tiredness, stress and engagement.

Compared to the first two nights, the values of the participants’ stated emotions during the following three nights of using the prototype has coincided. The overall feelings are all located between 0 to +2 (which refers to neutral, to very positive feelings). Also, stated feelings of stress are mostly located between the values 1 or 2, showing a decrease in stress compared to the first two regular nights. The values can be seen in figure 19.

Some quotes about the prototype from the sleep diaries:

“It was a nice prototype and I liked the dark interface during nighttime, so no light interrupted my sleep. I do not know if I would use the concept if it is meant to display random images on Instagram during nighttime. But if it would sort out a feed among images I am actually interested in it would have worked better!” - P8: Prototype (third night)

“It is quite difficult to get rid of all stress after use of the prototype. The stress is mostly work related or something private that occupies my mind while in bed. But it felt good to create a routine of looking at calming pictures. A little bit like meditation.” - P1: Prototype (fourth night)

“Lovely colors, very calming. Not so many pictures in the feed so it ended quickly. But good functionality to be able to delete images and customize my own feed. It felt better than the previous day, maybe because it was more familiar the second night.” - P3: Prototype (fourth night)

4Quotes are translated from Swedish to English
Some of the feedback about the prototype collected through the evaluation form after completion of the usability test is presented in table 4.

<table>
<thead>
<tr>
<th>General experience</th>
<th>Compared to Instagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Bad) 0%</td>
<td>1 (Worse) 14.3%</td>
</tr>
<tr>
<td>2 (Bad) 0%</td>
<td>2 (Worse) 0%</td>
</tr>
<tr>
<td>3 (Bad) 0%</td>
<td>3 (Worse) 14.3%</td>
</tr>
<tr>
<td>4 (Good) 57.14%</td>
<td>4 (Better) 42.86%</td>
</tr>
<tr>
<td>5 (Good) 42.86%</td>
<td>5 (Better) 28.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tried to filter out images</th>
<th>Want to filter out images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes 100%</td>
<td>Yes 57.14%</td>
</tr>
<tr>
<td>No 0%</td>
<td>No 42.86%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Turned off &quot;Sleep mode&quot;</th>
<th>Action after &quot;No more posts&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes 83.33%</td>
<td>Close app 42.86%</td>
</tr>
<tr>
<td>No 16.67%</td>
<td>See more 57.14%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noticed DM’s deactivated</th>
<th>Want DM’s deactivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes 28.6%</td>
<td>Yes 85.7%</td>
</tr>
<tr>
<td>No 71.4%</td>
<td>No 14.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sleep mode in all social media feeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes 71.5%</td>
</tr>
<tr>
<td>No 14.3%</td>
</tr>
<tr>
<td>Unsure 14.3%</td>
</tr>
</tbody>
</table>

Table 4: Summarized results of the evaluation form. Percentage of total 7 participants, due to one participant never completed the evaluation form. DM’s refers to Direct messages in Instagram.

The evaluation form also contained questions about what the participants liked in particular with the prototype, and which parts could be improved. The parts of the prototype the participants really **liked**:

- The dark and warm colors
- The internal filter functionality in the application, instead of having to download a specific sleep app.
- The imagery was calming and relaxing
- The finite feed and explanatory text in the bottom reduced *fear of missing out*
- Easy to use and understand
- Less focus on comments and videos, which usually needs more attention

The parts of the prototype the participants would like to **improve**:

- More posts in the feed
- Settings for number of posts or theme of the images
- Would have liked to see friends posts instead of generated pictures
For group B, two extra questions were included in the evaluation form according to their feelings towards the Sleep coach. When asking about if the Sleep coach affected their attitude towards their sleep routine and smartphone usage by sending them messages, 3 out of 4 participants answered Yes. One participant answered that it did not change their attitude, but it was a very cozy functionality that helped taking their mind of things. When asking if they would like to use a "sleep coach" as a nocturnal aid, 3 out of 4 were positive. Some quotes from the answers according using the sleep coach as an aid:

“I enjoyed writing back to the Sleep coach and when it asked me about my sleep/wake-up time. It felt nice that the Sleep coach sent hearts as well!”

“It was good since I started focusing on unwinding during nighttime. When the Sleep coach asked if I wanted to be reminded, I didn’t now if it meant as an alarm. In that case, I prefer being woken up by my usual alarm clock. Receiving messages each night could turn out as a something stressful, which could lead to turning off the Sleep coach when my sleep has improved.”

“It feels like a tool that could work really well to reduce stress, and facilitate a better sleep.”

“I liked the Sleep coach! I noticed changing my bedtime to an earlier time each night of the test, which I think the Sleep coach might have contributed to. I don’t know if I would be as interested using it during vacations, but I really liked the notifications during the working week. A Sleep coach with settings would be an awesome thing for me!”

4.5 Final design proposal

Due to the positive feedback from the usability test, the overall design of the hi-fi prototype is kept in the final design proposal, like the warm color scheme and the filtered feed. The button for Direct messages is still removed since 85.7% voted for its removal during nighttime. The button for filtering out images with disruptive content is still included, but the icon has been simplified according to some feedback in the evaluation form. The text in the dialogue area in the bottom of the feed has been refined, due to triggering feelings among one of the participants. Since the participants really enjoyed the Sleep coach’s gentle vocabulary and caring nature, the dialogue area has been given a heart icon to enhance those feelings via the feed as well. See figure 20.

5Quotes are translated from Swedish to English
Figure 20: Views from the final design proposal, displaying Instagram’s interface with *Sleep mode* activated.
Figure 21: Views from the final design proposal, displaying Instagram’s interface with *Sleep mode* turned off. A top bar serves as the navigator to enter the menu.
5 Discussion

Sleep problems and insomnia has proven being a complex and difficult issue to find a unanimous solution to. As several studies has stated, there is not one prominent factor [1][16]. Instead, there is a whole selection of both environmental and psychological influences affecting the health of the population. A big issue I have discovered during this study is the incoherent medical classification of sleep disorders. Both the International Classification of Sleep Disorders (ICSD-3) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) specifies chronic insomnia disorder by a variety of criterion [22][23]. The lack of clear lines between subjective bad sleep and a chronic sleep disorder is preventing people from seeking and receiving the right treatment. The only well documented correlation is between sleep difficulties and mental health problems [5][29][30], which in itself is already a huge problem looking into the large increase of depression during the last couple of years [4].

What can be dealt with immediately according to me is experienced stress, a factor well mentioned in relation to sleep problems [31]. Stress can grow from a variety of situations, and in particular from social pressure, the closest one in our interconnected society today. Social media platforms holds a big responsibility for the health and well being of the present and future generations. The worldwide smartphone usage is making its way to younger age groups each year [7]. A positive step towards a solution is when big companies like Google and Apple are releasing concepts of Digital Wellbeing [8][9]. Unfortunately, they have both taken an external approach by providing a separate dashboard where the user can enter and view their usage. Looking back to the findings by Ansfield et al., who identified conditions in which people’s purposeful attempts at falling asleep ironically led to paradoxical wakefulness [62]. They are stating that the harder a person is trying to fall asleep, the more difficult it will be. To provide the user with an external dashboard, forcing them to actively check and reflect their usage is according to me only giving fuel to the fire of sleep problems and paradoxical wakefulness. Instead, according to the findings in this study the solution is rather to transfer the solution from an external feature to an internal feature, acting closer to the end user in real time during lights out. During the initial interviews, the participants stated reluctant towards installing detached sleep related applications. By moving the functionality inside the most commonly used applications, the target group will experience digital well being first-hand, without having to take a conscious decision to actively try to improve their nighttime habits. Also, the participants in the usability test stated very positive feedback towards the internal functionality, instead of having to download a separate application.

The most common social media platforms in Sweden (2017) are Facebook and Instagram. People under the age of 25 holds the leading roll and activity on the platforms Snapchat and Youtube [6]. These platforms were also confirmed as the most commonly used during lights out in the initial interviews during this study. Instagram was the chosen target platform for prototyping and testing for this study, but there is no reason why the concepts generated and tested during this study could not be implemented into the other popular platforms as well. A filtered feed could be applied onto any feed, as long as the platform has knowledge about the content of the feed. In real life, the functionality could be applied by tagging posts and images according to the nature of the content,
or even implement intelligence that sorts out specific posts by image or text recognition. The technology today has both the potential and the capacity for handling these types of functions, if not even more advanced algorithms for providing each user with personalized content well suited during nocturnal use.

Throughout schools and universities, students are expressing a unified experienced social pressure to appear happy and successful online [42]. As a result, feelings of stress, anxiety and failure can spread like a virus. The terms *fear of missing out*, *phubbing* and *nomophobia* has taken their place into social scientists dictionaries due to their frequent appearance in studies [43][45]. According to the previous studies, females are especially affected by the social pressures [39], which might correlate with the findings of females using smartphones as facilitators of social interaction, compared to males that in general see smartphones as empowering devices [45]. Also, studies have shown that female students more frequently used mobile phones after lights out and more often experienced poor mental health [30][16]. The reason behind these gender differences is not investigated during this study, but a discussion about if the female participants during the previous studies are solely more honest about their problems could be made. An instant doubt comes to mind when reading about the gender differences in smartphone usage, which might not be as clearly defined as previously stated. On the other hand, a majority of the people who signed up and participated in this study were females. If the reason behind the predominantly female participation were due to the stated gender differences in previous studies, or if it was just by chance is hard to define. My initial belief that both genders are affected by social pressure and sleep problems in the same way can not be discarded, and is still in my opinion a valid assumption.

This study in combination with other studies like Christensen et al. and Cain et al. [12][13], states that the nocturnal usage is not necessary the problem. Instead, the pressure that social media platforms are creating among its users is the real issue. Functions that makes the users feel observed and patronized, like sharing information of the receivers last-seen time or sending push notifications to an inactive user, have been proven expanding the pressure [41]. Also, by providing the users with the ability to send messages during nighttime or posting real-time updates (like Instagram Stories or Snapchat) is like handing out cheat papers during an exam. If a function is provided to the user, it will most certainly be used.

The initial aim of finding suitable nocturnal interactions during this study has been proven feasible. By unexpectedly small means, fast results can be achieved. A quick and easy first step towards changing an application into being better suited for nocturnal usage is to change the colors of the interface into darker colors and restricting tones in blue hues. But if the aim is to really improve the user’s digital health (as it should be), the findings in this study shows that people are willing to get restricted during nighttime by reducing functionality inside applications. The results from the usability test states an appreciation towards specialized nocturnal feeds, providing the user with suitable interactions within their current platform. When the participants viewed a finite number of posts, containing imagery with sorted content, the sleep onset latency decreased and the subjective sleep quality was enhanced. By adding the secondary concept built on interaction via text messages, an initial concern was that the participants would experience the concept as stressful due to its similarities to push notifications. Proven the opposite, the participants really
enjoyed the Sleep coach’s gentle vocabulary and way of guiding them through their nocturnal usage, by phrases that encouraged them to dare to miss out. The combination of emotional suitable content and a caring way of interacting, the results showed both a subjective and objective improvement of their sleep onset.

Companies, application developers and designers needs to start take responsibility for their end users’ digital health, by providing them with suitable functionality for every hour of the day, even during nighttime. We know that people are currently using their smartphones throughout the 24 hours of a day, which needs to take into consideration when creating concepts. Today, the line of business of technology is a powerful and leading branch with a lot of fast money to be made. Hence, it is extremely important to remember to keep the human factor in the center of the process of development. Every application on the market is meant to be used by someone, and behind the application is the owner or creator held responsible for the release, therefor also responsible for the user’s experience.

Creating nocturnal interactive solutions in line with reducing experienced stress among the users will enhance the user’s well being, and in extension prolong their use of the application. It is a win-win situation for both parts, with a healthier, happier and more well rested group of people using the application in the end. The current experienced social pressure is partly a result from poorly made user experience within applications, which hopefully will be extincted in the near future by greater knowledge about nocturnal smartphone usage and beneficial interactions during sleep onset.
6 Conclusion

From the questionnaire and the initial interviews, this study has verified that a majority of people are using their smartphone in bed while trying to fall asleep. The most popular nocturnal task is to browse through social media. Most had in the past installed a specialized application targeting sleep. But the standing opinion was a reluctant attitude towards installing external applications. The nocturnal habits of the participants are hard wired and difficult to affect. Hence, this study has concluded that the most suitable way of reaching the target group through smartphone interaction is to integrate a solution within their current applications. An internal solution in social media applications is according to this study the best way of enhancing the digital well being and beneficial nocturnal interactions among users.

All of the most frequently used social media platforms on the current market are containing some kind of imagery, which is why mood management through filtered content is a universal solution. Through the interviews and usability test during this study, the method of mood management through imagery has been proven valid and beneficial during sleep onset. The other big problem with current social medias was the infinite feed, which was solved by restricting the amount of visible posts. When the user in first hand only got to view new unseen posts, they were forced to make an active decision about viewing older posts, and in extension make a decision about their own usage. The restricted feed gave the users a clear start and stopping point, which contributed to a reduced fear of missing out. Also, by reducing the amount of available functions, discarding hues in the blue color spectrum, turning the interface into a darker color scheme and providing users with encouragement during nighttime, the sleep onset latency decreased.

Even though nocturnal smartphone usage is one of the most frequent occurring activities today, the user experience during nighttime has not been given as much attention as it should. Studies should start to take a different approach than to state a prohibition of nighttime usage, solely blaming the users for bringing their smartphones into bed. Instead, the area of nocturnal usage needs to be given greater focus in the development of applications, especially by designers in charge of the user experience. There is a whole new area of designing suitable nocturnal features into both existing and upcoming platforms, which should be taken into consideration. With the knowledge about the user’s habits and preferences, one can start shape the foundation of real digital well being and construct healthy human-computer interactions for the future market of applications.
7 Future Work

The biggest concern from the participants of the usability test was that they did not get to view real posts from their friends in the feed. Due to the time frame of this study, the concept was implemented as a hi-fi prototype which restricted the functionality. For future work, the concept should be implemented as a real application able to load the user’s existing social media posts. Also, other platforms should be tested on to find suitable solutions for their concepts.

The target group for this study was people aged 18-30, who was currently using their smartphone in bed and experienced problems initiating sleep. Also, both genders were included without making any separation between the two. For future work, focus could be on a different age group or on a specific gender to narrow out any differences. An interesting age group is the adolescents, who are the next generation of influencing users. Various studies mentioned in this paper has stated that females are more exposed to sleep difficulties and health problems, which could be studied further. Also, people who are currently using their smartphone in bed without having any troubles with falling asleep could be an interesting target group to look into. When studies starts finding out exactly what works and what does not during nocturnal usage for the different types of users, new guidelines for designing applications and services could be developed.

The specifications of chronic insomnia disorder is an important field to do more research into. A clearer and unified definition should be constructed, but also handed higher up in the social hierarchy of our community, state, the governing body of a nation or even on an international level. Raising awareness of chronic insomnia can facilitate the treatment needed, but also help people to realize the seriousness of their own difficulties.

For the future, beneficial nocturnal smartphone usage is a very important field which should be investigated and studied further. There is much more to be done since the only solution so far has been to deny or blame the users for their nocturnal usage, at the same time as applications are pushing them into their apps by sending notifications and providing full functionality throughout the night. The current field of study has fallen behind the evolution of technology and the shift in wakefulness of the end users, which means that future work about beneficial nocturnal smartphone usage is highly recommended.
8 Acknowledgements

I would like to thank my amazing supervisors Fredrik Johansson and Robert Holma at Daresay, Umeå, for their inspiration, help and support throughout this study. Special thanks for their participation in the workshop, including Filip Hammarberg, that led to the final design proposal and for pushing me to complete this thesis. I also want to thank my supervisor Ulrik Söderström at Umeå University, for giving valuable feedback about the thesis and keeping the study on track throughout the whole summer.

Secondly, I want to thank all the people who answered the questionnaire and the six people participating in the interviews. Big thanks to the eight participants in my final usability test, without you I would not have got the final results. Also, thanks to the people providing me with valuable input during the study; to Andrea Norell at Daresay for the feedback about interview techniques, and to Malin Eriksson and Petter Wallin at Northcube for their inputs about designing applications for nocturnal use.

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Finally, big thanks to friends and family for your love and support.
Appendices

A Sleep diary

This is the values for the sleep diary used in the usability test of the final design proposal, written in swedish.

A.1 Introduktion


A.2 Frågor efter "vanliga" nätter

1. Vilken tid gick du och la dig igår?
2. Hur lång tid tog det att somna?
3. Vad gjorde du när du lagt dig i sängen?
4. Hur lång tid använde du mobilen efter du lagt dig i sängen?

A.3 Frågor efter nätter med prototypen

1. Vilken tid gick du och la dig igår?
2. Hur lång tid tog det att somna?
3. Hur lång tid använde du prototypen efter du lagt dig?

A.4 Värden

- Generell känsla (skala 1-5)
- Trötthet (skala 1-5)
- Stress (skala 1-5)
- Engagemang (skala 1-5)
- Andra tankar eller funderingar
B Evaluation form

This is the values for the evaluation form used after the usability test of the final design proposal, written in swedish.

B.1 Introduktion

Tack för att du var med i användartestet av prototypen för detta exjobb! Nu när det är klart får du gärna fylla i utvärderingen om hur din upplevelse var.

B.2 Frågor

- Hur var din generella upplevelse av att använda prototypen?
- Hur kändes det att använda prototypen på kvällen, gentemot Instagrams vanliga flöde?
- Tror du att din sömn skulle påverkas ifall sociala medier fick ett filtrerat flöde likt prototypens under kvällstid? Varför?
- Testade du funktionen att kunna filtrera bort bilder (via ikonen föreställande tumme ner)?
- Skulle du vilja ha möjligheten att kunna filtrera bort inlägg/bilder på sociala medier?
- Testade du att stänga av "Sleep mode" funktionen i prototypen?
- Hur upplevde du meddelandet längst ner i flödet som berättar att det inte finns några fler nya inlägg?
- Tror du att du (generellt) skulle välja att se äldre inlägg när det meddelandet visas?
- La du märke till att funktionen för att skicka direktmeddelanden var avaktiverad?
- Vad tycker du om att funktionen för att skicka direktmeddelanden avaktiveras under kvällstid?
- Vad tyckte du var bra med prototypen?
- Vad tycker du skulle kunna förbättras med prototypen?
- Skulle du vilja ha möjligheten att byta ut Instagrams flöde mot ett flöde liknande prototypens på kvällstid?
- Övriga synpunkter och funderingar

B.3 Tillagda frågor till grupp B

- Du fick även meddelanden av "Sömncoachen". Påverkade tjänsten dig något genom att skicka meddelanden?
- Är "Sömncoachen" något du skulle vilja ha som hjälpmedel?
C Sleep coach manuscript

This is the manuscript for the second concept called the Sleep coach, used in the usability test of the final design proposal. All phrases are written in swedish.

C.1 Dag 3
Kring kl 21:00 God kväll.... *AUTOMEDDELANDE*
Vill du att jag ska pärminna dig?
Här har du dagens prototyp, öppna när du är redo att lägga dig: länk
Om svar JA (Pärminnelse: 8 timmar kvar till uppvaknande) Nu är det 8 timmar kvar tills du ska kliva upp, om du släcker ned nu har du bästa möjliga chans att få tillräckligt med sömn <3
Om svar NEJ (Pärminnelse: 8 timmar kvar till uppvaknande) Gör dig själv en tjänst, stäng ner nu för din hälsas skull och kolla igenom imorgon istället <3
En timme efter planerat uppvaknande God morgon! Kom ihåg att fylla i dagboken <3

C.2 Dag 4
Kring kl 21:00 God kväll! Planerar du att kliva upp samma tid som igår?
Vill du att jag ska pärminna dig?
Här har du dagens prototyp, öppna när du är redo att lägga dig: länk
Om svar JA (Pärminnelse: 8 timmar kvar till uppvaknande) Nu är det 8 timmar kvar tills du ska kliva upp, om du släcker ned nu har du bästa möjliga chans att få tillräckligt med sömn <3
Om svar NEJ (Pärminnelse: 8 timmar kvar till uppvaknande) Gör dig själv en tjänst, stäng ner nu för din hälsas skull och kolla igenom imorgon istället <3
En timme efter planerat uppvaknande God morgon! Kom ihåg att fylla i dagboken <3

C.3 Dag 5
Kring kl 21:00 God kväll! Vilken tid planerar du att stiga upp imorgon?
Vill du att jag ska pärminna dig?
Här har du den sista prototypen, öppna när du är redo att lägga dig: länk
Om svar JA (Pärminnelse: 8 timmar kvar till uppvaknande) Nu är det 8 timmar kvar tills du ska kliva upp, om du släcker ned nu har du bästa möjliga chans att få tillräckligt med sömn <3
Om svar NEJ (Pärminnelse: 8 timmar kvar till uppvaknande) Börjar du känna dig trott? Låt sömnen få ta sin plats, efter en heldag har du gjort din kropp förtjänt att koppla av <3
En timme efter planerat uppvaknande God morgon! Kom ihåg att fylla i dagboken för sista dagen <3
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