

# Sweet Dreams, thanks to technology?



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## Abstract

Many young adults face sleeping problems that are caused by their interaction with technologies such as their smartphone. Mitigating the interaction with technology in the bedroom, for instance via a sleep technology that could cancel out the use of other technologies, could dissolve most of the sleeping problems for young adults. Therefore, this study focused on what the decisive factors are for young adults that determine the need for such sleep technology. In order to form an answer, 15 semi-structured interviews and one focus group interview were conducted with people within this age group to identify their needs. The results discovered that young adults are well able to act upon their own needs regarding sleep. This indicates that there is relatively little need for a technology that can cancel out the use of other technologies.

This resulted in the conclusion that the decisive factors that determine the need for sleep technology that cancels out the use of other technologies for young adults are that young adults are well able to act upon their own needs regarding sleep and that there are cheaper alternatives available.

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# 1. Introduction

Sleep plays a major role in our life. In fact, we spend one third of our lifetime sleeping. Physiological processes, emotion regulation and cognitive functioning are all determined by the quality of our sleep (Krause et al., 2017). Modern lifestyles with longer working hours and more usage of technology make it difficult to maintain a good sleep quality with sleep-related problems as a result, especially for young adults (Kecklund & Axelsson, 2016). This is stated as an unnoticed public health epidemic (Chattu et al., 2019).

Rosen et al. (2016) explained that there are four different factors that have an influence on the amount of sleeping problems for young adults. These are: smartphone use, multitasking preference, nighttime phone location, and nighttime phone awakenings (Rosen, Carrier, Miller, Rokkum, & Ruiz, 2016). Mitigating the use of technology within the bedroom, for instance via a sleep technology that could cancel out the use of other technologies, could dissolve most of the sleeping problems for young adults stated by Rosen et al. (2016). A technology as such is now in the developing phase and is currently formed like an application in combination with physical accessories. Further information regarding this technology cannot be provided with regards to the signed non-disclosure agreement (NDA). However, in order to successfully create this sleep technology, there must be known to what extent there is a need for such a product. Furthermore, there must be investigated to what extent these needs can be satisfied by such a product.

The objective for this thesis is to examine whether sleep related needs could be satisfied through the adoption of sleep technology. To reach this objective, ‘needs’ are closely examined. To start off, there will be looked at what type of ‘need’ sleep is. After that, consumer needs will be described and there will be discussed how these needs are satisfied through the creation of value. This will be explained through the concept of value proposition. Next, with help of Schwartz’s value theory (1992) and the Means-End Chain Theory by Gutman (1982) the differences in needs will be enlightened. Thereafter, there will be described which factors influence sleep (Rosen et al., 2016). Finally, sleep technology in wearables that are currently available will be evaluated.

This research will be guided by the following research question:

*‘What are the decisive factors that determine the need for sleep technology that cancels out the use of other technologies for young adults?’*

In order to obtain data, interviews will be taken to understand the personal needs of the target group. The target group will be young adults, aged between 18 and 30 years, as according to Rosen et al. (2016) they face the most sleeping problems caused by technology. After the data

has been collected, the results will be interpreted after which an answer to the research question will be given.

Most studies that have been executed with regards to sleep monitoring and sleep technology have focused on solving problems such sleep disorders. Little research has been carried out that focused on the needs of the consumer with regards to what could benefit them during their sleep. Therefore, the academic relevance of this thesis is that it focuses on the user and will try to identify what they value with regards to their sleep to eventually discover if there is a need for a sleep technology that cancels out the use of other technologies. This way, a light is shed on the current sleep-dependent needs of young adults and whether they could benefit from this new sleep technology. By investigating sleep related needs, developments such as technology that cancels out the use of other technology can tap into this mapped market by offering its problem-solving solutions.

## 2. Literature review

### 2.1 Physiological needs

Maslow's hierarchy of needs is a well-known theory that categorizes five different forms of human needs: Physiological needs, Safety need, Love and Belonging, Esteem and Self-actualization (Hopper, 2020). Figure 1 visualizes these categories as Maslow has stated them. The Physiological needs refer to basic physical needs and are therefore at the lowest level of the pyramid. These needs are the most urgent need to fulfill since human survival depends on it. One of these needs is sleep (Maslow, 1943).



Figure 1. Maslow's hierarchy of needs (Hopper, E. (2020))

One of the key takeaways of this hierarchy is that higher needs (within the pyramid) emerge only when people feel that have sufficiently fulfilled the previous needs (Maslow, 1943). Emphasizing the importance of the physiological needs, including sleep.

In the last few decades, researchers have tried to identify all the functions of our sleep. While some functions have been clarified, there are still a lot to be discovered. Overall, scientists agree upon the founding that sleep is a necessity for our health and therefore for our survival. Next to that, sleep is critical for the ability to think clearly, maintain attention, and being alert and vigilant. In other words, sleep is critical for our waking cognition. Moreover, sleep takes a primary part in emotion regulation and when sleeping, memories are consolidated. When sleep is inadequate, this has a negative influence on these functions (Worley, 2018). Which as a result, can harm our psychological well-being. According to Dr. Dinges, the required amount of sleep is 7 hours. If it drops below this amount, multiple disorders can start to occur. There has been consensus out of thousands of articles regarding this topic that the average adult requires between 7 and 7 and a half hours of sleep (Panel et al., 2015).



## 2.2 Adding value

Marketing, economic psychology, and consumer research are all driven by the concept of ‘needs’ which assists in the understanding of consumer behavior (Kassarjian & Robertson, 1968). For instance, the need for uniqueness and social identification is a psychological variable which assists in explaining why an individual adopts to an innovative product or service (Bartels & Reinders, 2011). Regarding to the paragraph above this will refer to the “Esteem” level of needs (Maslow, 1943).

Customer needs can be stated as the desired customer outcome and it sets the starting point for the creation and the development of a value proposition (Hankammer, Brenk, Fabry, Nordemann, & Piller, 2019). Value proposition can take an important part in explaining how value can be provided to consumers. It can help organizations to identify what the current problems are of consumers, and eventually solve these with creating value through a new service or product (Payne, Frow, & Eggert, 2017).

In order to create value, there must be known what value is. According to Grönroos & Voima (2013), the creation of value leads to a situation where a customer’s well-being is enhanced. This can take shape in multiple ways, for instance by solving problems of the customer (Sawhney, 2006), supporting the inner peace of the customer (Woodruff, 1997), or solely alleviate the customer from responsibilities (Strandvik, Holmlund, & Edvardsson, 2012). Next to that, value creation can be an ongoing process if the value is perceived as value-in-use for the customer (Grönroos & Voima, 2013). This implicates that value is created when the product or service is in use, which most often is temporary as this depends on the amount of time that the customer uses the product or service (Helkkula & Kelleher, 2010). Thus, the extent to which needs can be satisfied depends on the interaction between the user and the product or service (Echeverri & Skålén, 2011).

Some researchers described that the value proposition is the most crucial organizing principle of an organization (Webster, 2002). Lanning and Michaels (1988) explain that business is most often constrained due to the traditional product-oriented system, where products are created, made, and then sold. According to them, this system is too internally focused. As the receiver defines what the value is instead of the giver, there must be looked at the customers in order to determine what the value is (Ulrich & Brockbank, 2005). Therefore, instead, value proposition represents what a business should look like from a consumer’s perspective. By choosing the value, providing the value, and communicating the value, the consumers’ needs can be assessed and therefore there can be determined to what extent organizations can satisfy those needs (Lanning & Michaels, 1988). Lanning (1998) solely elaborated upon his theory in a later study in which he explains that providing value entails the consumer acceptance of the proposition, that he or she consumes the product and engages in

the experiences. Where communicating the value dives deeper into the experience where the consumer understands and appreciates the proposition during the whole life cycle of the product or service. To implement this correctly, it is important to gain an understanding of what it is like to be the customer (Lanning, 1998). Therefore, this study aims to identify if there is a need for a new sleep technology by putting the needs of the respondents in the center to eventually discover if value can be created by such a technology. As previously said, the receivers, thus the respondents in this study, define what the value is instead of the producers.

Important here is to take segmentation into account. According to the value proposition builder by Barnes, Blake and Pinder (2009), the first stage is to identify the customer segments. As the product or service that has the potential to deliver value can sometimes only be well suited for certain individuals (Barnes, Blake, & Pinder, 2009). Therefore, different value propositions are sometimes required for different segments and these segments might need adjustments over time in order to satisfy the needs for different customers (Payne, Frow, Steinhoff, & Eggert, 2020). The origin of the difference in needs will be elaborated upon in the next paragraph.

### 2.3 Difference in needs

In the last paragraph there is discussed what needs are and how these can be satisfied through the creation of value. As the subjective customer experiences recognizes value related to their constantly changing individual needs (Holbrook, 1999), value is continuously interpreted differently by everyone. Needs have become more diversified and personalized which makes it even more difficult yet more important to identify them (Yang, Shan, Jiang, Yang, & Yao, 2018). According to the Schwartz (2012), thinking of values equals thinking of what is important in our lives. What one values to be important might be valued as very unimportant by others.

Schwartz's value theory (1992) identifies six main characteristics which help to understand different perceptions of all values: values are beliefs, values refer to desirable goals, values transcend specific actions and situations, values serve as standards or criteria, values are ordered by importance, and the relative importance of multiple values guides action (Schwartz, 1992). These characteristics of values are differentiated from each other by the difference in motivation or goal that it exhibits. The value theory created ten different values that correspond with the motivation that embodies each of them (Schwartz, 2012) These ten values are: self-direction, stimulation, hedonism, achievement, power, security, conformity, tradition, benevolence, and universalism. Regarding this research, a few of these values will be further elaborated. Starting with self-direction, which implicates having an independent thought through action exploring and creating. It originates from the need for control and autonomy



(Bandura, 1977). Stimulation refers to enthusiasm and the creation of a stimulus to challenge oneself. It originates from the need for variety to maintain positive, excited, and optimal. Achievement implies the need for personal or group success through competent performances. Security is the need for safety for oneself and others, and stability of relationships (Schwartz, 2012).

Values are seen as the underlying dimension of our attitudes and behavior, and these determine if objects are seen as desirable or undesirable (Schwartz, 2012). If an object is seen as desirable, this might implicate that there is a need. Thus, the extent to which an individual score the importance of the ten values determines their attitude and behavior towards a service or product and whether it is desirable or undesirable, which eventually determines if there is a need. Therefore, the ten different values identified by Schwartz's value theory eventually determine the difference in attitudes and behaviors and thus the differences in needs.

Another theory which can assist in explaining the difference in needs is the Means-End Chain Theory (MEC) (Gutman, 1982), which helps to determine why consumers make decisions. It attaches tangible attributes of a products, also known as the mean, with emotional values which are intangible and often personal, also known as the end (Olson & Reynolds, 2001). This theory states that customers are goal-orientated decision-makers which makes decisions based upon what they think will lead to the most desired outcome (Costa, Dekker, & Jongen, 2004). There are two assumptions which outline the goal-oriented framework. The first assumption is that consumers buy and use products based on how they evaluate the consequences of buying and using these products. The consequences of these behaviors (buying and using) are self-relevant. The self-relevance of these consequences is based on individually held values, thus values that differ between individuals. The value of the consequences come from product attributes. The attributes, consequences, and values (ACV) and more importantly the link the consumers see between the ACV are the foundation of the most important part of MEC. The second assumption refers to the conscious and voluntary choices that consumers make which are led by evasive behavior towards negative consequences and the scout for positive outcomes (Olson & Reynolds, 2001).

The result of this theory is a value chain which relates a product attribute to the functional consequence, then to the psychological consequence, and eventually to the personal value. In this chain, attributes are the physical and tangible product or service features. Functional consequence relates to the benefits that are experienced when using the product or service. Psychological consequence are the emotional benefits which are obtained through the experience of the product or service. And value is desired result the consumer aims to achieve (Kuisma, Laukkanen, & Hiltunen, 2007). As the consequences are self-relevant and based on individually held values, the outcome of especially psychology consequence will deviate

among individuals. Which results in different outcomes of value in the last chain of the means-end value chain. And because the output of value differs per individual, needs differ too.

## 2.4 Factors regarding the use of technology that influence sleep

According to the National Sleep Foundation, the recommended sleep duration for a good quality sleep is for teenagers 8-10 hours, for adults 7-9 hours and for elderly 7-8 hours of sleep per night (Hirshkowitz et al., 2015). Studies show that especially young adults are not achieving the recommended amount of sleep (Lukowski & Milojevich, 2015). According to Rosen et al. (2016), there are four different factors that influence the amount of sleeping problems for young adults. These are: daily smartphone use, multitasking preference, nighttime phone location and nighttime phone awakenings.

A study showed that two out of three young adults who used their smartphones in the last hour before going to sleep had more problems falling asleep (Gradisar et al., 2013). What is also pointed out by the same study is that half of the young adults who used their phone before bed, left their sound on and were awakened multiple nights a week which led to the struggle of falling back asleep. This is backed up by another study which discovered that almost half of young adults respond to phone calls and other alerts at bedtime which also led to problems returning to sleep. These periods of awakenings lead to a lower amount of sleep which can lead to health-related problems (Adams & Kisler, 2013). This can be explained by the fact that the usage of technological devices mitigates the release of melatonin (West et al., 2011). This relationship is well defined and therefore the National Sleep Foundation recommends that we should not use interactive technology one hour prior to bedtime (Gradisar et al., 2013).

The reason that young adults can be awakened by their phone is that their phone is turned on, stated as the factor 'Nighttime-phone-awakenings', and their phone is located near their bed, stated as the factor 'Nighttime-phone-location'. Multiple researchers implicate that more concern needs to be raised regarding the usage of interactive technology before bedtime, as this has serious drawbacks (Hysing et al., 2015). In particular for young adults, as sufficient sleep is crucial during this development. Therefore, Bruni et al. (2015) state that public health systems need to focus on spreading information concerning the urgency of sleep and the additional importance with regards to limiting the use of interactive technologies before bedtime.

## 2.5 Sleep technology in wearables

Electronic devices, such as wearables and smartphones, can collect sleep data over a longer period of time and for a fraction of the price compared to polysomnography (PSG), known as the golden standard for measuring sleep quality due to its accuracy and expertise. By recording and monitoring sleep data via technologies in our electronic devices, detailed insights in the quality of sleep are collected and this can provide information of the user's health (Ko et al., 2015). There is a growing need for devices with integrated antennas which assist in monitoring and measuring multiple services as it is known that the results of these devices contribute to how people determine their physical and mental fitness (Naslund et al., 2016). For the healthcare industry, wearables are revolutionary for monitoring data to observe patients and thus creating a cooperation between patient and expert (De Zambotti, Godino, et al., 2016).

However, most of the applications that monitor and track the quality of sleep are not based on strong scientific evidence (Behar, Roebuck, Domingos, Gederi, & Clifford, 2013) and according to two PSG studies that compared smartphone assessments with the golden standard PSG, the reliability of the information collected by these applications are not accurate (Bhat et al., 2015). Another study reviewed all the current literature, at that time, regarding devices that measure sleep compared to PSG, and they concluded that the amount of sleep disruptions is underestimated, and the amount of total sleep is overestimated (Kolla, Mansukhani, & Mansukhani, 2016). The inaccuracy of these devices is confirmed by Rieck (2019) who compared three digital technologies that were compared with actigraphy, which is a simpler technique compared to PSG which bases its measurement only on the movement activity. The technologies undermeasured the total amount of sleep time by over 30 minutes (Rieck et al., 2019).

Throughout the years, there seem to be progression in the reliability of data provided by Fitbit, one of the most popular and well-known wearables on the market. A study in 2012 discovered that it overestimates the total amount of sleep time and the sleep quality as it constantly perceives the time being awake as sleeping time (Montgomery-Downs, Insana, & Bond, 2012). Yet, a more recent study by de Zambotti and colleagues (2016) concluded that the wearable is providing more accurate information concerning the heart rate and sleep time of the users. Although they are still slightly overestimating the total sleep time compared to PSG, there seems to be progression in the accuracy (de Zambotti et al., 2016). Nevertheless, these renewals are still not close to the precision of PSG, and therefore the question remains whether these devices are accurate enough for monitoring and assessing the amount and quality of sleep (Baron et al., 2018).

Important to point out is that most of the studies have been carried out with healthy sleepers. As wrist wearables seem to be quite inconsistent with healthy sleepers, they are even

more inconsistent according to the few studies that were carried out with people that have sleeping problems (Baron et al., 2018). This corresponds with existing literature carried out with wrist actigraphy, where there is also found that the lower the sleep quality, the lower the reliability of the measured results (Sadeh, 2011). Therefore, the usage of these wearables by people that suffer from sleeping problems would not collect reliable data.

Overall, one can conclude that sleep applications and wearable technologies are inaccurate and unreliable, especially for those who face sleeping problems. Yet, there is a large group of people that use this type of technology as they like to monitor their health and to determine their mental and physical fitness. These people feel the need to spend money on this type of technology while the accuracy of the collected data is not guaranteed. Thus, there is a large group of people that is interested in technology which would benefit their health. However, most studies that have been carried out regarding sleep monitoring so far focus on solving problems such as sleep disorders. Little research has been carried out that focused on the needs of the consumer with regards to what could benefit them during their sleep. This study will focus on the user and will try to identify what they value with regards to their sleep to eventually discover if there is a need for a sleep technology that can cancel out the use of other technologies.

## 2.6 Privacy and Radiation of sleep technology

Wearables can also be used to obtain functional or physiological data to monitor health (DeVore, Wosik, & Hernandez, 2019). However, because these data are collected continually and ubiquitously, privacy challenges can be faced. Therefore, it is important to understand what potential privacy concerns can be faced and how these are perceived by the users. However, this strongly differentiates per wearable (Motti & Caine, 2015). Most importantly, when designing a new wearable or other technology that collects data continually and ubiquitously, the potential privacy concerns and how these are conceived by the consumers' needs to be taken into account.

Next to privacy issues, there are concerns regarding effects of radiofrequency waves which are emitted by electronic devices such as smartphones and wearables, even when they are active in a 'standby' mode. Many people are not acquainted with the harmfulness of these effects and their link to serious diseases such as cancer (Moradi, Naghdi, Hemmati, Asadi-Samani, & Bahmani, 2016). The effects of the emitted radiofrequency waves could be taken into account by consumers when buying and using such an electronic device.

## 3. Research Methodology

### 3.1 Research strategy

This research focuses on the consumers' needs regarding sleep. The goal of this research is to identify if there is a need for sleep technology that can cancel out the use of other technologies during night's sleep. In order to determine if there is a need for such product this research focuses on current experiences of respondents during their sleep. To explore these experiences a qualitative approach is suited for this research. There are multiple arguments for why this approach is adopted. First of all, with qualitative research the focus can be on what people feel and think, and as the fundamentals of this research are the opinions, thoughts, and feelings of the respondents this approach suits this research well (Myers, 2019). Next to that, with qualitative research thorough and extensive data can be obtained through conversations with respondents as they have room to explain their thoughts, feelings, and perceptions within these conversations (Myers, 2019). Moreover, studies that focus on a phenomenon that has not been well researched can benefit from a qualitative approach as this approach allows researchers to discover themes and relationships before they are able to be quantified (Boeije & Bleijenbergh, 2019).

In order to understand how knowledge should be interpreted the epistemology of a qualitative research needs to be determined beforehand. The chosen epistemology approach for this research is an interpretivist perspective as this perspective considers that perceptions are not objective and are related to the context and the individual (Myers, 2019). As the fundamentals of this research are the opinions, thoughts, and feelings of the respondents there will be a lot of subjectiveness and the interpretivist perspective assists in understanding that the perceptions are in line with the individual and their context.

### 3.2 Research population

Due to time restrictions and to mitigate the risk of the occurrence of bias, there will be focused on one segment, which is the segment of young adults. This group consist of people between the ages 18 and 30. 15 participants within this age group are individually interviewed and 4 participants take part in a focus group interview. These participants will represent the age group of young adults in this research. Within this age range, there will be people who work and there will be people who study. Of the 15 participants interviewed, 6 are working full time and 9 are studying. Next to that the distribution of man/woman is more or less equal, as 7 interviewees are man and 8 are woman. Of the 4 participants that take part in the focus group interview, 2 are working and 2 are students. The distribution of man and woman is equal. The distribution of the participants can be seen in the participant list below. All interviewees work or study in or around Nijmegen. This age group is chosen as the study of Rosen et al. (2016) discovered



that young adults face sleeping problems which could be solved by sleep technology that cancels out the use of other technology.

Participant list individual interviews	Age	Gender	Student/ Work
Participant 1	29	W	Work
Participant 2	26	M	Student
Participant 3	24	M	Work
Participant 4	22	M	Student
Participant 5	23	M	Work
Participant 6	21	M	Student
Participant 7	21	W	Student
Participant 8	22	M	Student
Participant 9	26	W	Work
Participant 10	21	W	Student
Participant 11	28	W	Work
Participant 12	24	W	Work
Participant 13	20	W	Student
Participant 14	20	M	Student
Participant 15	19	W	Student

Participant list focus group interview	Age	Gender	Student/Work
Participant 1	24	M	Work
Participant 2	21	W	Student
Participant 3	20	M	Work
Participant 4	23	W	Student

### 3.3 Data collection

The data are obtained using interviews. Interviews create a conversation-like setting which allows respondents to explain their thoughts, feelings, and perceptions. Individual semi-structured interviews are conducted since this enables to ask in-depth questions that create elaborate answers with the possibility to ask follow-up questions. This type of interview gave room for the respondents to tell their story while at the same time areas were defined to explore (Gill, Stewart, Treasure, & Chadwick, 2008). The pre-formulated questions served as a guideline through which consistency in the interviews was assured, yet it allowed for divergence to pursue a more detailed answer per individual (Britten, 2006). The interviews gave

insight in understanding the needs of the participants based on their current experiences and personal values. The possibility to ask follow-up questions assisted in obtaining further information and led to a better understanding of what the needs are of the respondents regarding sleep. This will be of much importance in this thesis since detailed data is required to establish an answer on the research question.

In order to find appropriate interviewees, I asked around my social network and the networks of my friends to search for interested participants. For each and every interview I decided to go to the house of the interviewee, as I thought that there they would feel most at comfort and could easily think about their sleep as they are close to their place to sleep. Every interview was in a silent, private room, with no other persons present other than the interviewer and the interviewee. Before the interview started, I asked if I could record the conversation via my telephone, so that I could listen to their answers repeatedly and transcribe the interview. I decided not to take any notes so that I could give all my focus on the conversation itself.

To eventually discover if there is a need for a sleep technology that cancels out the use of other technologies, the following subjects were investigated: phone usage before sleep, phone placement during sleep, privacy, phone distraction, points for improvement of sleep, radiation, opinion regarding sleep track devices and need for a technology that cancels out the use of other technology. This is carried out with interview questions that are shown in the appendices. Yet, the interviews were semi-structured, meaning that additional questions were asked depended on the given answers by the participant. The interviews ended once every subject had been discussed.

After all semi-structured interviews had been conducted where data had been obtained and analyzed, a focus group interview was conducted as a supplementary source of data. This was carried out in order to compare the data of the interviews with the data of the focus group for confirmation purposes. Focus group interviews can be used in three different ways of which one is to use it as supplementary source of data (Morgan, 1996). This is also known as triangulation, which increases the validity and credibility of the research. A focus group interview is a qualitative research technique for data collection where a small group of individuals come together to discover perceptions and attitudes, and to explore feelings and ideas regarding a certain phenomenon (Denscombe, 2017). In this setting, the individuals reflect together on the questions that are stated by the researcher. A major benefit of a focus group interview is that it allows for a conversation-like setting, such as with individual interviews, yet it provides a more natural environment since the individuals are influenced by and influence other participants (Krueger & Casey, 2000). This creates a real life setting which results in high quality and honest data.

The participants of the focus group interview were also found within my social network and the network of my friends. The only limitation to participate was that they were in the age category of 18 to 30 and that they did not already participate in an individual interview. All four participants were familiar with each other which made it easier for them to open up about what they really feel and think. The focus group was held in the living room of one of the participants, without any attendees other than the participants and the interviewer. Before the interview started, I asked for permission to record the conversation via my telephone, so that I could relisten the conversation. In contrast to the individual interviews, I decided to take notes during the focus group interview. As a lot was said that was not relevant for this research. This will be elaborated upon in paragraph 4.2.

### 3.4 Data analysis

The goal of this research is to identify if there is a need for sleep technology that can cancel out the use of other technologies during night's sleep by focusing on the current experiences of respondents during their sleep. As previously discussed, the data will be gathered through semi-structured interviews and one focus group interview. Within these interviews there will be sought if perceptions, opinions, and experiences of the respondents are in line with the need for a sleep technology that cancels out the use of other technologies.

The outputs of the interviews need to be analyzed. Creswell (2014) created a framework which can serve as a guidance in analyzing these outputs. It starts with the raw obtained data. This needs to be organized and prepared for analysis. Then, the data is read whereafter it is coded into different themes and descriptions. After the coding, the themes and description will be interrelated through which the meaning can be interpreted. Out of these interpretations, a conclusion will be drawn. According to Creswell, the framework is an interactive model which entails that it is not a linear process, rather one is able to go back and forward through these different steps until one is satisfied (Creswell, 2014).

After each individual interview had been carried out, a transcription was made. This way, the interviews were still fresh in my mind. After the 15 individual interviews had been transcribed, they were coded in different categories. With these codes, the answers given in the interviews are more accessible to interpret. With these interpretations, the results were written.

After the results of the individual interviews were written, the decision was made to conduct one focus group interview in order to compare the results of the individual interviews with other data. This establishes triangulation, which increases the validity and credibility of the research. After the focus group interview was conducted, the notes made during the interview were reviewed. Thereafter, the recording of the interview was listened to in order to

make additional notes. The notes were then coded and interpreted after which the results were written.

### 3.5 Research ethics

The result of this research entirely depends on the input of the respondents. Therefore, it is of great importance that the respondents feel safe and at ease so that their answers can be honest and transparent. To assure privacy of the respondents, the interviews will be completely confidential and anonymous. The identity and other personal information of the respondent will be private, except for their age, gender and if they are studying or working. This will encourage openness of the respondents (Myers, 2019). The audio of the individual interviews will preferably be recorded, yet only with permission of the respondent. The reason for this is to quote exact answers to increase the credibility (Myers, 2019). The respondents will be informed beforehand that citations can be used, however these will not be traceable. The interviews will solely be used for this research and once transcripts have been made, the recordings will be deleted. The transcripts will be shared with the respondents, which is to ensure credibility. Next to that, the respondents are enlightened on the aim of the research, the method of research, their voluntary participation, and that they have the possibility to withdraw at any given time.

### 3.6 Research quality

The most appropriate criterion for assessing qualitative research is internal validity. This entails measuring what is needed to be measured (Myers, 2013). In order to reach internal validity for this research, it is important to reflect critically on the chosen interview questions, as these will guide the interview and thus guide the way of identifying the needs. Although semi-structured interviews make it possible for the participant to add details, which increases the internal validity (Myers, 2013), it is important that the main questions are thoroughly thought about. The pre-formulated questions of the semi-structured interviews assisted in providing consistency across all interviews through which the reliability of the results is improved. Moreover, the interviews were conducted in closed, private rooms which gave the participant more freedom to say what they want to say. Next to that, the combination of semi-structured interviews and a focus group interview created triangulation which increases the credibility and validity of the research. Triangulation also helps to prevent bias and it increases the trustworthiness of the research (Myers, 2013).

Since qualitative research contains fewer data than quantitative research, the results of qualitative research are not highly generalizable. Yet it can explore fascinating patterns that are useful for future research and practical applications (Myers, 2013). A downside to this research

is that the respondents are all highly educated, meaning an intellectual level of HBO or University students. This makes the results not very generalizable.

## 4. Results

### 4.1 Results of the individual interviews

After conducting the 15 interviews with participants ages 18 to 30, multiple insights are gained on what they find most important when they sleep, how they think and behave regarding their mobile phone usage in the bedroom, and the need for a sleep technology that cancels out the use of other technology. After transcribing the interviews, the transcriptions have been coded using open codes, axial codes, and selective codes. All interview subjects, which were addressed in the literature, are structured in the interview questions. These subjects are phone usage before sleep, phone placement during sleep, privacy, phone distraction, points of improvement for sleep, radiation, opinion regarding sleep track devices and need for a technology that cancels out the use of other technology. All subjects will be discussed in the paragraphs below.

#### 4.1.1 Phone usage before sleep

Gradisar et al. (2013) discovered that more problems with failing asleep are faced when one uses their mobile phone one hour before they intend to sleep. That is why the National Sleep Foundation recommends to no interfere with interactive technology one hour before we intend to sleep. Yet, all 15 participants replied that they use their phone in the last hour before they intend to sleep. Moreover, 13 mentioned that they use their phone in bed, seconds before they intend to sleep.

Participant 1 specifically charges their phone in the bathroom as the phone will then be of no distraction and the alarm clock can still be heard. Another participant, participant 2, does not use his or her phone in bed as he or she sleeps in a bunk bed and charges their phone downstairs. The duration of the phone usage of the 13 other participants varies a lot. Participant 7, 12, 13 and 15 mentioned that they use their phone for a short amount of time to check up on their texts and spend a few minutes on social media. However, they all explain that this only applies if they have to get up early. When they have the possibility to sleep in, they spend more time on their phone before they intend to sleep. Participant 13 adds to this that when he or she had a stressful day, using their phone for a longer period of time can ease their stress. The other 9 participants mentioned that they spend more time, meaning 20 minutes or more, on their phone before they intend to sleep. They like to watch short movies, listen to music, or listen to a podcast before they intent to sleep. Participant 5 specifically explained that he or she needs to put on YouTube shorts, whereafter the phone is put beneath their pillow so that the sound can be heard, in order to fall asleep. If not, he or she is distracted by their brooding thoughts and therefore has a hard time falling asleep. This cite is the answer on the question what would happen if he or she would sleep without the distraction of short movies: *I often think about a*



*lot of things and once I start thinking I can't fall asleep anymore, so I just listen to something after which I then fall asleep.*’ Participants 3, 10 13, 14, and 15 mentioned that they like to listen to music as a form of distraction from their own thoughts as the music helps them to become at peace. Participants 10 and 13 explain this in the following two cites: *‘I find it very soothing to be able to fall asleep with the sounds in the background. Music especially helps me to become calmer. So, I do like that very much yes.’* and *‘I sometimes listen to music to become calmer, which helps me to fall asleep, so I find it very nice to have my phone around for that.’* Participant 14 puts on a podcast every other night as this also helps him or her to fall asleep, as listening to another voice can be very peaceful. He or she explains this in the following cite: *‘I use it (their phone) mostly to listen to music or to listen to a podcast. And I often listen to those until I fall asleep, so it's all about the sound so to speak.’* So, the participants use their phone in a way to help them fall asleep. Even though it might be even better to sleep without any engagement with technology, they are used to their own habits and do not have a strong reason to adjust their behavior as they do not face sleeping problems. Participant 3 is an example for this: *‘Mmm, well I did try without it once. Without a phone at night in bed, and I noticed that I just fell asleep faster. But I just like to watch short movies sometimes.’* So, he or she described that without the use of technology, he or she fell asleep quicker, yet he or she just finds it relaxed to watch a short video every now and then before going to sleep as he also sleeps fine with the engagement with technology before going to sleep.

The findings of Gradisar et al. (2013) suggest that phone usage before sleeping result in having a hard time falling asleep. However, these results indicate that phone usage can be beneficial as some use their phone to relax, to ease stress levels and to become at peace. It can be a distraction from brooding thoughts and therefore assist in falling asleep. Thus, the extent to which phone usage creates problems to fall asleep strongly depends on the person as for some people it might help them to fall asleep. Next to that is the fact that the respondents are used to sleep this way and do not face sleeping problems to the extent that they need to change their current behavior. Some have tried to sleep without technology yet have not faced a significant change in their quality of sleep to the extent that they want to change their current behavior and eliminate the use of technology before they intend to sleep.

#### 4.1.2 Phone placement during sleep

The placement of your phone during your sleep has a direct relationship with the possibility of your phone to distract you. Simply stated, if the phone is not nearby, it will not be able to distract you. In the study of Rosen et al. (2016), this is stated as the bedtime phone location.

As said in the previous paragraph, participant 1 charges their phone in the bathroom, and participant 2 charges their phone downstairs. That leaves us with 13 participants who

mentioned that they have their phone nearby when they go to sleep. Participants 5, 9, 10, and 13 leave their phone under their pillow while the other 9 leave their phone on their nightstand. For all participants applies that they want to hear their alarm go off in the morning. That is their main reason that they want it close by. This also applies for participant 1 and 2, yet they are able to hear their alarm in the bathroom/downstairs as well. For the 13 participants who have them very nearby applies that they want to have their phone within reach at all times. This is explained by participant 10 in the following cite: *'Then I can get to it quickly, I do think that's important and nice for when someone important sends me something or when something is going on.'* Logically, for the ones listening to music or podcasts, an extra reason is to hear the sound. Yet, there is another important reason according to the participants why they want to have the phone very nearby and that is in cases of emergency. Participant 5 explains this in the following cite: *'Yes, I must always have it with me, because if something happens to someone I know, or if something happens at home at the company, like an alarm that goes off, then I must have the phone with me. It is always under my pillow, so that I can wake up when I get called.'* Another reason, according to participants 12, 13 and 15, is that it is nice to have the phone nearby in case of having a nightmare. Then, their phone can be a stress reliever, and it can help them to redirect their thoughts. Otherwise, they explained, when falling back asleep they immediately fall back into that nightmare if they do not take a moment to distract their thoughts through the use of their phone. This is explained by participant 13 in the following cite: *'But if I've had a nightmare, it does help me a lot to calm down, because if I wake up from a nightmare, then as soon as I close my eyes again, I immediately fall back into the nightmare, then my phone can make sure I don't think about that nightmare anymore.'*

13 out of 15 participants prefer to have their phone very nearby, meaning on their nightstand or under their pillow. The main reason for all 15 participants to have their phone nearby is to hear their alarm. The reasons that 13 participants want to have their phone very nearby is so that it is within reach, to be able to respond in case of emergencies, to hear the sound of their phone (music or podcasts) which helps them to fall asleep, and to distract their thoughts in case of having a nightmare. This corresponds with the need for control and autonomy. The study of Rosen et al. (2016) stated that having a smartphone close to bed during the night can lead to more nighttime awakenings which in turn result to sleeping problems. The results of the interviews on this topic show that the participants prefer to have their phone very nearby over the possible nighttime awakenings. A reason for this could be that the participants currently do not experience sleeping problems caused by the awakenings and therefore they do not see the problem of having their phone very nearby while sleeping. Thus, a technology that could prevent them for having their phone very nearby would not suit the interest of these

participants as they currently do not feel the need to change their behavior because they do not experience any troubles.

#### 4.1.3 Privacy

As Motti & Caine (2015) described, it is important to understand what potential privacy concerns can be faced and how these are perceived by the users when designing a wearable or other device which collects data always and everywhere. Smartphones are an example of such a device.

In the interviews, questions regarding privacy were asked such as if the participants reflect on the fact that there is a possibility that their smartphone camera or microphone could be hacked, and if they thought about this while using their phone in the bedroom or when placing their phone on a specific spot during their sleep. All participants mentioned that they do not think about possible violations on their privacy. They simply do not care and state that what they are doing while they sleep is of no one's interest. This is explained by Participants 4 and 12 in the following cities: *'As for privacy, I don't really believe that my phone can be hacked. And because you have your phone with you 24 hours a day anyway, those 8 hours that you sleep don't matter much to me. I'm not very concerned about that. So, for me it's not a sensitive topic.'* and *'But I'm not very concerned with privacy no. And if they were to overhear me, I think I say more embarrassing things during the day than at night'*. All participants responded likewise. This entails that these 15 participants are not concerned with potential privacy issues with regards to their smartphone. Thus, a product that can mitigate potential privacy issues would be of no interest for them, as they are not concerned with privacy issues regarding their smartphone.

#### 4.1.4 Phone distraction

According to Rosen et al. (2016), nighttime phone awakenings influence the amount of sleeping problems for young adults. As half of young adults leave their sound on at night, they can be distracted and awakened by incoming notifications which results in problems falling back a sleep.

The extent to which a phone distracts you during your sleep could determine whether or not you would be interested in a tool that can assist in mitigating the distraction. Out of the 15 participants, 14 responded that their phone does not distract them at all during their sleep once they decide to put it away. However, of those 14, 4 responded that they leave their sound on for incoming phone calls as they value being able to respond in cases of emergency. This aspect can be related to the need for security by Schwartz, which explained that there is a need

for safety for oneself and others, and stability of relationships. This is explained by participant 11 in the following cite: *'I have my notifications all off except my ringtone for when I get a call. And I do that so that I can always be reached at night for my brothers or my friends in case of an emergency. Because it's just nice to know that someone is always there for you. So that's what I have my phone on for.'* So, because there is a need for safety, these respondents value leaving there sound on at night.

Next to that, 5 out of the 14 participants replied that they do use their phone if it takes a long time for them to fall asleep. Yet, they all state that this only happens if this takes a very long time and that they are in full control over their action to use their phone. This is explained by participant 13 in the following cite: *'My phone is always on silent, so I am never distracted by it, unless I pick it up myself but that is only if I have been awake for 3 hours.'* The one who mentioned that their phone does distract them, participant 10, said that he or she is easily distracted by incoming notifications which interrupts their sleep. Though, he or she also mentioned that it is a habituation and therefore he or she does not feel the need to change this. This is explained by participant 10 in the following cite: *'Yes, when I get a notification, I do wake up and look at my phone. So, it does interrupt my sleep. But actually, I think it's fine. It is a kind of habituation.'*

Most participants reply that they are not distracted by their phone one they decide to sleep. And once they do, for instance by a phone call, they prefer that distraction over a night without any interruption. This can be derived from the need for security. Other participants reply that they do not get distracted by their phone, even if some actually do. Even if one feels to have the control over when he or she uses his phone, it is still a distraction. Yet if it is not acknowledged by them, they will not feel a need to do something about it as they feel to have total control over the situation. Therefore, there can be stated that these participants do not feel the need to mitigate the distractions from their smartphone.

#### 4.1.5 Points of improvement for sleep

When sleep is inadequate, this has a negative influence on our waking cognition, our emotion regulation, and the consolidation of our memories. As a result, this can harm our psychological well-being. Therefore, it is of utmost importance to obtain a good sleep, and when possible, to improve our sleep. Of the 15 participants, only 10 met the required 7 hours of sleep. This means that 5 participants do not sleep the required minimum amount. That is why questions were asked in the trend of what they find important during their sleep, and how they think they could improve their sleep. Their answers were diverse. The most common responses were going earlier to bed and building a rhythm, as they would sleep more hours and therefore feel more rested. The following cites of participant 11 are example answers: *'I think that depends more*

*on the quantity of sleep, because the time that I spend on my phone I also could have slept. And once I sleep, I do sleep, as I sleep consistently and I never wake up at night because of my phone.*’ and *‘That’s all focused on quantity, so going to bed earlier. Other than that, I sleep well.’* Next to that, most answers were given concerning light and sound distractions. As most of the participants (10 out of 15) live in student houses, they responded that they easily get woken up by roommates that make too much noise. Participant 12 explains this after there was asked what he or she finds most important during their sleep in the following cite: *‘A dark room and silence. With me, light and sound is really the nightmare of my sleep, those are really the two things I can do something about.’* Alongside, answers were given in context of having less stress and building a moment of peace before they go to bed, as this could relax their thoughts. This is explained by participant 15 in the following cite: *‘I think it would help if, before I go to bed, I don’t immediately go from doing tasks to going to bed. So in between I can take a minute to calm down and listen to some music or read for a while. Maybe not spending time on my phone anymore. But I don’t feel like that’s really a disturbance.’*

When the participants were asked if their phone is of any disturbance and if there could be improvements made concerning their phone while they sleep, all responded that they feel that their phone is of no concern during their sleep. This is also mentioned in the last cite. Most points of improvement are building a rhythm and sleeping more hours. Next to that, there is light and sound. However, smartphones are not the problem for this. It is the sound of noisemaking roommates or screaming cats which are bothering. And for those disturbances, it would be difficult to build a technology that can prevent these disturbances. Thus, the answers given with regards to improving sleep are mostly based on improving their own sleep rhythm rather than smartphone use in bed or smartphone distraction. As most of the participants, except for participant 10, do not see their smartphone use before bedtime or the distraction of their phone during the night as a problem, they will not see it as a point of improvement. Therefore, for most of these participants, there is no need for a technology that cancels out the use of other technology as they do not see their usage of other technology as problematic.

#### 4.1.6 Radiation

As Moradi and colleagues (2016) mentioned, many people are not aware of the harmfulness of radiofrequency waves that electronic devices emit, such as their smartphones. This is also the case of the participants. When the participants were asked if they ever thought about the radiation which their phone radiates, all the participants responded likewise. They all responded that they do not think about it and that they do not really care, as they carry their phone around all day long anyway. Some state that they are interested in the possible consequences of radiation, yet they have not carried out any research on it. Here are some example answers of

participants: *'Radiation? I do not really think about that, I am not worried about it and actually I do not really care'*. And: *'Well, I have never really thought about radiation, so I am not aware of the possible consequences. I would like to know more about it to really form an opinion'*. This backs up the statement by Moradi and colleagues that there is simply no awareness of the harmfulness that the radiation of smartphones can cause. There will only be need for a solution once the problem is recognized. In this case, the problem is not recognized. And therefore, there is no need for a solution. For instance, in the form of a product that can mitigate the radiofrequency waves.

#### 4.1.7 Opinions regarding sleep track devices

Even though sleep applications and wearable technologies are inaccurate and unreliable, there is still a large group of people that use this type of technology. Mainly because via these technologies they can monitor their health and determine their mental and physical fitness.

The opinions of the participants regarding wearable technologies and sleep track devices are varied. However, most of the participants do state that they are not interested in it. This is mainly driven by the view that they preferably listen to their own feeling instead of the output from technology. This is explained by participant 3 in the following cite: *'I'm never that concerned about it, I just always check how I feel when I get up, whether I'm a little fit or not. Very simple. So that's not really something for me.'* This is also driven by the view that most participants do not notice the added value of the provided information by sleep track devices. As stated by participants 2 and 5: *'I do wonder what conclusion you can draw from that data. What good is it to know that from 2 to 3 you were in a deep sleep, and 3 to 4 in a lighter sleep?'* And: *'I always have my smartwatch off while I sleep, as I do not really see the added value of knowing how long you slept or how deep you sleep.'* Nevertheless, three participants explained that they have used a Fitbit before and told they were interested in the output and enjoyed using it. Yet, all three of them have lost their interest and are not using their Fitbit anymore. Two out of these three described that the reason for losing interest was because their sleep track devices provided data, which was not in line with how they felt, which made them feel more tired that day than if they had not known the output of their sleep. This is explained by participant 12 in the following cite: *'I measured my sleep with my Fitbit for a year and then I would wake up feeling like I had slept well and then I would look on that app and I would see that it only said 6 hours and then suddenly I would think 'oh I didn't sleep that well'. And then I think I was more tired that day than if I hadn't used a Fitbit.'* Next to that there were two participants who think that sleep track devices are interesting, and they would be interested in having an insight in their sleep pattern, however they are not willing to spend any money on it.



Overall, there can be stated that these group of participants are not interested in using wearable technologies. Some have given it a try but have lost interest and others are not even interested in giving it a try. Next to that are some who have not given it a try and are interested in trying it out yet are not willing to spend money on it. The wearables are often seen as interesting and fun by the participants, yet there is no need for it.

#### 4.1.8 Need for a technology that cancels out the use of other technology.

At last, the participants were asked what their opinion is regarding a technology that could mitigate the temptation of using their phone in bed and prevent their phone from interrupting their sleep. The opinions were mostly one sided. 14 out of the 15 participants responded that they are not interested in using this type of technology while one participant explained that it might help him or her with improving his or her sleep. Of the 14 that responded not being interested in using the technology, 7 explained they feel that they do not need an accessory as they feel to have total control over their phone usage. The following citations are responses of participants 3 and 9 who feel to have total control over their phone usage in bed and thus are not interested in using the technology: *'No for myself not, I find it interesting but for myself not necessary. I think I can decide for myself whether I use my mobile phone or not. At least not so much that I think I need an accessory.'* And: *'I find it easy to have my phone next to my bed, and I can easily stay away from it. I have the feeling that I have complete control over when I use my phone or not, so I don't really need this kind of technology.'* The other 7 participants who are not interested in using the technology had different reasons. Two of those 7 mentioned that they leave their phone in another room or downstairs from their bunk bed. One of them responded that he or she finds it almost sad that we need to use technology to prevent us from using technology. The other 5 explained that they are not interested in using this type of technology as they feel that their phone is not a distraction from their sleep, and that they find it nice to have their phone around in case of emergencies, even if the technology would let calls go through. One of those 5 responded that is might have been beneficial when he or she was a kid, as then he or she would stay up all night to play on their Nintendo as kids do not have any responsibilities. This is explained by participant 5 in the following cite: *'I think it's something for kids, when you used to take your Nintendo to bed as a kid, you would stay up all night playing games because you don't have responsibilities. But now you have other responsibilities, and you just have to sleep well as you also have responsibilities for other people. For instance, if you get a call from someone who needs you then it's also necessary to be able to provide assistance. And I therefore think blocking your phone is not convenient.'* Participant 12 reacted in line with this citation as he or she thinks this technology could be beneficial for kids of the next generation: *'No, not necessarily, because I have the discipline to stay away from it. But I*

*can imagine that if I ever have children that I will find it very interesting because I fear that that generation will be even more phone dependent than we are.'* Yet, there is one participant who replied that he or she could benefit from this kind of technology as he or she has troubles with putting away their phone while sleeping. His or her reaction on the question if he or she would be interested in this type of technology is: *'I think I could benefit from that a lot'*. Then I asked: *'I what way could it benefit you?'* to which he or she replied: *'I might want to use just that little support that keeps me from reaching my phone at night. Yes, I think that might help me.'*

Only participant 10 of this group of participants does feel that a technology which could mitigate the temptation of using their phone in bed and prevent their phone from interrupting their sleep could benefit them. The larger part, the other 14, do not feel the need for such sleep technology as they simple do not face any troubles to the extent that they want to change their current behavior. Next to that, participants explained that even if they do experience sleeping problems caused by their phone, there are cheaper and easier alternatives for this sleep technology. For instance, the method of participant 1 and 2, they leave their phone in another room during their sleep. Thus, for most of the participants, there is no need for a technology that cancels out the use of other technology as they do not experience that their current behavior regarding other technology is problematic. This can be explained effectively with the Means-End Chain Theory. The result of this theory is a value chain which relates a product attribute to the functional consequence, then to the psychological consequence, and eventually to the personal value. In this chain, attributes are the physical and tangible product or service features. Functional consequence relates to the benefits that are experienced when using the product or service. Psychological consequence are the emotional benefits which are obtained through the experience of the product or service. And value is desired result the consumer aims to achieve. Specifically, the functional consequences and the psychological consequences are no thought to be realized by the participants as they think they will not realize a benefit or an emotional benefit by using the product. Therefore, value as they desired result will not be achieved.

## 4.2 Results of the focus group interview

As said in paragraph 3.3 'Data collection', I decided to take notes during the focus group interview as a lot was said that was not relevant for this research. This occurred since very broad questions were asked in order to identify their needs regarding sleep. Examples of these questions are 'What is important for you during your sleep?', 'Can you describe how your ideal night of sleep would look like?' and 'What is your sleep ritual?'. Through these questions the four participants explained what they find important about sleep, to what extent technology plays a part in their sleeping process and therefore what their needs are regarding sleep.

The results implicate that all four participants have a different routine regarding their technology use before they intend to sleep. They vary enormously regarding to their mobile phone usage. Yet, they all have one thing in common and that is that they feel to have total control over their behavior to the extent that they can satisfy their own needs regarding sleep. Participant 1 prefers to mitigate his or her use of technology by shutting down the technologies in the last half hour before intending to sleep. He or she prefers to clear their mind by cleaning up their room or writing down their thoughts. This routine assists him or her to obtain good sleep. Participant 2 uses their phone regularly while doing the necessary things before going to bed. He or she also uses their phone in bed before intending to sleep. Yet he or she feels to have total control over their behavior and is convinced that this ritual satisfies his or her needs as he or she likes to speak to their friends and family via social media or watch a short movie before intending to sleep. Participant 3 always uses their phone right before intending to sleep. Most of the nights he or she likes to watch a movie in bed which is watched from their phone. Next to that he or she always sleeps with the sound of music in the background. This assists in falling asleep more quickly as the sound of music helps to distract his or her thoughts through which he or she is not focused un falling asleep. Therefore, he or she does this every night. Participant 4 uses their phone in the last moments before intending to sleep as well. He or she likes to listen to a podcast every other night which he or she finds interesting and eventually also assists with falling asleep. This satisfies his or her needs as texting or listening to a podcast is what he or she wants to do in the last moments before intending to sleep.

They all agreed upon the fact that they believe they are in total control over their use of technology and that their needs regarding sleep are satisfied through their own routines.

## 5. Discussion

According to the literature, many young adults face sleeping problems mainly caused by their interaction with technologies. Using their smartphones before they intend to sleep, having their phone in or around their bed while sleeping or being awakened by notifications or incoming phone calls result in sleeping problems with all its consequences. Mitigating the usage of their mobile phone would diminish these sleeping problems. A technology that can cancel out the use of other technologies could assist in the diminishment of smartphone usage. Yet, in order for a technology to be successful, there must be known to what extent there is a need for this. Customers' needs set the starting point for the creation and the development of a value proposition. However, there are differences in needs and values. Schwartz's value theory together with the Means-End approach assisted to understand the different perceptions of values and therefore the differences in needs. Although the needs of each individual differ, this research aimed to identify what the needs of young adults are with regards to sleep in order to discover if there is a need for a sleep technology that can cancel out the use of other technologies such as smartphones. The literature outlined the expectation that there might be a need for sleeping without the distractions of technologies such as smartphones, due to the sleeping problems being caused by them. And, as there is an existing need for sleep technologies, such as wearables, there might also be the need for a technology which could assist in sleeping without the distractions of technologies such as smartphones. However, the results of this research differ with the outlined expectation.

The results of the individual interviews show that only 1 out of the 15 participants feels that he or she would benefit from and has a need for a technology that cancels out the use of other technologies. The other 14 participants prefer to have their phone nearby and on standby because of the alarm clock on the mobile phone, because they value listening to music whilst falling asleep, because being available for emergency calls is a priority, and because using the phone as a distraction from their own thoughts by listening to a podcast or a video is also valued. The privacy and radiation benefits that could be obtained by a sleep technology that cancels out the use of other technologies are not acknowledged since the participants do not seem to be bothered by the possible consequences. Moreover, the participants feel to have total control over their phone usage. The feeling of having total control over their phone usage means that the participants are convinced that their current behavior is not problematic, as they do not face any sleeping problems caused by their phone. Therefore, the vast majority of the participants of the individual interviews do not have the need for a sleep technology that withheld one from using their phone. The results of the focus group interview are in accordance with the results of

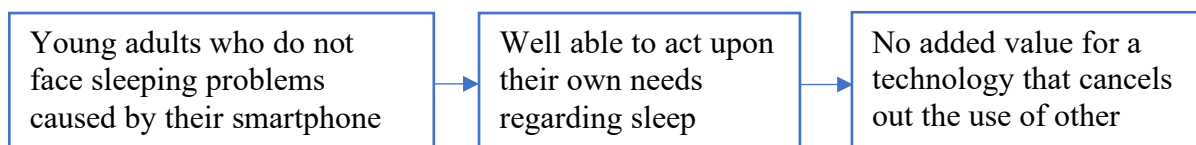
the individual interviews. All 4 participants had different routines regarding their technology usage before intending to sleep. Yet they all agreed upon that their routine satisfies their needs, and that they feel to have total control over their technology usage before intending to sleep. Therefore, they feel to have no need for a technology that can withheld them from using their phone.

These results are in line with the self-direction value by Schwartz, which originates from the need for control and autonomy. And as one's values determines their needs this explains why for these participants there is no need for a sleep technology that cancels out the use of other technologies. However, this is not in line with the outlined expectation from the literature. According to the literature, young adults face sleeping problems that are mainly caused by their smartphone usage before intending to sleep, smartphone location while sleeping and by leaving their sound on to which they can be awakened by incoming notifications and calls. In practice, young adults prefer to have their smartphone around at night because this satisfies their needs. They want to have their phone nearby and on standby because of the alarm clock that is on the mobile phone, because they value listening to music which helps them fall asleep, because they value being available for emergency calls, and because using their phone as a distraction from their own thoughts by listening to a podcast or a video is also satisfying their needs. They do not face sleeping problems caused by their smartphone, moreover, their mobile phone assists them in falling asleep. Thus, problems of falling asleep caused by using a smartphone in the last hour before intending to sleep stated by Gradisar et al. (2013) and caused by awakenings due to notifications of a smartphone stated by Adams & Kisler (2013) are not recognized by the participants. Furthermore, young adults feel to have total control over their smartphone usage so they do not need a device which can assist them with this. These results do not correspond with the literature. Now rests the question: why do these results deviate substantially from the literature?

There are multiple limitations of this research which might explain the deviated results. First of all, the participants are all found within the social network of the researcher. If participants were randomly found there could have been a different outcome, as they have a huge impact on the result. For instance, if participants did face sleeping problems caused by their smartphone, the result might suggest that there is a need for a technology that cancels out the use of other technology. Furthermore, the participants in this study are not very diverse since they are all highly educated, as they are studying at HBO/University, or have HBO/University degrees. This could result in bias as only a specific group of people within the age category 18-30 are interviewed. Therefore, more research on this topic has to be carried out with more interviewees, and more diverse interviewees in order to create more robust results.

Even though the participants might not represent the age group of young adults well because of their one-sided educational level and because they are all found within the social network of the researcher, the results remain significant. The participants explain that young adults are well able to satisfy their own needs regarding sleep and therefore there is no need for a device that can cancel out the use of other technologies. The added value of a new sleep technology is not recognized by the majority of the participants. Furthermore, the participants explain that they are in control over their smartphone usage to the point that if they do not want their phone next to their bed, they will leave it in another room. In other words, there are cheaper alternatives for the technology.

Thus, the results deviate from the literature and thereby from the expected outcome of this research. Problems of falling asleep caused by using a smartphone in the last hour before intending to sleep and by awakenings due to notifications of a smartphone are not recognized by the participants. Therefore, for the majority of the participants there is no need for a technology that cancels out the use of other technologies. This can be well explained as the participants are well able to act upon their needs regarding sleep. This leads to the following conceptual model, which is the theoretical contribution of this research:





## Conclusion

This research was conducted to identify what the decisive factors are that determine the need for sleep technology that cancels out the use of other technologies. This was realized by centering the needs of the respondents, to eventually discover if there is a need for the new sleep technology. This research was guided with the following research question is:

*‘What are the decisive factors that determine the need for sleep technology that cancels out the use of other technologies for young adults?’*

The decisive factors that determine the need for sleep technology that cancels out the use of other technologies for young adults are that young adults are well able to act upon their own needs regarding sleep and that there are cheaper alternatives available. Therefore, the added value of a technology that can cancel out the use of other technologies is not recognized. Thus, these decisive factors indicate that there is relatively little need for a technology that can cancel out the use of other technologies.

This study focused on the decisive factors of the need for a new sleep technology which has not been researched before. The newness of this research is that it had a consumer centered focus, as it focused on the needs of the participants. The contribution to the knowledge is that there is now known what decisive factors determine the need for sleep technology that cancels out the use of other technologies for young adults. This has the practical implication that developers and technicians of such technologies can take into account what is of importance for possible customers in the age group of young adults. As this research is the first in the field of this new technology, more research needs to be carried out in order to reinforce the conclusion that is drawn.

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## 7. Appendices

### 7.1 Interview questionnaire

Interview topic	Interview questions
Phone usage before sleep	<ul style="list-style-type: none"><li>- Do you use your phone when you are in bed?</li><li>- If you use your phone in bed, how long until you decide to go to sleep?</li><li>- What is your opinion on having your phone in your bedroom at night?</li></ul>
Phone placement during sleep	<ul style="list-style-type: none"><li>- Where do you leave your phone at night?</li><li>- Why do you leave your phone in that place at night? For example, to prevent the light from pop-ups from distracting you?</li></ul>
Privacy	<ul style="list-style-type: none"><li>- What is your opinion on having your phone in your bedroom at night regarding privacy?</li></ul>
Phone distraction	<ul style="list-style-type: none"><li>- Does the phone distract you (do you have the sound on, do you respond to notifications such as text messages or phone calls?</li></ul>
Points of improvement for sleep	<ul style="list-style-type: none"><li>- How would you rate your current quality of sleep?</li><li>- On average, how many hours of sleep do you get per night?</li><li>- What would you need to improve your sleep?</li><li>- Do you think using your phone in bed affects your quality of sleep?</li><li>- What do you think is most important for you during your sleep?</li><li>- What bothers you during your sleep?</li></ul>
Radiation	<ul style="list-style-type: none"><li>- What is your opinion on the radiation that your phone radiates?</li></ul>

Opinion regarding sleep track devices	- What is your opinion on sleep track devices such as Fitbit and smartwatches?
Need for a technology that cancels out the use of other technology	- Would you be interested in technology that prevents you from using your phone at night?