# Journey to Recovery

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Title:	Journey to Recovery: Creating a Pediatri
	Sleep Treatment that Motivates, Entertain
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: Creating a Pediatric User Experience for a mHealth ains and Informs

# Abstract

Sleep and recovery go hand in hand. With the intention of improving the quality of children's sleep, a sleep device that requires to be worn every evening has been developed using sound. Despite its health benefits, the sleep therapy is often abandoned by the children as it proceeds due to its repetitiveness and tediousness.

Journey to Recovery is a playful approach that combines by means of a companion app the sleep therapy with a captivating story. With it, the children can experience a narrative chapter every evening and learn something new about sleep in the morning. Through collaborative efforts, all parties involved had a say in the process, thereby bringing the expertise of sleep researchers and the creativity of children together.

On their journey to recovery, the children thereby enjoy an experience which motivates, entertains and informs them.

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Our thesis would not have been made possible, if by getting us in contact with teachers and their pupils it weren't for the support and engagement of some from the Primarschule Feldhof. amazing people.

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We wish to thank SleepLoop for this exciting colfor giving us an insight into their lives. Furthermore, laboration, for being so open towards our creative our gratitude goes out to André, Siân and Chris Buck, Kendy Chen, Wendy and William Truong for lending us approaches and allowing us to try out their sleep device ourselves. We especially appreciate their entheir support. gagement and that they all found the time to join us for the entire duration of our one day long workshop. A big thank you goes to our Interaction Design class To Nicole Foelsterl & Matthias Kappeler, we would (2017) for keeping us sane during the coronavirus like to express our thanks for their guidance in our lockdown. Despite the social-distancing, we had concept video. They recognised early on that tracing some great fun together by moving the atelier envieach drawing three times does have its charm. ronment online.

We wish to thank the teachers - Randi Malakatas, Al-<br/>exandra Vordisch and Henry Chen - and the studentsLast but not least, we would like to thank Martin<br/>Dušek, the man behind the scenes. We appreciate the<br/>work he has put into coordinating and supporting the<br/>Interaction Design Bachelor and for answering all of<br/>our questions. Especially in these crazy times, it must<br/>have been a challenging task.

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# **Introductory Remark**

During our project, we have met many incredible people that participated in our co-creation workshops, engaged with us in conversations and discussions and joined us on our journey. Many of them were minors since our target age were children. For this reason we felt obliged to handle their provided data with respect, keeping their identity anonymous. Those whose guardians gave us their permission are referred to by name.

In the year 2020 when our thesis took place, the lives of all people were affected by the coronavirus pandemic. In the fight against this rapidly spreading deadly disease, the Swiss government declared an extraordinary situation and ordered a national lockdown. For this reason, on the 13th of March, we were instructed to leave the Zurich University of the Arts and to practice social distancing. For the final two thirds of the thesis, we worked remotely from our homes.

We find it important to mention this context at the start of our thesis. It affected our process by moving conversations, meetings, workshops and the final exhibition online. Nevertheless, we were very fortunate to have stayed healthy throughout the pandemic.



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# 1. Introduction -



Sleep is all important for our health and our recovery In collaboration with SleepLoop, we've set out to from injuries. What's more, it's also essential for the cognitive and behavioural development of children. It is therefore to no surprise that any sleep disruptions have their toll on children's well-being.

Evidence suggests that concussions have a disruptive effect on the quality of sleep. An efficacious treatment is therefore crucial for children to recover from any sleep disruptions caused by such head injuries. This is why a research team from ETH Zurich and the University of Zurich called SleepLoop is currently investigating whether their sleep therapy can improve a child's quality of sleep. By using their mobile health device which emits an auditory stimulus to encourage a more deeper and restful sleep, they hope to treat children who are suffering from a concussion.

While working with their patients, SleepLoop observed that the motivation of children dropped over time, leading to an incomplete treatment. In fact, as health treatments are becoming increasingly detached from clinics due to the development of innovative medical mobile technologies (mHealth), non-adherence is turning into a more common problem.

make the sleep treatment more motivating, entertaining and informative for children. Through co-design and a user-centric approach, we met up with children of different ages and backgrounds to collaboratively develop a solution. Journey to Recovery deals with combining the sleep treatment with captivating storytelling and sleep education.







Our Bachelor project is in collaboration with a and effectively from a concussion, they hope to research team from ETH Zurich and the University become the standard of care when it comes to treatof Zurich, called SleepLoop. SleepLoop intends on ing this head injury. The image (Fig. 1) showcases improving and deepening the sleep of people in varihow SleepLoop's device could look like in the future. ous stages of life from childhood to old age with the help of their mHealth wearable which is worn on the During our months of collaboration with SleepLoop, head. While sleeping, the wearable tracks the brain we came in contact with five of SleepLoop's team activity and emits an auditory tone upon synchronimembers: Prof. Dr. Karlen Walter, a researcher in sation of the brain's neurons. This stimulus leads to mobile health systems; Prof. Dr. Reto Huber, a pediatpatients having a deeper and thus higher quality of ric psychiatrist with a focus on sleep; Joëlle Abrecht, a psychiatrist; Giulia Da Poian, a data scientist sleep. Alongside the device, the patient is required to fill out an evening and morning questionnaire which practised in wearables; and Dr. Laura Tüshaus, also a provides SleepLoop with additional information on researcher in mobile health systems. their patient's well-being.

Currently, the sleep treatment is still under research and development. Its purpose is to specifically treat people who are suffering from a concussion as they are consequently often afflicted with sleep disruptions. Up until today, there is no clinical treatment for improving concussions and its sleep disruptive consequences. Especially in children, these sleeping problems can cause future developmental disorders. This is why SleepLoop's focus has recently shifted from adults to children. Their definition lies on the target age group of children between 8-17 years.

Once SleepLoop has gathered enough medical evidence to support their hypothesis that a sleeping treatment can help children to recover more rapidly

# 3. Research -



# 3.1 Background & Context

### 3.1.1 Sleep & Concussion

Concussions are medically defined as a mild traumatic brain injury (mTBI). They are caused through a There is still a lot of research to be done which is physical impact or jolt to the head and are diagnosed as such when a brief change in mental status or conwhy our partner, SleepLoop, is currently conducting sciousness can be diagnosed. (Centers of Disease their own investigation in this field. They are in the Control and Prevention CDC, n.d.). When untreated, process of collecting medical data with which they mTBI can impact one's health several months after hope to prove the effectiveness of their methods for the incident (Sigurdardottir, 2009). In particular, improving sleep and thus stimulating brain recovery according to Wrickwire et al. (2016) mTBIs have a from mTBIs. profound effect on a human's sleep quality. This in return not only influences their cognitive abilities but also contributes to their morbidity.

Sleep has been observed to promote brain maturation in children (Walker, 2018, pp. 78-104) which is why it holds a high significance in their development. Today, there is little research on the impact of traumatic brain injuries (TBI) on a child's sleep. Nevertheless, the amount of publications are increasing and pointing towards useful evidence: while Barlow et al. (2010) argues that children and adolescents suffer from sleep problems after their mTBI, Landry-Roy et al. (2018) have found a correlation between sleep problems and executive functions (which describes the cognitive process necessary for controlling our behaviour) in children after a concussion, whereas executive functions are known to be important for a child's early cognitive, behavioural and social-emotional development. As more evidence emerges, it

becomes more and more apparent how severely sleep disruptions affect a child's development.

#### 3.1.2 mHealth

In the 90s, when the Internet became increasingly accessible to the public, the term mobile Health (mHealth) emerged as a subsection of a medical field called electronic Health (eHealth). Today, eHealth has become a substantial part of modern health systems: it describes the usage of electronic communication and information for health and the health care system, consisting of services such as the Electronic Health Records (EHR), Healthcare Information Systems (HIS), telemedicine, consumer health informatics and, of course, mHealth (Adibis, 2015).

There seems to be no standardised definition of the term "mHealth" which is why one can find several different understandings of the subject. Adibis (2015) describes mHealth as being solely practiced through the usage of smartphones, where its sensors are put to use to capture, analyse, process and transmit health-based information. Others deviate its meaning from eHealth and generalise it as follows: mHealth refers to the mobile communication of health-related information and services (Nacinovich, 2011). It involves any mobile technology and is not necessarily exclusive to smartphones (World Health Organisation WHO, 2011, pp. 6). Others, on the other hand, expounds their definition of mHealth:

"In addition, to be considered a mHealth intervention the purpose of the technology should be to enhance treatment or assessment, increase dissemination of interventions, or provide clinicians and clients with greater choice for accessing treatment materials or activities" (Clough & Casey, 2015).

mHealth Devices: Wellness vs. Medical Device mHealth technologies are often translated into mobile devices. These are electronic hardwares whose mobility offer a great range of applications. Therefore, devices capable of being worn, so called wearables, have become a rather favourable mHealth solution that supports the collection and communication of health-related data in a non-intrusive way. mHealth technologies can also take advantage of features from already available devices or be implemented as softwares into existing hardwares. For instance, mobile phones' built-in technologies and hardware are commonly used in mHealth (more on that later). Mentionable is also the fact that, in a mHeath setting, mobile phones can emerge as a companion to a wearable, acting as a visual communicator to the user

It is important to note that not all mHealth devices which have the ability to track and record health data are necessarily medically approved for a diagnosis. Depending on its applicable context, there seems

to be a differentiation between so-called "wellness devices" and "medical devices".

According to the Food and Drug Association FDA European Parliament & the Council of the European (2019), the regulatory administration office for health Union, 2017). Switzerland follows the guidelines set and human services in the United States, wellness up by the European Union and the EMA (Bundesamt devices must present a low safety risk towards für Gesundheit BAG Schweiz, 2020). users and are intended for general wellness use only, whereby "wellness use" refers to the maintenance To emphasise: not all mHealth devices that have the and encouragement of a healthy lifestyle whose ability to track health data are aimed for a diagnosis. This right is solely reserved for medical devices as impact is accepted to reduce the risk or offer a relief towards certain chronic diseases or conditions. On they must follow strict protocols and undergo testing the other hand, medical devices are seen as an instrubefore receiving a medical certification by regulatory health associations such as the FDA or its European ment, apparatus or machine which aim to diagnose, treat, mitigate or prevent diseases or other conditions equivalence, the EMA. This also means that the (Food & Drug Association FDA, 2018). Software is not accuracy of medical devices' sensors is guaranteed mentioned to be included in their definition of mobile (Goergi & Le Bouquin Jeannès, 2017), while the accuracy of current wellness products vary: a study or wellness devices. Instead, they've been classified under a new term called "Software as a Medical from 2017 concluded that diverse wellness products Device (SaMD)" (IMDRF SaMD Working Group, 2013). from various producers (Fitbit & Polar Electro Oy) performed differently although each promised to track Meanwhile, the European Medicines Agency EMA the same data, the heart rate (Gorny et al., 2017).

(2019) who is responsible for the regulation of health products within Europe does not differentiate strictly Here, it is also worth mentioning that one may between medical and wellness products. Instead, they differentiate between two different types of users, state that if a product is not clearly a medical device, depending on whether they're exposed to medical or it is classified as a borderline product and will need wellness devices: people who use medical devices to be assessed separately. Generally speaking, they are considered as patients, as the term "patients" is share many similarities in their definition of medical defined as a person who is receiving medical treatdevices with the FDA. Yet when it comes to software ment (Oxford University Press OUP, 2019). Wellness

they comply with an article from the European Union EU which states that within Europe, software does belong within the definition of "medical device" (The devices do not necessarily exclude patients, however, their purpose is more often for the benefit of lifestyle habits and is not automatically linked to medical care, wherefore the users are named more generally as healthcare consumers.

#### Proliferation

The application of mHealth in today's healthcare systems has been rapidly increasing since the turn of the 21st century. This can be attributed to several technological developments, two of which have been observed in Moore's Law and Nielsen's Law: Moore's Law describes the trend of transistor miniaturisation every two years (Tegmark, 2017, pp. 68); Nielsen's Law states how Internet broadband increases every twelve months by 50% (Nielsen, 1998). Computers with stronger computational power and better Internet connectivity have accelerated the progress in mHealth products and services, having created technology which is smaller, faster and cheaper. This encourages interconnectivity between healthcare providers and patients, allowing the latter to profit from medical treatment or healthcare services at home or beyond medical facilities.

Moreover, while researching mHealth, mobile phones were referred to have a profound importance in offering better and more accessible healthcare to the public. This is of no surprise because taking advantage of the wide use of mobile phones is a fantastic method to reach as many people in need of medical support as possible. Since 2000, the world-wide mobile cellular subscription has multiplied tenfold, from 738 million in 2000 to 7.678 billion in 2018 (World Bank, 2018), indicating how omnipresent this form of technology has become. Targeting mobile phones as the catalyst has therefore allowed mHealth products and services to proliferate swiftly and effectively, by using a mobile phone's built-in core technologies such as microphone, short messaging service (SMS), Bluetooth, global positioning system (GPS) and accelerator meter sensors, amongst others.

From the beginning, mHealth interventions were seen to promise great improvements in bringing medical aid to developing countries. Several projects launched in Africa, South America and South Asia not only explored the impact and effectiveness of mHealth solutions (Gurman et al., 2012), but intended to help those who had no or restricted access to basic medical services too. These commonly took advantage of the mobile phone's SMS service as a cheap and effective method to spread medical information. For example, SMS interventions by the Health Ministry of Bangladesh in 2007 resulted in several effective health awareness campaigns, one of which gave expectant mothers prenatal advice according to their gestation stage (World Health Organisation WHO, 2011, pp. 30-33). Other examples, in Kenya amongst others, use SMS to combat non-compliance

in appointments and drug intake (Hall et al., 2014). In Malawi, health workers text medical information, diagnosis and suggestive treatments to rural patients, reducing the distance between clinics and rural homes. This intervention has apparently even allowed many more people suffering from tuberculosis to get the aid necessary for their recovery (West, 2012). healthcare providers to identify and consequently recommend evidence-based products and services. Attempts at defining and communicating evaluation methods for medical mobile apps have been undertaken (Boudreaux et al., 2014), indicating how important and challenging it is even for experts to keep up with reliable and trustworthy mHealth solutions.

Generally, there is the consensus that mHealth interventions will have a great impact on the accessibility of healthcare in developing and industrialised countries. However, research in mHealth and its effectiveness in general is still in its infancy which is why researchers appeal for an increase in evidence based investigations before any new mHealth measures are excessively enforced (Tomlinson et al., 2013).

#### Issues

The augmentation of mHealth technologies has brought various products to the market, in particular mobile phone apps. Many of these have unfortu-There is also a concern about mHealth technologies nately not always included involvement of medical promoting surveillance. One could argue that devices experts, according to a review by the Copenhagen that track data leverage a panoptic system with which University Hospital Rigshospitalet (Subhi et al., health promoters can insert themselves more intru-2015). While peer-review is mandatory for medical sively into the private worlds of others and observe papers, a requirement of expert approval on an app's these individuals wherever they may be (Lupton, medical content is non-existent - an issue Subhi et al. 2012). This would mean for instance that health and other medical experts greatly criticise. Not only insurance companies would receive more power over does this lack of approval make it more difficult for their customers and allow them to adjust pricing in consumers to understand its legitimacy, but also for accordance to their customer's behaviour. These

The question of usability and data security has also been highlighted as being an intricacy which requires as much attention as the medical accuracy of mHealth products and services (Gurupur & Wan, 2017). In particular, Gurupur & Wan emphasise the relevance of human-centred design and simplicity to foster the sense of trust and authenticity. Others, too, encourage the practice of design, user experience and participatory approaches in order to achieve more positive experiences and prolonged adherence to mHealth products and services (Ludden et al., 2015). organisations would thereby gain more control over our everyday lives.

#### **Benefits**

mHealth may yet still bear many challenges, nevertheless, according to the World Health Organisation WHO and the International Telecommunication Union (2012) its benefits promise a great transformation in modern health service world-wide: mHealth will make health services more accessible to people all over the globe; ensure quality, safety and efficiency of care; allow health monitoring and reporting which in turn will help patients to profit from bespoke health interventions and healthcare providers to accelerate their medical research; provide access to health knowledge and education, thereby spreading awareness and prevention information for certain health conditions; and empower individuals in self-monitoring and in consciously managing their health data. As already briefly discussed above, great examples in developing countries have shown that mHealth interventions are beneficial and thereby also appealing to all participants.

Especially today in 2020, with the coronavirus forcing the world's population into isolation, the benefits of mHealth, or generally speaking eHealth, have become even more transparent to the world. A rise of eHealth developments is most likely to be expected (Politico Magazine, 2020) as it's been recognised that such

technological solutions can offer great support in combating the coronavirus and future pandemics: remote diagnosis and treatments, through video appointments for instance, could encourage people to stay home, thus complying to the social distancing mentality and keeping the infected away from highrisk individuals. Furthermore, mHealth technologies would allow patients to continue their treatment, for example a sleep treatment, in the safety of their homes.

#### **Our Definition**

For the purpose of our thesis, we'll define mHealth as being mobile technology which encompasses the usage of smartphones and wearables, the latter being any form of technology which collects and transmits health data while being worn by an individual. Our collaboration partner SleepLoop has implemented these two types of technology into its mHealth treatment. Moreover, we would like to emphasise our position towards mHealth: it is not only about technology, but most importantly about the health and well-being of the patients themselves.

### 3.1.3 Child Centered Design **Children & Adolescents**

SleepLoop have shifted their research focus to a younger age group, for which they have defined their target audience to be in the age of 8 to 17 years. When designing for such a wide age group, we need to understand who exactly we are addressing to define their needs and any concerning challenges.

Per definition of the World Health Organisation WHO (2013), the age for when a human is considered as a For now, when talking about our target group, we will child is 19 years or younger, unless national law imcontinue to describe them as "children", however, we plies differently. In Switzerland, there is a distinction will be referring to elementary children (8-12 years) between children (under 10 years) and adolescents and adolescents (13-17 years), unless otherwise (11-18 years old), although by law they are considered stated to be the same (Bundesamt für Sozialversicherungen BSV Schweiz, 2014). Since ten year olds are far from **Designing for Children** similar to a 19 year old, adolescents are often divided Creating content for children of all ages is very excitinto further age categories: into early (10-13 years), ing but also full of challenges. Even though they stand middle (14-16 years) and late (17-19 years) adolesgenerally speaking in a learning period in which their cents (World Health Organisation WHO, 2014). whole attention lies in discovering new things and

Meanwhile, Mitten et al. (2014) differentiate the age groups into toddlerhood (18 months to 3 years), preschool (3-6 years), elementary (6-12 years) and adolescents (13-19 years). When comparing these to SleepLoop's target audience, we find ourselves between the two entities of elementary children and adolescence.

Using age as measurement is a convenient way to label these different stages of life, but it is important to remember that the actual factors that matter are the physical, cognitive, social and emotional changes that vary for each individual. Both the WHO and Mitten et al. agree that the starting age of adolescents is when puberty hits. At this development phase, it is reported that the social context is also of importance (Poole and Peyton, 2013).

seeking entertainment, it is misleading to say that they are thereby easy to please. Designing successful products for children and adolescents requires an awareness of their developmental stages, gender, desires and aspirations, appealing traits and topics which are definite no-goes (Miller, 2008, pp. 131).

There is a general understanding that children learn by interacting with their environment which is a process of adaptation (Piaget, 1952). Seymour Papert (1991) elaborates on Piaget's views and states that this process works best when children are guided by public entities such as teachers or mentors. Accordingly, providing children with the right technologies and tools is essential so that they can be authors of their own instead of following a scripted ideology (Hourcade, 2007). What's more, others like Miller (2008) support the proposed potential of providing technologies, especially digital technologies.

"Furthermore, children and teens are among the most enthusiastic fans of digital media, and they often lead the way when it comes to the adaptation of new forms of interactive entertainment. Thus they often help push the entire field forward." (Miller, 2008)

Most importantly when designing for children and adolescents, it is essential to keep in mind that the experience should be special, exciting and meaningful. Children like to have fun, be challenged in a way they can understand and solve. Since they can get bored fast, modularity and an evolution over time is very effective in encouraging them to explore an experience on their own (Lepper & Malone, 1987). Additionally children like to act more mature and often look for a role model in characters.

"To borrow a term from the psychologists, kids have aspirational desires. In other words they aspire to accomplish certain things or behave in certain ways that seem attractive and grown up to them, and they look to their favorite characters to serve as models." (Miller, 2008)

Aspirations help them to mature and are an important part in their development. In this context, children prefer to be treated more maturely and accordingly they search for activities with which they can assuage this desire.

Overall we need to provide them with something fun during their treatment while also communicating its seriousness clearly. We also shouldn't make it too childish and create more age appropriate content and also give them the sense of ownership. While creating entertainment we don't want to interfere with their night routine too much. To truly understand these requirements we can not solely rely on literature and need to get to know the children better.

#### Gender Issues

In order to design effective multimedia mHealth experiences we must understand how children of both genders interact in a learning environment. It is of no surprise that boys and girls have different opinions on multimedia devices and entertainment that is provided to them. The differences included

the types of entertainment they like, what aspects of practice is overall helping to create an age and gender the entertainment are important to them, and to what appropriate design. degree the entertainment was a part of their social **Parents View** environment. For this reason, we need to be sensitive toward gender biases to ensure what our design is When designing for children and adolescents we appropriate for children of both genders (Inkpen, cannot ignore that parents have an immense role in 1997).

Early research on a trial where multiple developers and designers had to create educational software for students found that there were many gender stereotypes that influenced the product. What they considered to be appealing to girls and boys was proven to be wrong and the results show that there is much more complexity behind it all than just gender related factors (Huff & Cooper, 1987).

This is almost five decades old and the practices have changed over time. In an analysis of nine years of Interaction Design for Children (IDC) papers from 2002 to 2010, a total of 137 papers were examined that were published in relation to IDC conferences. There is a positive development in the analysis of Yarosh et al. (2011) that many papers indicate that the children are greatly valued during the design process: close to 30 percent of the papers viewed the children as active agents in the design process to ensure that the outcome is a reflection of the children's voices and making a design more well received (Yarosh et al., 2011). This change to the user centered design

their lives. Generally speaking we see that parents are quite involved in the lives of their children and when it comes to any digital devices and entertainment content they are often the person who is providing it or is giving access. They can have strong opinions on the content their child consumes. They also have a different perception of their child's life, what it likes, how his day looks and what's best for them. It makes sense to also gather insights from them during the field research.

#### 3.1.4 Adherence

In medicine, we speak of adherence when a patient correctly follows medical instructions. This includes the correct and regular usage of drugs, exercises or medical devices. Non-adherence is considered to be a world-wide and much discussed problem which not only affects the well-being of the patient but also wastes healthcare resources (World Health Organisation WHO, 2003, pp. 26). It knows no age-restrictions, meaning that it has been observed in adults and children alike.

With the help of mHealth devices, measures have been undertaken to combat non-adherence: in particular, healthcare providers tend to resort to mobile phones to send SMS reminders and notifications - a method which is said to be helpful and effective by patients (Park et al., 2019). However, it is also reported that regular reminders may turn into habituation which can result in a return to non-adherence (Vervloet et al., 2012).

According to Ryan and Deci (2000, pp.69), motivation is generally extremely valued by people who need to mobilise others to act. On the topic of adherence, motivation is therefore viewed to be of utmost importance.

#### 3.1.5 Motivation

Motivation describes the desire to act in accordance with a goal. It is influenced by sociocultural contexts and individual experiences which is why motivation differs from person to person (Ryan and Deci, 2000, pp. 69). It is of no surprise that kindling motivation is guite challenging - simply because there is hardly ever a case of "one size fits all".

There are two types of motivation that inspire individuals to act: intrinsic and extrinsic motivation. Intrinsic motivation is self-authored, unalienated and authentic, such as doing an activity out of personal, inherent interest, while extrinsic motivation is initiated by an external source. Common examples of the latter include rewards and threats. Intrinsic motivation is said to encourage interest, excitement, self-esteem and general well-being more than its counterpart (Ryan and Deci, 2000, pp.69). This observation has also been noted in children (Wolters et al., 1996, p. 233).

It is worth mentioning that extrinsic can develop into intrinsic motivation with time. The effectiveness of the two forms of motivation is - to say at the very least - a much discussed topic. In any case, both have influenced various methods of promoting motivation.

#### Self-Determination Theory (SDT)

According to the self-determination theory, in order for an effective approach in fostering motivation, three human needs have to be satisfied: autonomy, therefore of no surprise that gamification also shares competence and relatedness. Autonomy describes similarities with SDT. the perception of being the origin of one's own be-Gamification haviour and volition; competence refers to the feeling that one is able and effective in completing a task; When implementing gamification, the techniques, relatedness is defined as the sensation of being developments and design elements of games are respected, understood and cared for by others (Ng et borrowed and applied into traditional nongame al., 2012, pp. 327). environments. It is used to incentivise changes in

Autonomy especially espouses the idea of freedom documented to work really well (Hamari et al., 2014). of choice and active participation. Creating your own Yet, there are several factors that need to be considexercises (Berg & Petersen, 2013) or taking part in ered when creating a successful gamified experience. the decision process have been documented to lead to motivational outcomes. Positive, non-punitive Similar to the SDT, there is an understanding that the feedback is documented to encourage the feeling feeling of competence needs to be ensured, otherof competence (Ryan & Deci, 2000, pp. 70) and is wise users will quickly give up if they find the tasks linked as being a psychological factor that affects too challenging. Embedding a social community of adherence (Argent et al., 2018). Meanwhile, comlike-minded people into the experience is said to also munication and respect between an individual and have an encouraging effect (El-Hilly et al., 2016) even others in their surroundings promotes relatedness. when used to facilitate competition. Competition is This also includes the human support of a coach or actually documented to be one of many factors that healthcare provider, argued to have a positive effect can emit the sensation of fun (Almarshedi et al., on combating non-adherence by Mohr et al. (2011). 2015), and fun, or playfulness even, lies at the center of gamification.

The interest of applying SDT to the issue of non-adherence in medicine is most definitely present. It seems Certain pleasures when interacting with other agents to promise a lot of potential in creating efficacious and environments make an experience much more solutions for promoting motivation. The core ideas of engaging. Costello and Edmonds (2007), in their SDT have also been mentioned in other studies and context of studying engagement within interactive theories, often, however, under different terms. It is art, have suggested a framework for playfulness

behaviour (Almarshedi et al., 2015). Gamification is

which offers some inspirational ideas. This includes some of the following possible catalysts of pleasure: creation, exploration, discovery, simulation, sympathy and subversion. Each of these can trigger a feeling of enjoyment and thus capture an individual's attention.

Personalisation in the shape of self-representations, personally relevant rewards, challenges and information is also listed as an important factor for gamification, as described by both El-Hilly et al. (2016) and Almarshedi et al. (2015).

When it comes to gamification in medicine, known as Serious Games, it is essential to mention that it should not always be about fun and games. Because at the end of the day, the main concern is recovery and improving one's health. These two aspects also act as a motivator by themselves.

Critics argue that gamification does not only incorporate the advantageous sides of games but also its side effects such as addiction (Hyrynsalmi et al., 2017), leading users to become so hooked that they can neglect their health and other needs. We believe that addiction should definitely not be strongly endorsed, especially not within a medical context. Therefore, caution should be advised when designing Serious Games. We also acknowledge the concerns from Schmidt-Kraepelin et al. (2019) that gamification can distract the user from its actual health purpose,

and that medical topics are at times not presented with the serious and professional tone they deserve. Therefore, we recognise that communicating the health-related purpose and intentions is of great value and should not be neglected. Communicating these will allow the patient to understand and recognise that the gamified experience aligns with their own personal interest of recovery.

Schmidt-Kraepelin et al. (2019) also warn of the fact that games tend to lose their novelty effect over time which in turn diminishes motivation. This is most always induced when users consider the experience to be repetitive. This phenomenon can also be observed in one of gamifications most implemented functionalities - that of rewards.

#### Rewards

Rewards are categorised as being either intrinsic (pleasure) or extrinsic (points, trophies, money, praise, likes, etc.) motivators (Lewis et al., 2016). They function as a method of reinforcement - the psychological occurence of when a stimulus shapes and strengthens an organism's future behaviour. B. F. Skinner is notorious for being one of the core pursuers of instating reinforcements, having performed several (controversial at least to say) experiments and research studies with animals and humans throughout the 20th century. His work has shown how extrinsic rewards, such as food, can motivate others

to behave in a desired way (Skinner, 1965). Despite Skinner's discoveries, the effectiveness of extrinsic rewards in the upkeep of motivation is much discussed. For one, there exists the concern that reward-driven behaviours are generally not sustainable for a long period of time (Pereira et al., 2014). Often credited to its repetitiveness, rewards are argued to be ineffective once people become accustomed to them which simultaneously ceases their ambition in receiving them.

El-Hilly et al. (2016) are supporters of the idea that extrinsic rewards do successfully enthuse people. They recognise that when working towards one single, long-term goal, people struggle with complying. Setting rewards along the way as milestones, achievements or short-term goals makes it much easier to work towards the end result, while also acting as a feedback mechanism for their personal progress.

Interestingly, extrinsic rewards do work exceptionally well when combined with unpredictability. In fact, variable rewards strongly induce people to repeat actions (Eval, 2014, pp. 76-105). In the most extreme scenarios, it may even result in addiction, observable for example in playing slot machines where variable rewards are very much ingrained. This human attraction to the unpredictable is not exclusive to rewards but can also be found in storytelling:

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"The unknown is fascinating, and strong stories hold our attention by waiting to reveal what happens next." (Eyal, 2014, pp. 100)

What's more, rewards can also act as an intrinsic motivator where the reward is instigated inherently as a sensation of pleasure. These are very much subjectively driven. Certain activities - collecting post stamps; completing a puzzle - may be considered as inherently rewarding for one person, but not for another. Therefore, external pressure or rewards are not necessarily required for all individuals (Fogg, 2003, pp. 232).

#### Feedback

In STD, feedback is said to ensure the feeling of competence and initiate autonomy (Ryan & Deci, 2000). In addition to that, feedback has an even greater role in the sector of mHealth due to the fact that it commonly relies on patients monitoring themselves at home. Knowing how and whether they've correctly followed their healthcare provider's advice needs to be communicated clearly in order to avoid confusion, frustration and medical failures.

Positive, non-punitive feedback has been observed by Hysong et al. (2006) and Kluger and DeNisi (1996) to be more actionable for recipients. They allude to the notion that it should serve as an encouragement, not as a criticism. Furthermore, feedback should be clear,

purposeful and meaningful (Hattie & Timperley, 2007), otherwise the recipients will not act appropriately or enthusiastically. A similar observation on meaningfulness was made by El-Hilly et al. (2016): individuals who identified an alignment to their own personal objective appreciated such intentions much more than those which weren't considered as subjectively relevant.

According to Hattie and Timperley (2007), feedback which includes task-related information is most valuable. A task's context should be communicated within the feedback in order for recipients to gain a greater understanding of their progress and of how they may improve. The feedback should be compatible with the prior knowledge so that logical connections between "what has been done" and "what needs to be done next" can be made. Simple comments or praises such as "well done" are found to be counterproductive if there is no affiliation to the task's purpose. Phrases such as "well done for arriving on time" are recommended instead. To summarise:

"... in order to have a positive impact on performance, feedback should be timely, focused on the details of the task, particularly on information that helps the recipient see how his/her behavior should change to improve performance (correct solution information), and delivered in a goal-setting context." (Hysong et al., 2006) Content and intention aren't the only aspects that need to be kept in mind when giving feedback. Timing is said to also have an effect. For example, Clariana et al. (2000) argue that more difficult tasks require longer cognitive processing time which is why delayed feedback is much more effective in such contexts than if it were communicated immediately.

# 3.1.6 Conclusion: Background & Context

Non-adherence seems to be a general problem in medicine and is commonly linked to a lack of motivation. In our background research, we investigated various theories and methods which focus on the encouragement of motivation and have tried to cover a broad spectrum of topics.

We very much like the idea of autonomy, although we recognise that within our medical context it may be difficult to include it. This is because the majority of content and interactions are given in order to ensure an effective and medically accurate treatment. In our opinion, some sort of freedom of choice could offer the children an option to feel more integrated and we can imagine them being more motivated if they can take action on their own personal experience. We also acknowledge the importance of competence and fun, the latter, however, needs to be balanced in accordance with the seriousness of the medical treatment. By no means should playfulness be taken to the ridiculous. Although the effectiveness of extrinsic rewards is a authors of their own, especially involving them into much discussed topic, we do see a potential in using the process will give them a chance to show us what variable rewards. This is because we remember from really catches their attention and motivates them. our own childhood, how the element of surprise or unpredictability kept us excited and intrigued, in the After having looked into mHealth and its proliferation, form of a Christmas calendar for instance. As menwe feel rather inclined to the idea of taking advantage tioned already before, we would like to emphasise of the ubiquity of mobile phones: they offer a great that addiction, an extreme consequence of rewards, opportunity to reach a wide range of people and are a form of technology that people are familiar with. should be avoided at all cost, most importantly as it is not suitable in a medical context. Needless to say, gamified elements have to be wielded with caution. Ultimately, we've gathered several insights and have

On the topic of feedback, we believe it is important to facilitate transparency towards the patient's progress. It is their right to see what data is being collected about them and how they are advancing. Additionally, we are of the opinion that feedback can create a motivational environment, especially when presented in a positive, non-punitive manner.

From what we learnt about child-centred design, it became apparent to us that it is extremely challenging to create an experience for children aged between 8-17 years, while being able to accomodate the abilities, interests and needs of each unique age group. This observation encouraged us to investigate the differences in person by conducting classroom workshops and cultural probes in three classes (*see pages* 62 - 80). Furthermore we believe in Papert (1991) view of providing the children with tools to become Ultimately, we've gathered several insights and have set up a solid foundation on which we can base our field research and project development on.

## 3.2 Related Work

### 3.2.1 mHealth

#### TytoHome (TytoCare, 2012)

TytoHome is a mHealth service which allows people to perform guided medical examinations with a healthcare provider at home. A mobile device offers modular technology to examine and document their health while attending a video appointment with a healthcare provider. The entire diagnosis is done without physically needing to visit the doctors. The project has launched successfully in the US and has just recently been uptaken as a pilot project in Switzerland by the insurance company SWICA (2020). Amidst the Coronavirus crisis, an Israeli Medical Center is using TytoHome to monitor infected patients while minimising the medical staff's exposure to the virus (Tercatin, 2020).

TytoHome interested us as it has split its product into two corresponding platforms: one for healthcare providers and one for its consumers. Naturally, their business plan requires such a split as doctors will need to access different intformations and content than their patients. We've been contemplating whether two different interfaces or products could work for us too. Because SleepLoop's application, treatment and collected data does not only concern the child, but also their guardian.

#### Dreem (Mercier & Soulet de Brugère, 2014)

for the treatment of concussions, they are required Dreem is a mHealth wearable headband that tracks to follow many strict rules and ethics in order for your sleep and creates a tailored sleep schedule. Their them to be acknowledged as one. Since the goal of SleepLoop is to become the "standard of care" after a goal is to resolve the mystery surrounding the topic of sleep for non experts. Their tool allows people to concussion, being cautious of feedback which labels explore the data which is collected while they sleep. sleep as being either good or bad is essential because In addition, it gives recommendations according to any sort of feedback will in turn have an impact on their progress on how they may improve their sleep. the person's behaviour towards sleep. Dreem on the Even though Dreem and SleepLoop share the same other hand emphasises the notion of self-monitoring idea of improving sleep, there are differences that we by giving their customers access to all information can point out. and goes as far as evaluating each individual's sleep.

Compared to SleepLoop, Dreem is not a medical device and is more of a gadget. They may resemble each other in looks and the idea of improving sleep, however, as SleepLoop aims to be a medical device





#### PARO (Shibata, 2001)

PARO is designed for the elderly who live in a retirement home. It is a robot which mimics the form and appearance of a seal, its movements and sounds inclusively. It promises to help combat depression, by cheering them up and motivating them on their daily routine. It also helps reduce stressful situations with the elderly's caregivers. In a situation where many feel left alone, the elderly are given an opportunity to improve their lives with the help of companionship.

PARO is a very different and brave approach on mHealth devices. They involved the visual appearance of the device to make it feel less like a machine and more like a toy. This shows that there are many possibilities outside of the screen-based solution.



#### Medic Mobile (Nesbit & Holeman, 2010)

Founded in 2010, the nonprofit organisation Medic Mobile strives to provide better care to people in rural ground, thereby aiding in saving several lives. communities. Having started off solely with using SMS, today they develop and deliver open-source Medic Mobile was quick to recognise how the prosoftware for health workers and health systems. Their liferation of mobile phones can help to bring better tools intend to strengthen community health systems, healthcare to rural communities. They've focused reduce maternal and neonatal mortality and improve exclusively on this technology and have proven over child health. Their portfolio includes successful the years that it works as an effective mHealth interprojects across Africa and Asia . In an interview with vention - especially in rural areas. We found Medic the magazine Popular Mechanics (Sweeney, 2011), Mobile inspiring not only because of their charitable the founder Josh Nesbit shares his story of how it intentions but also because they're using ubiquity to their advantage. They've shown that one does all started, in particular how Medic Mobile was able to help victims in Port-au-Prince, Haiti, after having not need to reinvent products or services to have a just been hit by the devastating earthquake in 2010: positive impact on society. Medic Mobile mapped the location of people in need,



translated their text messages and forwarded the gathered information to the U.S. Army force on the

### 3.2.2 Gamification Sea Hero Quest (Glitchers, 2016)

Sea Hero Quest is a game created to innovate the way we are doing dementia research so far. Its purpose is to collect dementia data from players through a playful world in which you navigate and explore. Today in 2020, it has iterated itself and has become a different game whose story is more literal, and which tries to abstractly inform people of dementia through a geometric asteroids game.

The researchers have a wider reach for collecting valuable data with which, after analysis, they hope to improve the early detection of Alzheimer's, the medical development for future treatments and the communication and education on this common and

wide-spread illness. This game can be played by people in all age groups and is not exclusive to people who are dispositioned to the illness.

Collecting medical data through a playful approach is something we believe could work really well with accommodating SleepLoop's current problem of accessing consistent and reliable medical data over time. This approach is especially appropriate in the context of a pediatric treatment. Sea Hero Quest has created a fun environment with creative and entertaining interactions which encourage players to continue playing. We very much like the idea of turning medical exercises or questionnaires which are commonly plain and boring into more enjoyable experiences.

#### Anton App (solocode GMbH, 2019)

Similar to our initial broad target age group, Anton what exercise to do next, the decision is theirs to caters to children in their first to the tenth school year. make. This observation and input was most valuable From mathematics, German to biology and music, the to us, having made us understand that liberty may application offers exercises in various difficulties also act as a motivator. according to each age. When having solved a task In regard to Anton's design, we observed that its correctly, the child is rewarded with coins which can be spent on a vast choice of mini-games. The notion simplicity and reduced layout and colours are the of "reward-after-effort" stands at its core and serves most likely cause why the app works well with eight as one of the main gamified motivators throughout year olds and 15 year olds alike. This fascinated us inthe experience. stantly, although we are of the opinion that its design does lack emotion.

We came across Anton during a workshop with a class of eight year olds. They were absolutely mesmerised and excited by its usability and functionalities, expressing their enthusiasm especially for its





freedom of choice: in fact, the app never tells them

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#### Arm Coach (Meier & Bauer, 2011)

People who have suffered from a stroke need to perform daily physical exercises in order for them to recover their arm's motor skills. In their Interaction Design Bachelor project at the ZHdK, Meier and Bauer investigated how they could improve the treatment through a mHealth technology, a mobile wristband. They designed not only the product itself, but also its user experience and interface. Non-adherence was an important topic for them too, having learnt from medical experts that it is a recurring problem in rehabilitation treatments. The wristband therefore acts as a reminder, notifying the patient whenever their arm is in need of exercise, while also monitoring their progress. What started as a Bachelor project, developed into the startup company called yband therapy AG.

Our project interestingly enough shares a lot of similarities to that of Meier and Bauer. Their approach in dealing with non-adherence is most informative: they focused on creating a motivational and encouraging environment that respects and incorporates the required rehabilitation exercises. Today's design of the rehabilitation tree is an inspiring method of implementing visuals as motivation. They, too, worked with medical experts and heterogeneous patients, which meant they also had to take the interests of all parties into account.

Kwit (Kwit, 2012) we'll be tackling adherence, this approach will serve The mobile application Kwit praises themselves at the very least as inspiration. Gamification, too, for wielding "positivity and kindness" to encourage is applied through an achievement-based and a leveling-up functionality, although we do question smoking cessation. To elaborate further, they take use of positive reinforcements to raise the self-conits effectiveness. What we also appreciate is Kwit's fidence in users with the intention to strengthen their use of statistics to visualise and communicate one's motivation. Simultaneously, they've implemented progress and current state of health, wellbeing and both gamification and cognitive and behavioural therfinancial savings after having stopped smoking. Its apies (CBTs) into their product in an effort to make presentations of these definitely caught our attention the personal challenge of stopping smoking more and we recognised their attempt of creating motivaentertaining, supportive and effective. tional incentives.

The reasons why we found Kwit an interesting project is first of all their practice of positive reinforcements as a method to inspire motivation. They do so with uplifting encouragement and positive advice. As







### 3.2.3 Data Visualisation

#### Sleep Art (ACNE, BETC Paris & ibis Hotels, 2012)

In 2012, beds in a selection of ibis Hotels were furnished with sensors. Their purpose was to collect a guest's movements, temperature and sounds while they slept. The project pursued the question of "how does sleep look like" and aimed to visualise a night's sleep with the collected data. At night, the data was transmitted to a robot which would interpret and paint them on a canvas. By the morning, the hotel guest would wake up to an artistic visualisation of their sleep. The success of the project led ibis Hotels to release an app with which anyone could create their own sleep art at home.

Naturally, Sleep Art caught our attention as it utilises sleep data to create a visualisation. From the images, one may not intrinsically be able to read the data, however, they can be considered as visually pleasing. In regard to that, the question of aesthetics in its relation to data readability emerged. So to what extent should aesthetics shape and influence the data?

Brawl Stats for Brawl Stars (Overwolf, 2020) We found Brawl Stats through talking to adolescents Brawl Stats is an additional accomplice app to the in their classes. They mentioned that they love to very popular game Brawl Stars whose audience compare their statistics as a form of competing with ranges from children aged seven and above. It uses friends to see who has more achievements. It seems the game's API to collect all available information on that by having this competition and performance the Brawl Stars player's account, including data which overview, they were more driven to improve themare usually hidden and inaccessible on the game's selves and to continue playing the game. official interface. The information is visualised and presented in player stats, thus making the game much more transparent and accessible to the players. Brawl Stats has only one function, that of giving people a tool to track their own personal Brawl Stars progress.





## 3.3 Situating Our Work

In the majority of the related works the motivation aspect is a relevant feature. This was also a search criteria since we were eager to investigate different approaches.

First off, we could observe how gamification emerged as a key player in encouraging motivation. With Anton, pupils earn rewards by completing educational exercises with which they can unlock mini-games. Kwit makes use of the level-up feature known from game theory, having their users advance in rank by completing achievements. Sea Hero Quest has turned their entire research methodology into a game and yband therapy AG rewards rehabilitation activity with "water" with which a digital tree can be taken care of.

We very much like the idea of accomplishing motivation through gamification, however, without neglecting the medical appropriateness and seriousness which our medical topic deserves. When looking into Sea Hero Quest, we appeal to their playfulness, but find that visually they represent themselves too strongly as a game. We can imagine that the developers of Sea Hero Quest have reached the same conclusion as this would explain why their newest development deals more directly with the topic of Alzheimer's.

In regard to this topic of medical appropriateness, we situate ourselves closer to Kwit which do not hide their health-related context, and which constantly

communicates their alignment with their user's own personal interest of cessation.

We very much feel attracted to Anton when it comes to the topic of autonomy. This project has completely gripped its users simply because they can actively choose which educational exercise they can complete. We are also fond of Anton's split between its educational purpose and gamified features: their math questions are not modified into a fun adventure. They still remain fairly close to what you would see in a textbook. Thereby, the appropriate seriousness is upheld.

Transparency regarding relevant health-related data is a topic we investigated in our background research and which we find Kwit implements extremely well. In particular, they do well in including general health information about smoking and turn these into more personal, relatable feedback. We feel very inspired to do so too and use this form of communication as a motivational incentive.

When it comes to data visualisation, we compared the "classic data representation", as seen in Kwit and Brawn Stats for Brawl Stars, with a more abstract approach, represented by Sleep Art. We concluded that we prefered the former solution as we felt it empowers the users more. They can actively understand what is being documented about their progress and can see where they can improve themselves. But what about the application of technology? Paro is an interesting example of a non-screen based mHealth project, where treatment and interactions occur between human and machine. Nevertheless, we are more inclined in creating an user interface because, amongst other things, we've learned through our research that by targeting mobile phones, we can reach and therefore help many more people. Additionally, we feel it will allow us to take advantage of a medium which the patients are already familiar with.

# 3.4 Research Question & Hypothesis

In our thesis we would like to investigate the topic of adherence and motivation in a mHealth sleeping treatment for children. For this, we have phrased the following research question:

How can we create a positive experience that motivates, entertains and informs children throughout their sleeping treatment?

How can we encourage children to properly and consciously use a medical wearable at home?

From our gathered research we hypothesize that with enough information, a proper feedback loop and individualisation we can uphold children's motivation and ensure the daily adherence to a mHealth sleeping treatment. Especially by using positive, non-punitive feedback we believe it is possible to create a motivating experience which is enjoyable and informative to children.

Ultimately, we aim to conceptualize a design proposal of how a home based treatment can be combined with entertainment and medicine.

How can we create a positive experience that motivates, entertains and informs children throughout their sleeping treatment?

How can we encourage children to properly and consciously use a medical wearable at home?

# 3.5 Methodology

Many of our chosen methodologies are aimed at helping us in getting a better understanding of our target audience and the medical context which we are designing for. This decision was made because we realised during the concept seminar, a module held in preparation for our Bachelor project, that we were underestimating the abilities of our target age group - in fact, we often came up with ideas for children younger than eight years old - and that we did not have a proper overview of the SleepLoop's treatment.

Furthermore, we found it important to give both our users and our partners a voice and allow each of them to equally contribute to the development of the project. While conducting literary research, we came across papers in support of our intentions by calling for the use of participatory design in mHealth projects (Ludden et al., 2015) or when working with children (Yarosh et al., 2011). For this reason, our methodology is strongly based on co-creation.

#### 3.5.1 Cultural Probes

Early on, it became apparent that we were lacking an understanding towards children, aged 8-17 years. This had to be improved if we were to successfully design an experience for them.

Having made this observation, we decided on taking advantage of the cultural probe methodology. Our main intention is to familiarise ourselves with the age group we are designing for; to get an insight into their interests, behaviour and ways of thinking. We also appreciated the notion of play and ambiguity which cultural probes provide: through playful and creative explorations, we hoped to reach all ages and to receive inspirational surprises.

#### 3.5.2 Collaborative Workshops

We felt that, for us, workshops are the most suitable method of participatory design as it allows us to interact with each group of participants in person, to observe our users in real time and to initiate a discussion.

Our collaborative session with children would explore their interests, abilities and imagination for inspiration. Here, our intention was to create a playful environment in which the children can have fun and enjoy sharing their thoughts. On the other hand, the workshop with our partners SleepLoop would focus on sharing expertise and collaboratively coming up with ideas. This format was strongly influenced by methodologies used in Design Sprints.

One workshop with children was organised online due to the coronavirus as the Swiss government's call for social-distancing had to be complied. We conducted the session over Skype video call and an online whiteboard web page called AWWApp.

#### 3.5.3 Interviews

In order for us to gain more in-depth knowledge and expert opinions, we decided to use the interview methodology. We took up conversation with teachers, children and parents, wanting to investigate their general stance towards motivation and adherence. Within all of our workshops, we led conversations with our participants, be it with the children or the SleepLoop team, from which we probably gained the most valuable insights.

### 3.5.4 Self-Experience

Investigating an experience through user research when having not utilised it ourselves is, in our opinion, only a research half done. In order for us to understand the implications of using SleepLoop, we are required to experience and test it ourselves. For this reason, in arrangement with the SleepLoop team, we organised a testing trial on ourselves. Thereby, we are physically and emotionally able to understand the user journey in more depth, which in turn will strengthen our ability to empathise and design accordingly.

#### 3.5.5 Experiments & Prototypes

Through experiments and prototypes, we intended on investigating ideas and technologies. Whether they are quick or more refined developments, this methodology helped us to progress and to iterate. When working in workshops with children, rough prototypes helped us to communicate our intentions and to capture their imaginations. These often allowed them to contribute and to expand on what we had already developed. Due to social distancing, these prototypes were presented digitally over video chat to the children.

## 3.6 Motivation and Intended Contribution

Our biggest interest lies in dealing with an existing problem which affects people's lives and whose solution can have a profound positive impact. Combating non-adherence is a world-wide challenge which concerns all forms of medical treatments, not only that of SleepLoop's. The fact that this is such a relevant and much discussed topic and that our contribution may be of high importance has continued to motivate us even more. Both of us are also excited about the idea of working with children, as we have not yet properly designed for the user group before. Already throughout the concept seminar did we realise how much we underestimated children for which reason we look forward to rectifying our impressions.

In terms of contribution, we intend to help the pediatric mHealth experience advance in the field of usability and enjoyment. Having to apply a wearable and answering similar questions each day is a repetitive task and becomes even more mundane as the week progresses. These interactions need to be improved and any sources that demotivate and bore children should be abolished. Ideally, our project will encourage the overall consensus that medical treatment can be engaging and entertaining. Additionally, our contribution can even support the research of SleepLoop and consequently perhaps, if evidence and finance allows, the founding of their startup company. By establishing themselves as a venture with a strong interest in UX and Service Design, they will be

able to attract more investors and supporters. If their research can provide evidence that their wearable helps children (and adults alike) to gain higher quality sleep and an improved recovery from a concussion, our work will have a positive influence on the health of other children in future.

## 3.7 Chapter Overview

The second development of our Bachelor's thesis fol-In the third development of our thesis, we return to lows a very collaborative course. In the beginning, we our target audience to collaborate on storylines and present our field research which includes the process to find inspiration from the creativity and imagination and observations from our classroom workshops, of children. From our results, we then define and cultural probes and user interviews. Based on our apportion the plot. Accordingly, we describe our results, we then make the decision of narrowing the experiments and prototype which in turn influence age of our target audience down to eight to twelve the story and the app. This is followed by a chapter year olds. about the design of our app, its colours and structure. Ultimately, we conclude our process by revisiting the We then continue with a chapter about experiencing children and our partners to evaluate the appropriatethe sleep device ourselves in order for us to get a ness of the app and its story.

We then continue with a chapter about experiencing the sleep device ourselves in order for us to get a proper understanding of the treatment's current user experience and the challenges that we are facing. Our findings directly influence our collaborative workshop with SleepLoop which we organised in order to collectively define priorities and exchange expertise. Based on the ideas which emerged within the workshop, we present our concept of combining stories with the medical sleep treatment.



# 4.Concept ► Development

## 4.1 Angle

On our search for a Bachelor project subject, each of text of collaborating with SleepLoop, we realised that us took a different approach. Having read Walker's it made more sense to conceptualise a mobile phone book "Why We Sleep" (2018), Claudia was fascisolution. This is for one because mobile phones are nated about sleep's undervalued importance and a non-intrusive and familiar way to provide mHealth the immense impact it has on health and human solutions to a wider audience. Simultaneously, we development. Randy meanwhile felt attracted to the recognised that the device itself is an unknown piece application of new technologies and their possible of technology which may overwhelm our users. We benefits in health. This reinforced itself even more felt it therefore better to provide a companion prodafter talking with his cousin who has diabetes and uct that would not strengthen this negative feeling. uses a medical device to monitor his health. Instead it should accommodate a more supportive experience.

Our interests merged when the unique opportunity arose to collaborate with SleepLoop. With their application on children's sleep, we recognised that we could improve an medical experience for a target group that is often neglected.

From our background research, we saw that we need to understand our user groups better, in particular by meeting them in person. Because when working with children we require sensibility and this can only be achieved by gathering knowledge about our audience. Furthermore, so far, we had read a lot about mHealth technologies, however, we knew little about the mHealth sleeping device which we are designing for - something we definitely wanted to change.

Before our research, we had played around with the idea of creating a physical solution to motivate and instruct children. Yet, with our research and in our conIt is really important to state in the beginning of this chapter that we unfortunately could not get in contact with SleepLoop's ex-patients for a user interview. Due to their research ethics and that of their universities, SleepLoop was not able to provide us with their patient's contact details. This is why we could not interview and learn from those who had already experienced the current treatment.

## 4.2 Field Research & Findings

#### 4.2.1 Classroom Workshop

Since we realised in the concept seminar that we kept underestimating our target group, we wanted to get to know the diversely aged children better - and that as soon as possible. We decided to conduct a workshop as we wanted to meet them in person and through playful methods investigate their interests.

Luckily, with the help of friends we quickly managed to contact multiple teachers and found a 2nd, 6th and 10th class willing to participate in workshops held in February. The ages of these children perfectly covered our initial target of 8 to 17 year olds. We had also selected these classes because of the equal age gaps of four years between each of them.

As recommended by one of our mentors Nicole Foelsterl, we interviewed each teacher before planning our visit. They are the experts of their class and we wanted to learn from them what methods of communication and participation worked well within the age groups.

Alex Vordisch, who teaches the 2nd class, stressed how important it is for us to lead the session - we wouldn't be able to expect an open discussion with her pupils. She advised that we prepared simple questions to which the children could give answers. Additionally, she warned us of how examples can cause bias: "Examples are good to get the children to understand the question but beware that they will strongly influence the children's answers."

From Randi Malakatas, the teacher of the 6th class, we were told that it was important to communicate through simple language. Creative challenges which include drawing and crafting are also preferred. "Anything related to technology (mobile phones, tablets, etc.) or social media always catches their attention too", she explained.

Henry Chen, an IT teacher, informed us that his 10th year class enjoys actively participating in conversations and sharing their personal opinion on a specific topic. Since their typical school day is often spent in front of a screen, anything that is active and physical is a welcoming change.

After consultation with the teachers we were able to prepare a 45min long workshop. Based on what we had learnt from the teachers, we decided to conduct the same workshop format for the 6th and 10th class. For the 2nd class, we planned out a slightly different, more simple itinerary in hope to not overwhelm them. One of our goals was to receive an insight into their interests and abilities. For the older classes, we planned a task for which we selected the following topics:

#### Books

- For reasons of literacy and entertainment: at what level of literacy do they enjoy reading? What stories do they enjoy reading?
- Movies & Series

For reasons of entertainment and storytelling: what topics entertain them? What visualisations / stories catch their attention?

Apps, Websites & Social Media

For reasons of usability: what digital interactions do they enjoy? What designs do they like? What content attracts them? How is it communicated and presented?

Games

For reasons of usability and entertainment: what interactions and stories do they seek for?

· Famous Personalities

For reasons of understanding trends: who do they follow or idolise? What content do these personalities produce that attracts them?

We planned on splitting a class into five groups and allocating them to one of the above topics in order for them to speed brainstorm and share what they like. With the results we hoped to create a mind map from which we could not only identify their common interests but also find inspiration for in future. Subsequently, we instructed the children to perform a drawing exercise where they could fully use their creativity and express themselves. When introducing ourselves, we intentionally didn't inform any of the classes of SleepLoop or the medical context we are designing for. We kept our communication more open and concentrated on the topic of sleep in general. We didn't want to influence or bias their answers or confuse them with details. However, we did find it important to communicate to them our intentions, the work of interaction designers and the real-life impact their inputs from the workshop will have. Especially the latter did we try to emphasise as we are of the opinion that knowing that one's participation will have a real influence and is valued acts as a motivational boost.

#### 2nd Class (7-8 Years Old)

Meeting the youngest children from our age group early on in our project helped us clear up any misconceptions we might have had.

One of the differences was the class dynamics that we noticed upon entering the 2nd grade classroom. The teacher portrayed a strong authority and through a hand clapping routine, quickly gathered their attention and achieved silence. They are very obedient and the teacher doesn't tolerate any chit chat during class. Having visited the 6th class just beforehand made the contrast between the ages much more perceptible. Luckily, we came prepared and had purposefully made sure that our tasks were fun and simple to follow.

There is a children game which we both remember having played when we were younger that is called "I packed my bag". The first person starts with "I packed my bags and in it I put..." followed by an item of their preference. The next person repeats the whole sentence including every item that was named so far. We altered the starting sentence to "In my dream room I have..." and instructed them to add items which to them are fun and which they would love to have in their own bedroom. With this reframing, we wanted to catch their interests. Whenever an item was mentioned, we enquired their choices and reasons for why they liked it, and thereby quickly recognised that eight year olds struggle with self reflection. They couldn't understand why we asked them these questions. This resulted in them looking at us with big, frightened eyes and answering with "just because I like it".

The "I packed my bag" exercise introduced us to the learning app Anton which we've added to our list of related projects (see page 45). The entire class became all excited when we asked them more about it and suddenly everyone wanted to share their opinion. All of them expressed their enthusiasm for the notion of freedom of choice, a feature strongly ingrained into Anton. Autonomy, a factor we explored in our background research (see pages 34 - 35), was independently confirmed by this 2nd class of being really effective for fostering motivation.

Furthermore, we learned that the eight year olds seem to enjoy any game (mostly physical) or object with which they can socialise or play with others. Items such as "Connect Four", "Jasscards", a "three-storeyed bunk bed", "UNO" or "Lego" were mentioned.

For the drawing exercise we instructed them to draw an avatar of their choice with no restrictions. "How would you like to look like in Anton?", we asked, bringing the task into a context which they were familiar with and which they were enthused about. By doing so, we hoped that we could use their drawings as inspiration in our design process, or to be more specific for the storytelling and character creation.

The children's imagination knew no boundaries: some drew animals, their pets or a self-portrait, others created images of aliens, dragons or monsters (all smiling and not at all scary though). One child even



created an avatar which we believe looks very much like the famous singer, Billie Eilish. Probably our most favourite drawing is of a person with the body of a leg of meat (*Fig. 12*), mostly because the avatar surprised and amused us the most.

#### 6th Class (11-13 Years Old)

Before visiting the 2nd class, we held our workshop first with the 6th graders. The interaction between the teacher and the children was a little more relaxed but they were still obedient and followed instructions once their teacher got them to listen. During the workshop, there was a lot of energy in the room and our setting of having groups surrounding one of the topics of interest encouraged the children to talk and actively participate.

Randi, the teacher, explained to us that her students were really looking forward to our input since our session offered an alternative to their regular class. This novelty effect just shows how open children are to visitors and sessions that are organised independently from school.

During this workshop, we had the chance to answer questions and have a conversation with a few of the children. One memorable chat was with a girl who was concerned about the credibility of the results in regard to the maturity of her class. She expressed that she feels more advanced in certain social aspects. This confirms that even though children share the same biological age, we need to remember throughout our design process that there are differences in their mental development and social behaviour, as already mentioned in our background research (*see page 31*). From the interests exercise, we especially learnt that Japanese entertainment, such as manga and anime, are very much liked by the 6th graders. In reference to anime this observation shows that visual forms are more successful in catching the children's attention. The social media app TikTok most definitely has established itself in this age group: when introducing ourselves and our work as interaction designers, we purposefully took TikTok as an example for an interaction design project. The class screamed in excitement on hearing the social media app being named. Musicians were especially well represented in the list of famous personalities and included celebrities such as Ariana Grande, Capital Bra, Ed Sheeran, Loredana, Marshmello and Charlie Puth.

What surprised us was that some of the films and games they claim to consume are actually for over 18. The games "Call of Duty" and "Hitman", or the films "It" and "Predator" are actually not advised for children their age. Our assumption is that these children have older siblings and are thus more likely to be exposed to adult products. Additionally, their interest into older, more mature products can also be explained by the fact that children, as already mentioned (see page 32), aspire to be more grown-up.

The drawing exercise for the 6th class was very creative, playful and rather advanced. Our intention was to see how they imagined a head device could look like. Based on our design context, we thus gave them the instruction to visualise a wearable that helps them sleep at night. To make it more playful, the task was framed around the idea of creating an Instagram post where they had to draw the "photo", add hashtags and a description of the functionality of their wearable and how it works (*Fig. 13*). Unfortunately, when noticing that the children were confused (the term "wearable" was unfamiliar to the majority of them), their teacher stepped in and described it as



#### 10th Class (16-17 Years Old)

Our last workshop ended with the tenth class. Here, it is important to mention that their education system differs to that of the 2nd and 6th graders. This is because the 10th year of education is a bridge year in which students prepare themselves for their future apprenticeship. Based on occupational interests, the students are allocated into different major subjects and no longer have one principal teacher. The 10th class, we were fortunate enough to visit, majors in IT and is educated primarily in computer sciences.

The itinerary of the workshop stayed the same as with the 6th class. However, due to the confusion that emerged in the Instagram post exercise which led to rather biased results, we decided to alter the task by asking them to draw their ideal avatar in the post instead. Reflecting on this decision a few weeks later, we believe we should have stuck to our initial intention; that we should have owned our first decision and see how this older class would have interpreted the question.

The interests of the 10th class included, similar to the 6th class, many animes and mangas (*Fig. 14*). Multiplayer video games were also well represented. Interestingly, many video game streamers and e-sport athletes were also referred to, however, in the context of an IT majoring class this is actually of no surprise. When comparing their app and website consumption to that of the 6th (whose main focus lies on social media), we can observe that the 10th class are starting to become much more independent from their guardians: they are very much interested in platforms where they can exercise their own purchasing power (Digitec, Twint, Uber, Uber Eats and Zalando) and advance themselves in their skills and knowledge (cooking platform Tasty, Github and Google Podcasts). One very honest student even named Pornhub.

The adolescents from the 10th class were generally similarly motivated to participate for the same novelty reason as the 6th class were. Although they hesitated with the drawing exercise at first (as some felt that they can't draw at all), everyone quietly gave in once the timer started. By the end, each of them had drawn their Instagram post.

Nearly all of the avatars were visualisations of known characters from comics, anime or shows. Some even incorporated their home town or internet memes into their drawings.

Compared to both previous visits the age difference was once again clearly noticeable, especially in their communication and behaviour. In fact, we were advised by the teacher to use the formal form when addressing the students. This mutual respect between educators and pupils is in place due to the school system's approach on preparing the students for adulthood. But on entering the class, keeping up the formal form became hard for us. Because these 10th class "children" behaved similar to ourselves and shared the same interests that we do. This led us to identify our own social group within the class. In other words, 10th graders are more similar to young adults than to the children from the previous two classes.

Sicano The Wolfot Wallst Juman 11 Houseles Geldes stranger thinks Harry Potter Couth park Thewitcher Fast & Furices Boruto Naruto next Birebox Nandalorian Grenerations ME word alt ALWASSIC Park/world chlipp PSYCH. OPASSIL spongetor the Punisher ONL + unlor x Hunter tellay Akane 94 Fseed Matrix Vick and many fail y fail Naruta final space demon slaves gealt the witchel altered carbon allission Impossible the travellers Stranger things Avatar der letzte hetbandiger

#### **Conclusion: Classroom Workshops**

Overall the classroom workshop was a great success and we were so glad that we had taken the initiative to perform them so early in the process. After each class, we walked out feeling more confident, having gained a better understanding of the age groups and how they differ to each other.

The main goal of the exercises was to get more information on their interests and abilities. In addition we could identify trends, content and products from which we can take inspiration. Generally, we are of the opinion that we were able to achieve this.

However, looking back to the workshop, we wished we had approached the interest exercise slightly differently: having wanted to collect a wide variety of interests, we told the children to write down an enjoyable book, film, game, etc. only if it had not yet been mentioned. In the end, this caused us to not be able to rate the popularity of the interest - based on recurring references this would have otherwise been possible. We quickly realised this error after visiting the 6th class and therefore asked the tenth class to underline the interest if it had already been documented. Our findings from the 10th class are thereby more informative to us.

Besides exercises, being able to personally converse with each age group and observe how they behave and socialise with friends was such an invaluable opportunity to us. Each class had their own unique characteristics. It became even more apparent to us how heterogenous our initial target group of children aged between 8-17 years is and that it would be really challenging to design an experience which could do each age group justice and deal with their interests, abilities and needs appropriately. Our experience amongst others led to and emphasised the decision of narrowing our target audience down to an age group of eight to twelve year old children.

### **4.2.2** Cultural Probes

Parallel to preparing for the classroom workshops, we developed cultural probes with the intention of handing them out to the children we were visiting in class. This research tool should help us to learn more about their personalities, skill levels, daily lives and environments. In particular, we included questions and tasks related to the context of sleep (*Fig. 15*).

Due to the fact that SleepLoop's treatment lasts for In total, we handed out the cultural probes to 55 children, each containing seven envelopes for every day an entire week, we decided to distribute the questions of the cultural probe over a period of seven days. By of a week. This resulted in 385 individually prepared envelopes. Each guardian received one envelope with giving the children a task to complete each day, we hoped we could get an impression of their motivation a set of questions too. To keep an overview we made over a long period of time. The content of the quessure to number each class differently, creating a tions were varied apart from one continuous enquiry system with which we could easily tell the age groups on the duration of each night's sleep. This notion of apart. a repeating pattern was deviated from SleepLoop's medical questionnaire.

While creating the probes we wanted to ensure that the content was enjoyable and suitable to all ages. With that in mind, our cultural probes were kept simple in language and playful. The reason why we handed out the same materials to all classes is because we wanted to investigate how the different age groups responded to the phrasing and content. It also helped the analysis and comparison of the findings. Furthermore, we prepared a cultural probe for the parents. As the guardian, we knew we couldn't disregard their perspective on their children's lives and development. Besides asking for information on their child, we used this opportunity to ask them for their personal contact details so that they could participate in a further part of our design process if interested (*Fig. 16*).
	Cultural Probes for Children
Day 1	Draw yourself, tell us your age and give yourself a nickname
	Draw your sleep routine before going to bed (four sketch panels)
	How long did you sleep last night? From when to when?
Day 2	Describe or draw something that bores you
	Draw the last person you saw before you went to bed
	How long did you sleep last night? From when to when?
Day 3	Draw four things that are important to you
	How long did you sleep last night? From when to when?
Day 4	Imagine how you sleep in the future
	How does your bedroom look like? draw it or send us a photo.
	How long did you sleep last night? From when to when?
Day 5	What is next to your bed? Draw or describe it
	What helps you to fall asleep? Draw or describe it
	How long did you sleep last night? From when to when?
Day 6	What did you dream last night? Draw or describe it
	Draw your morning routine after you wake up (four sketch panel)
	How long did you sleep last night? From when to when?
Day 7	Draw your favorite position to sleep in
	Which tasks from the cultural probe did you like the most and why?
	Which tasks from the cultural probe didn't you like or bored you and why?
	How long did you sleep last night? From when to when?

	Questionnaire for Parents		
Question 1	How do you motivate your child?		
Question 2	Which objects are important to you		
	(Without asking him/her) Draw/desc		
Question 3	How many hours do you sleep on ave		
Question 4	How many hours do you think your cl		
Question 5	Do you have anything else you want t		

child in your opinion?

ribe them or send a photo?

erage?

child sleeps on average?

to share with us?

### 2nd Class (7-8 Years Old)

From the twenty 2nd graders, twelve cultural probes were returned. Out of those that came back, only five were incomplete. On collecting the envelopes, Alex, their teacher, explained to us that her class had struggled to understand the questions or were simply overwhelmed with the amount. This is the reason why a lot of them didn't participate.

On average the 2nd class children slept for 10 hours and 45 mins. Compared to the other two age groups, they slept the longest. Comments from the parents infer that this need for a high amount of sleep is due to the children's high energy level during the day and the amount of physical activity. One mother wrote that her child "is mentally and physically very active during the day and needs a lot of sleep". Her son was the longest sleeper with twelve hours on average per night.

Almost every child had documented "reading" as a part of their evening routine. This activity also served for some as an aid to fall asleep. Others wrote that their stuffed animal, their pet or their parents were required to be present. This led us to believe that the eight year olds like to have a guardian around who helps them feel secure. Two of them shared their religious and spiritual beliefs with us, stating that "two special crystals" or praying to god help them fall asleep. Interestingly enough, none of them mentioned

using any digital media such as tablets or phones before going to bed. Most likely this can be traced back to their guardian's influence.

Similar to our findings from the classroom workshop, we could observe that the children highly value company and socialisation. This became apparent on the topic of boredom, where one girl said that "I don't like to play alone", while also on the topic of what they consider as being important to them: here, parents and friends topped the chart of having the highest significance in their lives. People and pets seemed to be extremely important because the children mentioned these things much more than objects or hobbies.

The children's favourite task was to draw. What they disliked most was the recurring question on their duration of sleep. As it repeated itself each day, they described this task as being boring. They also didn't see the purpose of this question since they all were following a strict sleep routine and their bedtimes thus hardly ever changed.

One key moment was when we met the 2nd graders when we first entered the class room. Seeing them we both quickly realised that we could not and did not want to ask a seven or eight year old to take a picture of their bedroom. Even though we already heavily discussed this particular task because of ethical questions we agreed on keeping it in our cultural probes since we also gave the option to draw it instead of taking a picture. We realise that it was encroaching on the child's privacy and did not want to follow this direction. We also did not want to give a false impression to the parents and quickly removed it before handing out the envelopes.



### 6th Class (11-12 Years Old)

From the 6th class, a total of eighteen from nineteen cultural probes were returned. Their teacher Randi instructed the class to bring back the letters after each day regardless of whether they were filled out. Only three of the probes were incomplete which makes it overall the best response rate out of all classes.

In comparison to the 2nd graders, the 6th class pupils slept 1h 30mins less making it an average of 9h and 15mins. This stems from an average delayed bedtime, while the morning wake up time for school stays the same.

What helps them fall asleep is reading, listening to music or stimulating sounds like ASMR (Autonomous Sensory Meridian Response), having a nightlight or using their phone. Smartphones seem to have a rather dominant role in their lives as we could observe on the question of what is important to them: smartphones were named equally as many times as family and friends (Fig. 18).

Similar to the 2nd graders the 6th graders voiced that "doing nothing" causes boredom. What's more, they lack patience - be it waiting for a text message reply or during long periods of time where they need to pay attention before they can do something themselves (Fig. 19). This opinion reflected in their feedback to our cultural probes as they disliked assignments that

took too long to finish. Short and varied tasks that do not take up a lot of time were much more preferred.

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### 10th Class (16-17 Years Old)

Because we have only received three out of seventeen distributed cultural probes, we cannot draw too many conclusions from the responses of the 10th class. Although, just due to the fact that not many have participated we established that it can be difficult to motivate adolescents.

With an average of 7 h and 10 mins, the students from rhythm presented to them. the 10th class sleep the least out of all questioned age groups. From the three participants, the waking time was more consistent than their time when they went to sleep. The bedtime is very inconsistent for instance the person that stood out the most went to bed between 23:00 pm and 4:00 am.

On day four, we were presented with a rather amusing answer: the task was to "imagine how the future of sleep will look like" to which one student simply wrote: "Ok, I imagined it". Since we didn't actually give the explicit instruction to draw or describe their imagination, the student took the opportunity to take the question very literally. We suspect that the adolescent knew exactly what was being expected but purposefully decided to exert their freedom of interpretation. This example made us aware that when giving instructions, we need to ensure that they are as clear as possible in order to achieve the desired outcome.

Unfortunately, as only one feedback form was fully answered we can't really draw any proper conclusions on what exercises the 10th graders liked or disliked. "Recording the bedtimes, because I could observe my sleep rhythm" is the only response worth mentioning (*Fig. 20*). It shows that their sleeping behaviour is normally not something they consciously follow. The responder seemed to have enjoyed having their sleep rhythm presented to them.

# Welche Aufgaben der letzten Woche hat dir am Meisten gefallen? Wieso? Das Mit der Schlafenszeit weil ich mein Schlafrythmus beobrahten konntc

Tag 07



### **Parents**

We received 25 out of the 55 envelopes that were meant for the parents. We observed that the relationships between parent and child were very diverse. When asked about their children's bedtime habits, we saw that both 2nd grade and 6th grade parents responded similarly or identically to their children's feedback. In contrast, the parents of the 10th graders knew little about the true sleep patterns of their child.

The first question on how they motivate their children could see that many of them use rewards. Very interesting was that for many parents it is important to explain to their child why they have to do certain things and show them for example why doing good in school will benefit them later on in life. Giving them a context on the matter and educating them is something that attracted us a lot.

### **Conclusion: Cultural Probes**

From the 55 handed out cultural probes, a total of 33 were returned. Even though we have received a good impression in regards to what is going on in the participants' lives, the data collected and the conclusions we make are not scientifically valid information. We use it to enrich and inspire our design process, to learn from the children in a participatory, more playful way.

One thing that created difficulties when post-processing the data was our strong efforts to keep everything anonymous and ethically correct. We asked them to give themselves nicknames, in hope that we could use this information as an anonymous reference point which should enable us to track the responses from the same child. Unfortunately, we assumed incorrectly that all responses would return in the package in which we distributed the culture probe. The envelopes from the 6th class parents were returned individually, separating them from the answers of their child. This made it really hard to tell which parent envelope belongs to which student.

Generally, we've learnt a lot from the cultural probes about our target age group which most definitely inspire our design process. Repetitive, long-lasting tasks should be avoided and shorter, varied and more creative interactions encouraged. Technology, in particular smartphones, are very present in a child's everyday life, especially in the 6th and 10th graders.

The 2nd class pupils require more simplified phrasing and easy tasks in order for them to feel competent in performing it correctly. The exercises should be written out as precisely and clearly as possible to avoid undesired responses and confusions. Reading or exposing themselves to some form of entertainment was a common practice that the children did before going to sleep.

# 4.2.3 Interviews & Conversations **Interview with Teachers**

Before visiting the three classes and preparing the cultural probes, we talked on the telephone with each teacher and asked them how they keep their pupils engaged and motivated. We've briefly summarised our core insights from our conversations.

Alexandra Vordisch teaches the 2nd class and rience, this age group loses interest if they are asked explained to us that it was important to display to be passive and simply listen. appreciation towards what a child has created. If an **Interview with Children & Parent** eight year old child feels valued and acknowledged their motivation increases. She also stated that any Early on in our process, before having narrowed down form of technology (she took tablets and phones as our target age, we interviewed two siblings and once examples) always catches their attention and gets again we wanted to get to know our audience a little them excited. What really caught our interest was better. As we had more time to spend with them perher opinion towards freedom of choice and how well sonally, we took this opportunity to also learn about it works in getting her pupils to comply. This clearly their experience of adhering to treatments and having aligned with our literary research of autonomy and its access to their medical data. impact on motivation.

The first child we interviewed was a 12 year old boy Randi Malakatas is the teacher of the 6th class. She called James. On answering our question about told us that she always likes to communicate to her specific stories he enjoys consuming in books, film or pupils the purpose of activities. By giving them "the games, he told us that he is fond of funny, adventure bigger picture" they would understand what they are based storylines. When reading books or watching working towards. She confirmed to us the fact that shows, he's recently started to enjoy informative and anything childish (or clearly younger than their age educational settings in which he can learn something. group) is instantly disliked. She emphasised that it is When it comes to video games, he explained to us that much easier to get her class to become motivated for he finds stories which are made out of several plots an activity if these are challenging. Too easy and they the most entertaining. If these included multiplayer

get bored. Yet, these activities still need to be accomplishable. This comment aligned with our findings on competence.

When talking to Henry Chen, the IT teacher for the 10th graders, we learnt that his pupils respond well to engagement. Any activity in which they can actively take part in works really well. According to his expe-

friends, the better.

When we asked him to describe his experience of adhering to a physiotherapy treatment, he mentioned how pointless he had considered the ligament exercise to be which is why he had stopped the week long treatment after just two days. He elucidated that the exercise was painful; but more interestingly, at the time, he couldn't identify any improvements in health and was therefore of the opinion that the treatment wasn't making any difference.

Our second interviewee was with 15 year old Amélie. She also expressed an interest in consuming informative and factual content. So far she had not had any need to receive a medical treatment which is why she couldn't tell us much about that topic. She keeps herself mainly motivated by planning time schedules and itineraries; or by going outside to catch some fresh air. Because of her love for creating routines, she could give us a very detailed overview of her sleeping behaviour. As such we learnt that she allows herself time in the evening and in the morning to relax, watch TV or read.

Our second interviewee was with the 15 year old Amélie. She also expressed an interest in consuming informative and factual content. So far she had not had any need to receive a medical treatment which

environments in which he could enjoy the story with is why she couldn't tell us much about that topic. She keeps herself mainly motivated by planning time schedules and itineraries; or by going outside to catch some fresh air. Because of her love for creating routines, she could give us a very detailed overview of her sleeping behaviour. As such we learnt that she allows herself time in the evening and in the morning to relax, watch TV or read.

> We also talked to Carolyn, the mother of the two siblings (the father was unfortunately not available) and listened to her perspective. She retold James' experience with the physio therapy, saying that it was she who had made sure that he was following the exercises but had forgotten to remind him on the third day.

> As he was of the opinion that the treatment was ineffective, he clearly felt that there was no need to take the initiative. When it comes to motivating James to do an activity he does not want to do, she resorts to rewarding him with extra gaming time after completion.

> She continued explaining to us that Amélie is rather independent. Many health related aspects are done without her supervision or help. She would motivate her by talking to her and showing examples with which they could compare with. In other situations, she would nag her daughter until she would comply.

Our talks with these two siblings and their mother were helpful mainly because they reinforced our learnings from our literary research (for example, the importance of feedback) or from our field research and its cultural probes (for example the children's interests and sleeping routines).

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# 4.2.4 Self-Experience

In accordance with SleepLoop, each of us received a sleeping device for the duration of six nights at the beginning of March. With it, we hoped to understand more in depth the process and experience which patients currently go under. Simultaneously, SleepLoop could use our data to further their research, therefore all of us could mutually profit from this procedure.

Firstly, it is important to note that the current experience which we were exposed to is tailored to the current temporal research setting: there are many steps which will most likely disappear in the final version of the device. As agreed with SleepLoop, we'll be designing for the experience for the future when their device is hoped to be acknowledged as being "standard of care". This means, for example, they intend on simplifying the setup process, which - in its current state - we felt was one of our greatest pain points. Currently, however, the most frustrating step is necessary to complete on the very first evening, allowing "the access point", a separate raspberry pi, to wirelessly connect to the wearable device.

### Setup

At the time, we were able to test SleepLoop's newest development of their sleeping device (*Fig. 21*). This new version has abandoned the usage of cables to communicate between the wearable and the "access point", the raspberry pi, which sends the collected

data to SleepLoop. Instead, while sleeping a mobile computational part which rests on the top of the head collects the data from the electrodes and passes it wirelessly on to the "access point". Additionally, the computational part has an audio jack embedded which also serves as the power switch. The audio cables are linked to two sleeping speakers that emit the auditive treatment at night. These speakers need to be positioned correctly over the ears before going to bed. The whole sleeping device is made out of modifiable straps in order for it to be put on more easily and to fit to various head sizes.

It is fashioned with seven differently coloured cables, each for one electrode. These electrodes are placed all over the face before connecting them to their specific wires and before putting on the wearable for the night: one behind each ear; one on the forehead between the eyes; one above the right eye, the other below the left; and one on each side of the jaw (*Fig. 22 & Fig. 23*). These electrodes need to be replaced each night.

Because there weren't enough electrodes for a full six night experience, we could only use the sleeping device to its full potential for three nights. Only on those three occasions did we also use the corresponding app in which we simultaneously filled out a questionnaire. Claudia, however, wanted to try to come as close as possible to a full week which is why





she decided to wear the sleeping wearable for all of the six nights. On those occasions where she had no electrodes available she tried to replicate (or dry-run) the usability process as accurately as possible.

### **Observations**

Throughout the week we made sure to document what feelings we had. By the end, we collected these onto an Emotional Journey Map (Fig. 24). With this overview, we could pinpoint critical interactions which we intend on looking into in our work. Each evening and morning consisted of the same sequence except for the very first evening when additional setup (connecting to the local WiFi and pairing the

wearable with the "access point" through bluetooth) had to be performed. As already mentioned above, this is a process which SleepLoop intends to simplify in the final version of their wearable. At any rate, on our first evening, we both became exposed to feelings of frustration, insecurities and confusion. The setup procedure lasted for 40-60 mins mainly because the raspberry pi "access point" couldn't find the wearable device. From this experience, we learnt how crucial it is to avoid insecurities, to offer answers to any emerging questions, and to keep the duration of setup as short as possible. As setup will most likely occur before going to sleep (as it did in our case), it is by no means ideal if it prolongs bedtime (especially not



for 40-60 mins). As it's also the first time of usage, answers - neither in the evening nor in the morning questions will pop up. By the end of our session, we on the following day, after having worn the device for had become more tired, uncertain and confused. For the night. Children and their guardians will most likely SleepLoop's users the experience had thereby started also come across these uncertainties and we will off at a low with a negative interaction, an undesirable have to ensure that feedback and additional support way to start off the patient relationship. can assuage these.

In bed on the first night, with the electrodes and wear-By the third day, we had learnt to apply the electrodes able attached to our heads, excitement and curiosity and the steps of the questionnaire nearly off by heart. grasped us. What data will the device collect? What As our confidence grew, our motivation dropped. We will it be able to tell about my sleep? How will it affect knew the drill and were, over time, getting more and my night - will I sleep deeper? Such thoughts and more tired of having to repeat the same tasks every questions occupied us and kept us awake, thereby evening and every morning. Simultaneously, the novshortening our overall sleep time - an undesirable elty effect of being exposed to data driven technology consequence if sleep is essential for the recovery wore off. Here, we see an opportunity of stepping in process. This shows just how sensitive sleep is as designers: as soon as the users have learnt the procedures and feel more secure, the journey could towards mental factors. Amusingly enough, excitebecome more playful. Repetitive instructions which ment and curiosity are positive emotions but in the context of sleep they do bear additional hurdles. By have been especially important for the beginning of the morning, however, these feelings quickly turned the treatment can now move to the background. Nevinto disappointment simply because our curiosity ertheless, if questions do arise, help should always be had not been satisfied: no feedback on our sleep was easily accessible. available. Curiosity may arguably kill the cat, but it most definitely kills motivation when unsatisfied. **Conclusion: Self-Experience** 

In general, using the sleep wearable allowed us to Generally, on the first two days, we observed that we learn so much about the overall experience. We felt rather overwhelmed and uncertain in whether we immersed ourselves into the position of a child and were following and understanding the instructions their guardian, focusing on empathising with them properly. "Am I doing it correctly" was a question we on each individual day. We could quickly confirm our kept asking ourselves for which we never received any assumption that each day bears its own emotional

challenges: the one week journey is far from being linear and has many unmotivational hurdles to overcome. In particular, on the very first evening, there are many insecurities to face.

It is here important to note again that the sleep device and its medical experience have been developed with children in mind. Its current state was initially intended for adults. And this was most definitely noticeable. Its current presentation often even caused both of us adults to frown in confusion. For example:

"How many minutes were you approximately awake after falling asleep until you got up (time of falling asleep not included)."

How can a child feel competent in following the instructions when it even causes adults to feel insecure? In this example, we had to reread the question a few times until we felt we had understood it properly. Furthermore, we had no confidence in our answer, how could we know how long we had lain awake last night?

Additionally, with no feedback informing us whether the night was successfully tracked or not, we never knew whether we were following the treatment properly. The combination of the two definitely has an effect on motivation and especially does not guarantee competence, a factor strongly emphasised by Ryan and Deci (2000) in their self-determination theory (see page 34).

Naturally, we fully understand that children who are enrolled as patients for the sleeping treatment are exposed to a very different context: their history of having been injured and their goal of recovery will affect their approach towards adhering to the instructions. Because acting on behalf of one's health is most definitely its own motivator. Nevertheless, motivation is very likely to drop at some point and the feeling of laziness will kick in, as it did for us, however, probably in a later stage. Joëlle Albrecht, a psychologist from the SleepLoop team, who works closely with the children being treated for their concussion confirmed this understanding: on seeing our Emotional Journey Map, she remarked that based on her own observations laziness appears towards the end of the treatment, from the fifth day onwards.

Our insights into the treatment's one week experience also greatly influenced our communication with the team from SleepLoop and supported us in the preparation for our workshop. After having returned the device, we felt more knowledgeable and confident as designers. Our task and the context for which we'll be designing had at that point become much more transparent, comprehensive and relatable to us.

# 4.2.5 SleepLoop Workshop

Collaboration and participatory design are factors both of us appreciate and wanted to practice in our design process. For this reason, we organised and held in the Toni-Areal a one day workshop with the entire team from SleepLoop. Our goal was to initiate a discussion between designers, researchers and developers, to identify priorities and to collaboratively brainstorm ideas. As designers, we also hoped to understand the needs and challenges of our partner more in depth in order for us to focus on creating more fluent and natural interactions.

Equipped with gipfelis, coffee, and enough post-its to decorate the entire Toni-Areal building, we started the workshop punctually at ten o'clock on a sunny March morning. Besides the two of us, all five members of Inspired by the Design Sprint methodology, the work-SleepLoop attended, accounting for a total number shop's itinerary followed a structure which Claudia of seven participants. In fact, we were very fortunate had become acquainted with in a previous work exto have found a date on which the entire SleepLoop perience. The morning was reserved for discussions, team could be present. This allowed us to fully profit from the various experts who are closely affiliated to sharing knowledge and opinions and to mutually decide on priorities. In the afternoon, creative meththe development of the wearable and / or the execuods were resorted to and the gathered information tion of their medical research. It also ensured that everyone could share their opinion in the workshop. from the morning came together for the development of various concepts.

After our introduction to the day and a fun warm-up As introduced in Jake Knapp's Sprint book (2016), the roles, the facilitator and the decider, were represented. Due to her previous experience and having led some workshops in the past, we decided that Claudia should be taking on the role of the facilitator. She stood in charge of moderating the day and of keeping the time. Meanwhile, the decider was represented

by Walter Karlen from SleepLoop. This role requires a person who has a good overview of the whole subject. Walter was elected as the decider by the team and therefore was in charge of making the final decisions - of course, after having taken the intuition of everyone else into account.

# Morning: Exchange of Expertise & Setting Priorities











First, we looked at the user journey map of the very was important to be transparent and straightforward first 24h of the treatment (Fig. 29). We had decided to in communicating our identified problems and opporprimarily focus on this part of the experience because tunities. Because the SleepLoop team can learn from it not only incorporates all important usability steps our findings as much as we have. Based on this, the that are repeated every evening and morning of the issue of "time spent on setting up the sleeping device week-long treatment but also other actions that are before going to sleep" was greatly discussed. If too unique and exclusive to those first hours after having long and too confusing, it will tire users out and shortbeen medically assessed by a doctor. Together as a en actual sleep time. We also touched on the topic of team, we took our time to look at each step. feedback and how both of us were unfortunately left in the dark during our "treatment". In any case, these The purpose of this session was for us to check with page.

discussions ensured that we all were on the same the experts of SleepLoop that the current user journey was mapped out correctly, especially regarding the interactions of the child and their guardian. We The subsequent exercise asked everyone to turn their then advanced further by discussing how the journey assumptions and opinions of the existing challenge will change once SleepLoop should be established into a HMW (How Might We ...?) question. We wouldn't as a "standard of care". Here, we documented open be able to delve into all of the subjects on the one questions and challenges significant to our task of workshop day which is why each voted for what they designing the experience. Could emitting the feeling thought were the most important challenges. Thereby of responsibility towards the device encourage chilthe following questions emerged as having the highdren to use it more consciously and independently? est priority: Or if the device were to identify a medical emergency How might we keep patients involved and (such as epilepsy at night), how could SleepLoop give support and alert medical authorities? motivated for the whole period?

Subsequently, we moved to our Emotional Journey Map, the same one we had created during our self-experience (see page 86). Here, we explained to SleepLoop what pain points and enjoyments we were exposed to while using the sleeping device. To us, it We felt it was important to share the research and knowledge which we had accumulated: in a short presentation, we introduced our most interesting and relevant findings on gamification, autonomy, rewards & unpredictability, feedback and parent involvement. The input was kept short in order to allow time for a group discussion. In particular, we had some questions to ask SleepLoop regarding some topics we needed clarification on.

As such, we asked what their stance is towards feedback because we strongly believed that feedback is essential for motivation. Reto Huber, an experienced psychologist from SleepLoop, expressed his concerns with feedback and its application in medicine: evaluating the behaviour of patients is something he didn't feel he could fully endorse, especially in the context of such a delicate subject as sleep. He explained that it may bring negative consequences about which will in turn cause an undesirable interference on the patient's sleep. The role of feedback was in fact a topic which was heavily discussed throughout the entire day and which we will delve into more thoroughly in a later segment of this chapter (see page 98).

Joëlle Albrecht, one of SleepLoop's participating psychologists, shared her experience of working with children and how they had expressed a preference in adult designs: in previous trials, she had given the children fun and colourful stickers to customise the appearance of the sleeping device in belief that they would make the device prettier and more attractive to the children. However, the children always relinquished these in favour of the plain, more mature appearance. This observation only strengthens the fact that maturity seems to be a much sought design aspect by children (see page 32).

On the topic of gamification it was agreed that caution is advised: although gamification offers great opportunities for making SleepLoop's treatment more motivating and entertaining, no gamified functionalities or designs should overshadow the seriousness and importance of the treatment. The medical context should stay in the foreground and not be forgotten. In addition, the beneficial impact of gamification should be well communicated to guardians and children alike.

Furthermore, we took this moment to quickly present an idea that we had developed in the concept seminar. We asked "what if the sleep data could be represented into a more tangible form?". Could a representation of the data act as a motivational memento and physical reward at the end of the experience? The notion of a personal "fingerprint" definitely caught the interest of the workshop team and served as inspiration in the afternoon's creative brainstorming session. By lunchtime, the exchange of expertise resulted in a<br/>good collection of new insights and various clarifica-<br/>tions. Similar to beforehand, each of us documentedHow might we give positive feedback without the<br/>negative consequences?tions. Similar to beforehand, each of us documentedHow might we create a child-appropriate but not<br/>childish experience?tion an affinity map (Fig. 30), categorising the post-its<br/>into autonomy, gamification, feedback, community,<br/>communication and personalisation, and once again<br/>voted upon what we felt had the highest priority.How might we use positive feedback to correct<br/>the wrong use of the device?

j



How might we create a personalised "fingerprint" of sleep?

### **Afternoon: Collaboratively Sketching Ideas**

The afternoon started off with a short presentation of related projects. For this, we had asked in advance that every participant should bring two examples and to describe what they liked or disliked about it. Our intention was to gain inspiration for the upcoming creative sketching session and to understand what we needed to avoid when continuing on the design of the experience. The example Dreem, presented by Walter Karlen, Reto Huber and Giulia Da Poian, was later added to our list of related projects (see page 41). This project had in fact become even more relevant after our previous discussion on evaluative feedback as Dreem is a big supporter of such an approach without really taking the negative consequences into account. What's more, SleepLoop strongly criticised the project for its excessive claims and approach of overpromising on medical interventions.

The rest of the afternoon focused on more creative and visual methods. Based on the morning discussions and the defined priorities, everyone was tasked to brainstorm how they imagined a solution could look like. For this, the "Crazy 8" method got everyone to rapidly sketch out eight different ideas within eight minutes. These quick sketches were merged later on into one final sketch.

All seven of these were hung up on the walls for the final presentation of the day. As the common under-

standing was that a mobile application is a part of the entire medical experience, many of the final sketches focused on using this technology.

From the results, what instantly caught our attention was that four out of the seven participants had independently developed the same idea: they all saw the treatment as a journey and each of its days as a milestone. Claudia's concept described the milestones as individual chapters of an overarching story that lasted the entire week. Joëlle Albrecht conceptualised them as being checkpoints at which decisions playfully influence the interface of the app (*Fig. 31*).

Giulia Da Poian sketched them out as levels which need to be unlocked by sleeping. Meanwhile, Laura Tüshaus' milestones incorporated games, information and stories that varied each day. This showed that there was a general, although yet unspoken understanding that the treatment is a journey on which the patient sets out on for their recovery.

To check whether the electrodes are placed correctly on the face, Augmented Reality AR was suggested by Walter Karlen as a method of how the patient could be guided through this crucial process. The idea enthused the entire workshop team, leading to a discussion of perhaps incorporating rewards into AR. There were some open questions regarding the technological development of augmented facial recognition algorithms, however, fortunately, the team kept being open minded and considered ideas which may currently be difficult to realise. What's more, the team agreed on the proposition that the questionnaire should be constructed out of immersive and playful interactions, making the completion of the form much more entertaining and fun.

The idea of making the sleeping data more perceptiblesleep data representation could still take place withinreemerged in form of an auditive data representation.another part of the experience.Randy sketched out the idea of having the child wakeup to the sounds of their sleep: the sleep data couldBy five o'clock, everyone felt tired of the intense day,be calculated into a tune, thereby allowing the patientbut happy of the results: as a team, we had collaborationratively developed and discussed some great ideas



collected during the night. Initially, the idea was to use the sound as an alarm for in the morning, however, Reto Huber argued strongly against it, saying that an alarm is too intrusive because it interrupts sleep, the main requirement for a quick recovery. "If a child needs to sleep longer then they should be allowed to do so". His reasoning instantly convinced us all. Instead of an alarm, it was agreed that the auditive sleep data representation could still take place within another part of the experience. which in turn helped us to define the direction in which the design should go. Or to be more precise, we agreed on the following understandings and features: overall the treatment is seen as a journey in which each day serves as a milestone or chapter. Through AR and playful interactions, immersion is provided and adherence should thus be encouraged.

### **Feedback Ethics**

From various discussions that were held throughout the workshop, feedback emerged as being a very delicate topic in mHealth and requires a lot of sensitivity in its application. It is one of greatest learnings from the day and of such importance that we would like to highlight it in a segment of its own.

At first, as discussed in our literature research (see *page 26*), there is a distinction to make between medical devices and wellness gadgets. When designing in a medical setting, there are ethics that need to be regarded when it comes to data communication. Although the sleep device is a medical device with the right to be used for a diagnosis, SleepLoop insisted on having the data feedback be communicated by a medical practitioner. They did acknowledge our desire for data transparency, but were of the strong opinion that this had to be done differently.

Above all, in the context of sleep, feedback should not evaluate the recovery progress as it may interfere with the treatment. Positive feedback is said to encourage motivation (*see page 37*), however, what should be communicated if the patient's performance does not align with what is medically expected? Critical or corrective feedback can be perceived negatively which may in turn trouble and distract the patient to such an extent that they find themselves stressed by it, or having difficulties falling asleep. In fact, even without feedback, the knowledge and curiosity from being tracked in bed has such a profound effect on a person's ability to fall asleep, that they end up staying awake longer at night (Hegemann, 2019). So the cumulation of troublesome feedback and general reflections of the experience would by no means provide for a restful and restorative environment.

The workshop team acknowledged that some sort of feedback should still be provided because it is expected that the patient will naturally become curious and encounter questions. Their needs have to be appeased to ensure a positive experience. For this reason, it was agreed that the feedback should refer to general information about sleep and should serve to educate the patient through their treatment. This may in turn have a positive effect on their sleeping behaviour beyond the duration of the treatment. Furthermore, an abstract representation of the sleep data in the form of an auditive memento would allow the communication of the data without being evaluated.

### Conclusion: SleepLoop Workshop

In general, we were very pleased with how the workshop had progressed. In our opinion, the day had gone smoothly and the discussions and exercises allowed us to gain the information and results which we had initially hoped for. As such, we had collaboratively agreed on three core ideas with which we can continue to work with: the treatment is considered as a journey in which each day acts as a milestone; through AR and playful interactions, the child should feel immersed when following the medical instructions and when filling out the questionnaire; a rewarding, auditive memento made from the sleep data acts as an abstract form of feedback, thereby avoiding any evaluation of the collected data.

In regard to the idea of having the treatment as a journey, the child would be able to enjoy a new adventure each day in the form of a story. This approach bases itself on using variable rewards to keep the child engaged. At what point this reward would be unlocked would be down to us. Based on our self-experience, we found it made sense to place the story in the evening, as this is the most crucial time to encourage adherence:

In addition, we could validate the user journey we had mapped out beforehand, thus confirming our understanding of the full experience. In this workshop it was also agreed that we'll be designing for the future case when SleepLoop should become "standard of care". This means that in occurrence of a concussion, doctor's would instantly resort to SleepLoop's sleeping device as the natural choice of treatment.

The workshop was well received by SleepLoop too, stating in our feedback round that they appreciated the preparation we had done in advance. They seemed to have enjoyed the collaborative and creative exercises, describing them as being fun and also inspirational for their future work. In regard to time, they expressed that they felt the workshop was rather long and could have started earlier in the morning. In addition to that, they suggested that a more diverse team could have made the day more interesting. We can fully see where they are coming from because some of our discussions may have been a repetition to them and not equally as informative as they were to us. Nevertheless, we were pleased to see that the day was also beneficial to the SleepLoop team and that they could learn from our more creative approach.

# 4.3 Concept

From our field research, we ended up narrowing our target age down from 8-17 to 8-12 years. This is because we recognised that we could not simultaneously satisfy the needs and interests of an eight year old child and a 17 year old teenager. This raises the following question: why exactly this age group?

For one, we saw from our background research that this categorisation is prevalently defined and accepted. Also from our own observations we could see similarities between eight and twelve year old children, provided that puberty had not yet begun. For another and more importantly, when we presented to SleepLoop our intentions of narrowing down the target age group, we asked them what the average age of their patients were. From their own experience, they explained that the children were often eight to ten years old. For this reason, we decided to focus on this younger age group.

Our literary and field research helped us to develop a concept which we believe takes the interests of our medical partners and our audience into account. At the core of our concept lies the understanding that the treatment is designed as a journey.

Each day, the patient child can look forward to a chapter of a story that takes them on a narrative adventure. The story lasts for the duration of one week (in accordance with the duration of the treatment), whereas each chapter is unlocked after having put on the sleeping device. We are using these chapters as a form of unpredictable, variable rewards which, as we've discovered in our literary research, works well in fostering motivation (*see page 37*). The inspiration for the usage of stories came from the workshop but also from our observation that children enjoy consuming some form of entertainment before going to sleep. Thereby, we are tapping into the children's evening routine, making our solution less intrusive.

The concept comes in the form of an app which includes not only the stories but also the medical questionnaire and instructions on how to use the wearable. For the latter, Augmented Reality (AR) will help them to place the electrodes correctly.

The app will provide the child feedback, while respecting the ethics as discussed with SleepLoop. We do not want to give the child any reasons to worry and to stay up at night. In the ideation workshop with the SleepLoop team, it was agreed that the idea of having the feedback be something abstract could work. We suggested using sound since we can instantly generate it through algorithms based on their unique sleep data. Additionally, we liked the idea of sound because it links to the sonic sleeping treatment - as sound is being used to treat the children. This sonic data representation would be offered as a reward that is slowly created over time until the end of the treatment.

# 4.4 Next Steps

Having decided on applying a story within the treatment, we feel it appropriate to return to our target audience and see what storylines we can come up with as a team. In that sense, we intend on continuing our collaborative efforts and letting ourselves be guided by the children's imagination. From our results, we hope to proceed in structuring the story and explore how to distribute the narration over the course of the treatment.

Certainly, we will be working on the architecture and design of the app, starting from basic wireframes to creating its skins. Additionally, we would like to investigate the aspect of Augmented Reality and the abstract auditive representation of the sleep data. How could we prototype them? In particular, our intention is to find a solution in combining the AR features with the app in order that we can seamlessly test and experience the concept that we are creating.

# 5.Project • Development



# **5.1 Online Storytelling Workshops**

After our successful collaboration with the SleepLoop In preparation for the workshop, we sketched out each team, it became even more apparent to us that we step on our AwwApp workboard, from introduction to should conduct a collaborative workshop with chilstoryboard. This map served us and the children as a dren. As we had decided that we'll be implementing visual guide. Together with the children, we followed a story into the week-long treatment, we felt it was the map and sketched out ideas. Initially, our intention right to work on these storylines with the children and was that the children could draw onto the whiteboard to give them an opportunity to influence our creative themselves, however, it guickly became apparent that process. This led to the organisation of a storytelling they were rather overwhelmed by the online tool and workshop with which we hoped to co-create ideas for felt shy about their own drawing skills. They preferred characters and an entertaining story. to just tell us their imaginations and to not sketch them out. For this reason, Randy spontaneously start-When the Swiss government ordered social-dised to sketch out what they were saying.

When the Swiss government ordered social-dis-<br/>tancing and the closing of our university due to the<br/>coronavirus outbreak in mid March, we had to seek<br/>an online alternative for our workshop. After some<br/>research, we found an online drawing tool called<br/>AwwApp which allowed us to invite other participants<br/>to contribute without the need of any logins, making<br/>the process for the children much less complicated.ed to sketch out what they were saying.When the Swiss government ordered social-dis-<br/>tancing and the closing of our university due to the<br/>coronavirus outbreak in mid March, we had to seek<br/>an online alternative for our workshop. After some<br/>visualised in an instant. They laughed in elation and<br/>gave us instructions on how certain images should<br/>look like. The oldest of the sisters even took advan-<br/>tage of AwwApps' implemented chat function and<br/>sent us emojis to emphasise her ideas.To communicate we resorted to Skype.

In total, we conducted two workshop sessions with three children, one with two sisters aged nine and eleven, and another with a ten year old boy. We intentionally decided to not mix these children into one workshop, as we wanted to avoid any feelings of shyness that are evoked when being confronted by strangers. Meeting us two we felt was already enough.

# 5.1.1 First Workshop: Two Sisters

The first workshop was held with the two sisters. The two girls were very outspoken and displayed to our surprise no major signs of shyness towards us. After the introduction where they could sketch themselves, we asked them to describe the story genres they enjoyed the most. While the oldest sibling expressed a preference for detective and mystery novels, such as "Die Drei ???", the nine year old girl told us that she really likes fantasy settings in which magic and magical creatures appear. In addition to that, she also agreed with her sister's preference, saying that she also enjoys "Die Drei ???" and other detective stories.

In a later phase, we asked them to name a location where they would like to have the story take place. The sisters quickly suggested a big old house with a haunted garden. When we asked why the garden was haunted, the sisters invented the story of an evil man who had sent an army of zombies to the garden in order to scare and chase off an old lady living inside the grand old house. This led to the development of the entire story in which the evil man desperately wanted to own the house, but after his offer was rejected, he searched for an alternative method to get the old lady to part from her property (*Fig. 32*). Instead of asking for help, the old lady takes measures into her own hand (in the form of a slipper) and beats the evil man and his army of zombies out of her garden.

Throughout the workshop, we asked the girls to describe the appearance of the characters and certain scenes for clarity. From the two sisters, the oldest one was leading the conversations, it seemed that she was more confident in conversing with strangers. By the end of the session many of the inputs had come from her, meanwhile, the younger sister chipped in to agree to her sibling's suggestions or to share her own opinion only whenever we prompted her.

# 5.1.2 Second Workshop: Boy & Mother

Compared to the workshop with the sisters, our second session with the ten year old boy took a completely different course. To begin with, he was very shy towards us which is why he asked for his mother to stay by his side. This had an immense impact on our conversation. His inputs often came from his mother who was giving him suggestions to our questions based on what she thought he liked. Nearly always did he follow her prompts and rarely did he himself take the initiative to share his own ideas or feelings. We kept trying to direct the conversation more to the boy, yet he often did not answer, whereupon he turned to his mother for help. His concentration quickly diminished too and his mother repeatedly had to ask him to focus.

This setting may not have been the most ideal for us because we quickly realised that our conversation was heavily influenced by the mother's biased opinion towards her child and that the true feelings of the boy most likely couldn't emerge properly. Nevertheless, it was a very informative session in which we could observe the close interaction between mother and child.

The storyline of the boy was heavily based on his own real life. This was of no surprise to us because he stated during the introduction that he absolutely loves the book series "Diary of a Wimpy Kid" by Jeff Kinney in which the everyday life of an ordinary boy is told in a comical fashion. Furthermore, the ten year old boy's family had just recently adopted a dog - an exciting occasion for him. He instantly based his narration on the experiences he's had with the new pet so far.

The story centers on one of the boy's very first walks with the dog and on how the young dog overcomes his fear of water (*Fig. 33*). Already from the previous workshop with the sister did we recognise how absurd and unexpected events are perceived as funny and comical by children. These absurdities also appeared in this storyline: as such, the mischievous boy unexpectedly pushes his dog into the water after the scared pet refuses to fetch a stick in the lake. Out of revenge for this sudden shock, the dog rolls itself in cow dung and then chases the boy around the field. As soon as the dog realises that the filth can only be washed off by having a bath, it learns that there is no need to be scared of water.





# 5.1.3 Conclusion: Online Storytelling Workshops

First of all, the storytelling workshop gave us another opportunity to interact with our target audience and to reconfirm our impressions and ideas. We learnt that detective stories and comical events were well received by both genders. They seem to find absurd scenarios especially funny. Interestingly enough, in both workshops the lead character was a human. There was no interest in telling a story from the perspective of an animal or some other creature.

Aside from the content, we mostly learnt how to im-There was no interest in telling a story from the perprove our approach when working with children. Above all, we saw how important it is to split the child from their guardian in order to avoid bias and to uncover Initially, we had hoped to receive a rough outline of the child's true feelings. If, at first, a child feels uncoma story that was more related to sleep and which we fortable to work with strangers, we believe that their could have implemented into our project. Despite our guardian can most definitely help in getting them to efforts in inspiring the children to think about sleep, feel more comfortable, and should therefore be prestheir imaginations took over and they created a narraent. This can easily be done in the introductory phase. tion based on what popped into their minds. This was However, when it comes to directly learning from the by no means a bad thing, we simply had expected child, it is probably better if the guardian were to leave other results. the conversation. Naturally, only if it's appropriate.

Having identified the two sister's interest for detective Furthermore, we also observed that drawing (online) and mystery stories, we decided to choose this genre was considered difficult to the children, mainly for our storyline. Although comedy and absurdity because they felt conscious about their drawing abilities. Our sketches on the other hand were liked predominated the workshop plots, we found it better to not fully embrace this aspect simply because very much by the children, although, in our opinion, we feared that in a medical context this may lead they are quick and dirty. We realised at that moment that children seem to like any forms of illustrations the children (and others) to not take the treatment seriously enough. As a reminder, we had set a goal and that for our design process we were not to worry of upholding the seriousness towards the treatment much about our illustrative style.

at the beginning of our project. Basing ourselves on a detective and mystery plot is furthermore not at all unsubstantiated due to the fact that many children from our classroom workshop had in fact listed this genre as one of their favourites, including the book series "Die Drei ???", "Die Drei !!!", the "James Bond Series" and "The Famous Five" for instance.

# **5.2 Story Development**



# 5.2.1 Defining the Plot

From the online storytelling workshop we had decided to explore a detective, crime fiction, mystery based storyline. To gain a better understanding of how these mystery stories are structured, we read the summaries and a few chapters of some of the "Die Drei ???". It surprised us to see how similar the plotlines at times were. Most of the time they follow a "seek and find a person / object", "prevent a bad event from happening" or "solve an unexplainable situation" narration.

To us it was also important to tell a story which is related to the context in which the whole experience is based on: sleep. Yet we did not want to base the narration on the actual experience of the child - the retelling of their concussion and their recovery - because this may lead to the children worrying too much about their injury and the treatment. Additionally, it may not be the most entertaining story.

We contemplated whether we should integrate the What's more, in an extreme and mischievous case, sleeping device within the story, but decided against giving a child access to their data and its relation it as we felt it unwise to turn a medical device into to the treatment may entice them to change their a toy. Consequently, we also decided against the sleeping behaviour in order to observe how it may initial idea of including the treatment's questionnaire influence the narration of their story. Setting an alarm within the plot. Similar to our considerations towards in the middle of the night or getting up earlier than the the application of absurdity and humour, we wanted day before simply to see the differences in their sleep to maintain a sense of seriousness when interacting data will most definitely not help the child's recovery with the medical products and content. and should therefore be avoided.

We brainstormed our own narrative ideas which ranged from fantastical adventures, such as jumping from dream to dream while hunting a dream thief, to more educational settings, in which the children take on the role of a sleep doctor who wants to unlock the "secret to sleep" (*Fig. 34*). As the story is set to be enjoyed in the evening, after having put on the sleeping device and before going to sleep, it became apparent that the story could neither be too scary nor too thrilling as this may influence a child's ability of falling asleep. Our mentor Verena confirmed to us this thought, saying that her nine year old daughter loves crime stories, yet prefers to avoid them before going to sleep.

At the beginning, we liked the notion of giving the children an active role in evaluating their sleep data and in influencing their own treatment. However, we had to drop this idea as this too may lead to the unwanted consequence of having problems falling asleep (see page 98). This change of behaviour was something we realised could also happen if we were to give the child any form of feedback throughout their treatment. As such, the audio feedback, although abstract and non-evaluative, could also lead to a change of sleeping behaviour. It would thus be wiser to give the child their data by the end of the treatment, or in other words by the end of the story.

With this in mind, we decided to center the story on the construction of a sleep machine which turns sleep into music. We took inspiration from the "seek and find a person / object" narration, found in our research on crime fiction and mystery books, and decided to have the child follow their journey to fix a sleep machine and to find the four missing sleep crystals. Each of these is responsible for translating one of the sleep stages NREM-1, NREM-2, NREM-3 and REM into sounds. In a sense, this reconstruction of the sleep machine mirrors the child's own recovery to a better sleep (*Fig. 35*).

The story starts off slowly simply because, as we had observed ourselves in our self-experience session, the beginning of the treatment has a lot of new information that needs to be taken in. Only from the third evening onwards, once the patient has slowly gotten accustomed to the procedure will the story start to become more profound.

By the end of the week, the protagonist would have collected all the sleep crystals in order to fix the machine and to finally listen to the auditive translation of their own sleep. This would also act as the final reward.









# **5.2.2 Content Apportionment**

Initially, we had intended to merge the questionnaire and the story together with the idea that this would make the former more enjoyable to fill out. But the questions do not change over the course of the week; in fact, every evening and morning are identical to each other. To no surprise, we found it difficult to invent an unique and entertaining narration around the same questions (which by the way added up to a minimum of 17 questions). Simultaneously, we recognised that our priority of upholding the seriousness towards the medical treatment was being impaired too. As the questionnaire needs to be completed accurately and in earnest, the child should not suddenly want to falsify their answers simply to see whether it affects the story or not. Out of these reasons, we decided to keep the questionnaire and the story separate from each other.

In addition to that, there was the question of how to apportion the story among the morning and evening sessions. Should there be a total of 14 story-based chapters or only seven? When should the story be told, in the morning, in the evening or at both times? Based on our observations from the cultural probes, we decided it was most suitable to have the story based chapter in the evening. At this time of day children anyway spend time reading books or watching videos for entertainment, especially before going to bed. More importantly, in the evening, it is easier for children to create time for the treatment without interfering in their sleep schedule. Meanwhile, in the mornings, the child would need to get up earlier, thereby shortening their sleep time, in order to experience the story. Besides the questionnaire, we concluded that the entertaining content in the morning should be optional, simply a bonus to the experience that can be enjoyed whenever it suits the child. The most crucial time of the treatment is most definitely in the evening, when the sleeping device needs to be put on and when upholding motivation is most crucial. This is where we will come in with a story to act as an incentive.

Having decided on this apportionment, we looked into what content we could offer in the morning. We decided on having educational sleep content on the morning chapters. This decision was heavily influenced by an input of our mentors: what message does our story have?

# 5.2.3 Intention of the Story

In a mentoring session with Dr. Joëlle Bitton and Verena Ziegler, after having outlined the draft of our story, we were asked what the metaphorical level of our narration was. They were of the opinion that this would serve as another motivational incentive of wanting to experience the next chapter. In particular, they expressed the idea that a hidden meaning would give a bigger weight to the story and "allow the child to grow".

We had not yet contemplated this aspect for our story and initially felt rather overwhelmed with the idea of having to incorporate a moral. We took some time to research examples of children's books that make use of allegories, morals and metaphors. Values such as honesty, responsibility, gratitude, empathy, perseverance and respect emerge in many famous books, from Harry Potter to Dr. Seuss' books to Aesop's fables.

For this reason, we agreed on offering educational sleep content in the morning chapters. This would We recognised the value of morals, but felt uncominclude information on the different sleep stages, fortable in focusing on these principally because their function and how the sleeping device works. these messages are often hidden or can not always Furthermore, we intended to have these information be instantly identified by children. Due to the fact that on sleep correlate to the previous story based chapour story is one which children will most likely only ter: for example, in the evening, the child would enjoy experience once, we preferred to communicate somean entertaining story of how the protagonist learns thing more transparent and more comprehensive. a piano piece with the help of sleep, while in the following morning, they would see which sleep stage enables the brain to learn abilities.

With this in mind, we became rather fond of the idea of an educational intention of our story in which children learn throughout the one week period something related to sleep. Once again, we were restricted in resorting to personalised sleep information because of the feedback ethics. We wouldn't be able to emphasise the importance of sleep either.

From our online workshop and our cultural probes we had already gained a good enough impression to understand that sleep is an unknown subject to the children. It is something that is part of life and besides the restorative effect, children seem to not be aware of the other benefits it offers. So we thought it made sense to communicate educational information about sleep. If communicated properly, the children might want to continue to maintain a healthy sleep behaviour in future.

# 5.2.4 Augmented Reality Inclusion

So far, we intended to use Augmented Reality to help the children place the electrodes correctly. Yet, the question emerged whether we could go further with its application in order to cater for more playful interactions.

At the time, the coronavirus had just forced the Swiss population into isolation and video conferences were becoming the norm. It is then while staying in contact with our friends that we stumbled upon Snap Camera which allows you to use the AR filters from the social media platform Snapchat on your desktop computer's camera. When on a video call, we found ourselves playing around with the face filters - giving ourselves glasses or turning ourselves into babies - and having a lot of fun while doing so. This led to the idea of the children also being able to choose from a selection of AR filters. These customisations could then be reflected on their in-app avatar's appearance too.

We received the feedback from our mentors that we should integrate AR into the story itself. They suggested that the playful AR feature should have an impact on the story and allow the children to actively influence certain aspects of the plot - perhaps they could choose what tools to use. We took their feedback on board, having also recognised the opportunity which this combination offered. Yet, we felt hesitant in giving the AR selection a major influence on the outcome of the plot itself: offering the children the option of choosing which narrative path to follow meant that we would have to construct different outcomes, scenarios and images, making the creation of the story more complicated as it progresses. Instead, we preferred to keep the story's architecture simple and linear.

We altered our developed narration to fit the application of the AR within our linear structure. As such, we gave the protagonist a backpack with various costumes which would help them on their adventure. Five out of the seven chapters require the child to put on a costume via the AR feature in order to progress: in three chapters, the solution of what costume to wear is given, thereby turning those chapters into a riddle; in the other two, the child has the freedom to decide for themselves what to put on (*Fig. 36 & Fig. 37*).





# **5.3 App Development**

# **5.3.1 Information Architecture**

Before designing the app, we sat down to create the information architecture of the user interface. We started off asking ourselves what screen should be the first to appear when opening the app. A menu? An overview of the treatment?

We found it appropriate for the user to reach the chapter selection menu first as this was the core of the app and would always need to be accessed. There would be a chapter for every morning and evening in which the user would be able to get to the story. Within those chapters, we also included the electrode placement check and the questionnaire which have to be completed to unlock the chapter's story (Fig. 38).

We initially looked into keeping the evening and morning chapters separate, adding up to a total of 14 chapters. However, after having agreed on establishing a correlation between the content of the morning and evening chapters, we found it made sense to visually connect these segments. We also preferred to have the number of chapters correspond with the treatment's duration of seven days. Thereby we reduced the numbers of chapters from 14 to seven and split these into parts for the evening and morning. These can be selected in the chapter selection page, the first page to appear when opening up the app.

From the chapter selection, the user could access their profile page and the help segment. In their profile,

the avatar's appearance can be customised. More impatient could be notified the following morning and portantly, the user would receive notifications about get in contact with their doctor. the status of their treatment. We couldn't provide too Within the help page, the children and their parents much information due to the feedback ethics, however, we found it was important to offer some kind of would be able to find the answers to their questions update of the most recent sleep tracking: from our and additional instructions. The AR electrode instrucself-experience, we realised how unsettling it was on tions should offer enough guidance towards the not receiving any feedback about whether the night's correct usage of the wearable, yet if more information tracking was successful or not. is needed, the users would be able to find it here. Furthermore, we thought it would be good to have the For this reason, the user would be able to access a contact details listed up here: for technical problems, status message board which would let them know if the users could contact SleepLoop's hotline; for medthere were any technical or health-related problems. ical problems, they could quickly get in contact with For example, in case of a medical emergency (such their personal doctor.

as having the device identify epilepsy at night), the





of our development lies the motivational aspect of the

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app, the story. They suggested that we should keep the setup, the full development of the questionnaire and the instructions of the device as a lower priority. Also because, these were aspects that strongly depended on the progress of the research itself. Their feedback made sense to us. We had so far wanted to cover all aspects of the user flow despite not having all technical details at hand. This meant we were

We returned to our user flow and made some arrangements. Overall, it helped us to prepare the wireframes, to identify some unanswered, open questions and to

# 5.4 Design

To us it was important that the app's design was colour, we selected a bright red (#EC4713) and a child appropriate, but not childish. The seriousness bright orange (#FF9933) that stand out more. and the trustworthiness of the treatment should also come across, without making it appear too boring or reserved - as we've found some other medical apps to be.

# 5.4.1 Colour Style

There is a lot of controversy regarding the usage of screen-based gadgets before going to sleep due to its blue LED light. In fact, the blue wavelengths of light does suppress melatonin, a crucial hormone necessary for the initiation of sleep, and shift our circadian rhythm, our inner body clock (Walker, 2018, pp.269). The warmer light spectrum, on the other hand, has the least power to affect these.

With this in mind, we decided to go for a red (#DB5024) and an orange (#FC7E01) when creating our colour styles. We split these colours up, reserving the colour spectrum red for the illustrations and the orange spectrum for the user interface. The reason why we selected red for the illustrations is that we could make the diverse human skin colours look more natural (Fig. 40). Within our selected colours, we simply adjusted the lightness in their HSL model by ten, giving us for each colour a range of nine steps.

For the user interface, we used the orange colours for accentuation and the background. For our primary

We didn't completely avoid the blue light colours, but we tried to keep them to the minimum. For the AR screen which checks the correct placement of the electrodes, we are using the colour blue simply because the physical electrodes have this colour too. With it, we want to create a visual correlation between the electrodes and the AR placement screen.

# **Colour** Palette



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# **Fonts**

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# 5.4.2 Illustrations

For the story, we felt it was important to include illustrations for the following reasons: for one, we could observe in our field research that most of what the children read were comics or books which included some illustrations; for another, it would give the children something visual to look at, allowing them to enjoy the gist of the story without having to read the text. We had also observed how much joy the children had in our online storytelling workshop where we had sketched out some illustrations fitting to the story.

We took inspiration from short comic strips found in newspapers, such as "Calvin and Hobbes": each story is around four images long, the illustrations are amusing to look at, and overall the plot is quick to read. Hence, we kept each chapter roughly around four to seven images long: long enough to tell a story, but short enough so that it doesn't take the child too much time to finish the chapter.

To define the style of our illustration, we started off with a moodboard. Our focus lay in developing a style which was quick to create (for we were expecting to draw at least 70 unique illustrations, roughly five for every morning and evening chapter) and which allowed us to easily make customisable characters (because the child's avatar would change its appearance according to the costume selected with the AR feature). Additionally, it was important to us that the drawings are attractive to look at and they do not appear as being too childish.

Based on our moodboard, we made some trials of different illustration styles before deciding (*Fig. 41*). From our chosen style, we sketched out different variations in faces, hairstyles and bodies. Before having agreed on the colour palette, we used these initial sketches to help us agree on a colour scheme too (*Fig. 42*).

By the end, we had agreed on an art style that is child appropriate without looking too childish. Each shape is constructed from an outline and its filled shape. We've shifted the filled shape slightly to the right to make the images more dynamic.







# 5.4.3 Wireframes & Design Developments

Along with the user flow, the wireframes helped us to identify missing content and open questions. We started off with quick sketches by hand, then moved over to Figma in order to create a clickable prototype. We didn't want to spend too much time on the details, so we made sure to have set up the fundamental frames of the wireframe in Figma within a day. This process also helped us to quickly get an impression of our end results. (*Fig. 43*)

The chapter selection screen, being our "home screen", naturally became our biggest focus: we tried out different designs, searching for the most intuitive solution to visually communicate the correlation between the evening and morning chapters. For this, we ended up moving away from the basic wireframe style and conducted some visual experiments with our selected colour palette.

We iteratively designed the chapter selection screen. We resorted to a moon and sun icon to indicate the evening and morning chapters and looked at how to place them alongside each other. We then had the idea of imitating the path of these two celestial bodies: what if the user could switch between evening and morning by moving the moon or the sun across the sky and thereby change between the two chapters? We especially liked the playfulness this interaction

offered. We progressed further and added a sky in the background which would turn from a dark, starry to a bright, cloudy sky (*Fig. 44*).





# 5.5 Experiments & Prototypes

# 5.5.1 AR Development Prototype

The AR prototype initially started as an experiment for the electrode placement. We conducted some research online first and had found some AR filter tools by social media companies such as Snapchat and Instagram. Yet, what we didn't like about those was the fact that we had to publish these publicly within their services - there was no option to export the results and to combine them with our visual screens.

We investigated further and learnt that for the game engine Unity there are third party AR software development kits (SDKs). What's more, we found out that it was possible to build responsive user interfaces within Unity too, allowing us to create an "all-in one" product which could include the AR feature and the interface. With those findings, we sought a technical solution within Unity and started to experiment with an SDK by Google called "ARCore".

Randy took charge of this prototype due to his great interest in programming. It took some time to become acquainted with the SDK as very little documentation existed online. For the electrode experiment, we had to create plains on a 3D face in order to have each individual electrode attach itself correctly on the identified face (*Fig. 45*). Once finished, we were very surprised to see how well the detection actually worked. For this reason, we decided to move onto a prototype for the playful facial filters.

We followed the same procedure for the filters, but placed the plains on different areas of the face. While Randy built the Unity file, Claudia prepared the images for the AR filters. Here, we matched the art style to one developed for the app's illustrations, to keep a coherent visual language throughout the experience. This too worked pretty well (*Fig. 46*).





# 5.5.2 Unity Click-Dummy Prototype

Having discovered that Unity allowed us to not only prototype with AR, but to create responsive mobile interfaces too, we wanted to see how well both could work together. We exported individual segments of our designs from Figma and placed them within Unity. Unity also gave us much more freedom in creating animations and interactions than Figma. So we ended up doing some trials for the microinteractions of the chapter selection page too (*Fig. 47*).

As a result, we had a promising click-dummy prototype which included AR and the user interface. By using Unity, we also found an option for exporting a future prototype as a functional Android and iOS app. Furthermore, this would allow a responsive interface layouting so that the app would fit to the majority of Android and iOS screens. If we were to create a functional prototype in future, we had discover that we could do so with Unity.



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# 5.5.3 Audio Memento

The audio memento is the abstract representation of one night's sleep data which is presented at the end of the treatment as part of the story. We worked early on with Processing to explore how this auditive data representation could sound like. For this, we used the data from a friend's fitbit sleep tracker. The audio memento was divided and mapped to each sleep phase, its duration and frequency (Fig. 48).

As mentioned before, the reason why we decided to resort to audio for the data representation is because of the following reasons: for one, it returns to the roots of the sleep therapy in which sonic stimuli are used; for another, we observed from our field research that audio were represented in some children's bedtime routines in form of music or ASMR sounds (see page 76).

From SleepLoop, we had received a sample of a night's tracked data and it was our initial intention to resort to these for our prototype. However, on inspection we realised that the data was too raw for our usage. The data was so large and difficult to handle, that SleepLoop could only send us two hours of one night and this already included over 900'000 lines of information and raw numbers. For this we would have needed to work much closer with SleepLoop or a datascienticst to figure out how this could be properly translated. We decided to put this idea on hold and

look into this further after the core of our concept was more refined.

In a presentation to our interaction design department, this concept was generally well received, however, our selection of sounds brought up questions. They were very abstract and didn't really harmonise together. If we were to continue with this idea we would need to investigate its sound design. This would offer another opportunity to work alongside children in a participatory environment.



# 5.6 Conversing with the Parties Involved

# 5.6.1 With SleepLoop

Having made progress, we had an online meeting with the SleepLoop team in which we updated them. We demonstrated our wireframes, our first design drafts, the story apportionment and its content.

SleepLoop's feedback was generally very positive they appreciated the considerations that were made in accordance to the context of sleep. Some time was spent discussing the educational aspect of the experience, in particular its content because we wanted to confirm with them that the topics and facts which we had picked out were (medically) accurate.

Simultaneously, we asked them to share any ideas because as sleep experts, they might have other creative insights for the content. Particularly for the sleep stages NREM-1 and NREM-3 which we knew little of, we wanted to hear their suggestions. This exchange helped us in finalising the storyline and its sleep related facts.

# 5.6.2 With Children

Besides talking to our partners and after having set up the structure of the story, we conducted an online workshop with Verena's nine year old daughter. The aim of this session was to consolidate with our target audience, to learn whether the direction we were heading was the appropriate one.

We sketched out the scenes of each chapter and narrated the plot to her. We followed the chronological order of the treatment, continuously switching from the story to the educational part. At times, we asked for her input to see how her creativity or ideas may inspire the project. To us it was important to investigate whether the story and the sleep facts were comprehensive and entertaining. We also wanted to find out whether she had learnt something about sleep after having been told the story.

Overall, she expressed that she enjoyed the narration and the protagonist's quest to find the missing machine pieces. She suggested changing some details which she found could be more immersive, and a comment of hers emphasised the notion that the AR feature should also manifest itself within the story. When being asked to share her opinion on sleep, she told us that she realises now how much more there is to it. Yet, what surprised us the most was her comment on not having to worry about falling asleep: "I shouldn't be so stressed about falling asleep. [...] If you worry less about it - there's actually no reason to be worried - you can fall asleep faster."

Throughout our process, we had constantly been aware of the feedback ethics and had aimed to avoid information that may cause problems of falling asleep. With this comment, it seemed that we had been successful.

We also took this opportunity to user-test our AR prototype and to see how easy it is for a nine year old girl to place the electrodes on her face. For this, we simply asked her to describe and point to the facial areas where she would place an imaginary sticker. We were very pleased to see how well the AR test worked out, she had no problems in finding the accurate areas. Soley the indicators behind the ears need some refinement as she would have placed the electrodes on the earlobes.

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# 5.7 Usertesting

With a usertest, we wanted to see how suitable our prototype is for our target audience. We conducted a usertest with a nine year old girl named Julia - her six year old brother Tristan also sat down with us, despite being outside of our target age group. Furthermore, we had their mother Nina listen into the session (*Fig. 49*).

It took some time for the children to understand the context of a usertest, having never done one before. We were pleased to see that the day / night toggle feature, the AR costumes and the AR electrodes were understood and well received. The costume segment was especially considered to be "fun and cool". The story was liked very much too: for example, the tiger chapter and its combination with the AR was described as being funny - we had therefore struck a chord with the children's sense of humour.

There was a general interest in learning about sleep, though we were surprised to find that the children knew a lot about sleep already. Both Julia, Tristan and Nina asked whether they could receive personal feedback regarding their sleep measurements. Yet, when explaining to them that we decided to not display such kind of feedback Nina instantly presented the reasoning herself: it was really interesting and reassuring to hear that their mother independently recognised the feedback ethics that we were following.

In regards to the length and amount of the text, Julia gave us the feedback that it was fine and suitable, although based on her behaviour we could observe that she at first felt hesitant towards starting to read. Yet, once having gotten into the story, she became more interested in making an effort in reading. Even Tristan said he would enjoy reading the text, however, his mother did mention that he is someone who is fond of books.

Based on the usertest we could make some changes in our prototype: for one, there were some words that they did not understand which we changed. For another, we decided to remove the teaser texts on each chapter card on the home screen and to enlarge the illustration. This is because we saw that the children mostly ignored it and were focusing on the images.

We also added a new conceptual feature: within the chapters the children have the option of listening to the story and sleep facts too. This was a feature that was suggested by the children and the mother.

Yet, our biggest learning from this session is that this usual usertesting format is not really suitable for our project. The app's content is meant for a duration of a week, presenting it all to a child within one sitting simply doesn't allow us to investigate properly - the amount to look at was at times just too overwhelming. Ideally, in a further testing, we would have to organise a week long schedule in which each day the child would receive a new segment of the story - preferable perhaps even alongside the sleeping device. Thereby we could properly assess how the story would influence the motivation over time. The usertesting was nevertheless helpful to identify usability issues.



# **5.8 Results**

Our final outcome at the end of our Bachelor project is a companion app that combines the sleep therapy with a captivating story. Its purpose is to increase adherence and motivation by means of using a story as a variable reward. By portraying the therapy as a journey, we can offer the children a narrative adventure which they can look forward to every evening.

The children can unlock the chapters to the story every evening once having completed the medical questionnaire and the instructions. By offering entertainment before going to sleep, we are tapping into the bedtime behaviour of our target audience which we could observe in our field research.

Alongside the story the children can enjoy every the patien morning an educational chapter about sleep in general. Its contents alway refer to the story from the previous evening and educates them on how sleep is constructed and what influence it has on their everyday lives. Both narrative and educational chapters are visually supported through illustrations in order to make its contents fun and easy to understand. From our usertesting, we found that an audio narration would be appreciated by the children too who at times prefer to listen to then reading a story. This option could easily be added in a further development step.

With Augmented Reality, we've found a promising way of guiding the children while putting the device on: it helps them to instantly see on their face where they need to place the electrodes. We took the notion of using AR a step further and included it within the story in order to make it more engaging. This was done by providing the children with AR costumes which can be selected and worn by the protagonist to progress within the story. Although we explored a rather simplified implementation of this idea, it serves as a proof of concept from which we see great potential in making the narrative experience more captivating and diversified.

Another experimental approach we tried out was a sound memento. Having recognised the problem of causing additional stress during the therapy by giving the patient full transparency of their performance by means of personal feedback, we decided to provide them with an alternative form of feedback. The idea is to represent the tracked sleep data in form of a personal tune which serves as an abstract summary of a night.

With a simple prototype in which we mapped the five sleep phases to distinctive sounds, we received some promising first results. Presenting this idea to the SleepLoop team they confirmed the potential as it wouldn't interfere with their concerns with their feedback ethics and if digitally generated by algorithm it would not add more cost to the product. Given the complexity of the raw data that SleepLoop provided we would have to work much closer with data scientists to investigate how the data could quickly and effectively be translated into sound.

As the deadline loomed closer, we realised that we couldn't develop all features as we would have liked in time. Instead, we decided to focus on communicating the core idea of our investigation: the story. Never-theless, both the AR and the sound memento offer solid ground for future investigations. In the time frame of our Bachelor project it made the most sense to put our focus on the story as it is the core of our investigation of combating boredom, repetitiveness and lack of interactions.



The following pages and images (*Fig.* 50 - 66) show the main screens, the storyline of the evening chapters and the educational content from the morning chapters. The texts were written in German as this allowed us to usertest the narration and the app's usability with local children.

# **Session 1 – Evening Story Screens**

# $\leftarrow$

Kapitel 1 **Der Schlaf-O-Ton** 

"Mir ist langweilig", sage ich gähnend. Ich sitze im Wohnzimmer meiner Grosseltern und es gibt nichts zu tun. Wie bei jedem Besuch.



Zu meinem Erstaunen entdecke ich in

der Mitte des Raumes das Gerüst

einer ungewöhnlichen Maschine. "Gefällt sie dir?", fragt mich meine

Oma, die neben der Maschine steht.

"Wir nennen sie den Schlaf-O-Ton!

"Schlaf? Was gibt es denn da zu

hören?", frage ich verwirrt.

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Damit wollen wir deinen Schlaf hören!"

4/4



Wenn ich mich umschaue, sehe ich nur wissenschaftliche Objekte, welche meine Grosseltern über die Jahre selber gebaut haben. Als Schlafforscher erfinden sie in ihrer Freizeit gerne neue Maschinen. Doch benutzen darf ich sie nie... Es ist niemand in der Nähe, stelle ich fest. Vielleicht könnte ich doch eines...

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\*WUUMS\*. Ich werde aus meinen Gedanken gerissen. Was war denn das für ein Geräusch?, frage ich mich. Es kommt wohl aus der Werkstatt meiner Grosseltern. Was könnte das sein? Ob jemand eingebrochen ist? Plötzlich ist mier nicht mehr langweilig und ich wage mich in die Werkstatt.



# **Session 1 - Morning Education Screens**



# **Session 2 - Evening Story Screens**

# **Session 2 - Morning Education Screens**





Ihre Platzierung sorgt dafür, dass die Schlafmessung genau und vollständig durchgeführt werden kann.

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Schlafgeräts, welches du in der Nacht

beim Schlafen trägst, können wir diese

Aktivitäten. Mit Hilfe deines

messen und erkennen.

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Alle erlaben diesen Schlafkreislauf. Doch gibt es je nach Person grosse Unterschiede

Ebenfalls ändert sich dein Schlaf mit dem Alter: Als Baby hast du mehr Zeit in der REM Schlafphase verbracht, als dass du jetzt tust.







Die Schlafphasen werden in einem sogenannten **Hypnogram** aufgezeichnet. Dieses zeigt an, wie lange man sich im Schlaf in einer Phase befindet. Anhand des obrigen Beispiels erkennst du, dass sich die Schlafphasen wiederholen, doch der Schlaf beginnt immer mit der NREM-1 Phase, die Einschlafphase.

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### **Session 3 - Evening Story Screens**

### **Session 3 - Morning Education Screens**







Das Einschlafen kann einem vielleicht schwer fallen. Doch für die Pflege des gesunden Schlafes gibt es Ratschläge, die einem helfen können.

Empfehlenswert ist es einen Schlafplan zu folgen: Das heisst, dass man die Einschlaf- und Aufstehzeit bestimmen und einhalten sollte.



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### **Session 4 - Evening Story Screens**

### **Session 4 - Morning Education Screens**

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Die Informationen, die du durch den Tag sammelst, werden in deinem Kurzzeitgedächtnis gespeichert. Nun stelle dir vor, dass dieses ein Glas Wasser ist, welches sich immer mehr füllt. Am Abend ist das Glas bis am Rande voll. Es können somit keine neue Informationen mehr hinzugefügt werden, denn es fehlt an Platz.





Mit einem vollen Kurzzeitgedächtnis kann nichts neues gelernt werden. Deswegen sorgen die NREM Phasen dafür, dass die Informationen ins Langzeitgedächtnis verlegt werden, wo mehr Platz besteht. Die stärksten Informationen, die zum Beispiel durchs Üben und Wiederholen entstehen, haben dabei den Vorrang.



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Tatsächlich hilft dir Schlaf, wenn du dich im Sport oder im Spiel eines Instruments verbessern möchtest.

Schlaf ist somit also fürs Lernen oder für die Verbesserung von Fähigkeiten eine grosse Hilfe. Natürlich aber nur wenn am Tag genügend geübt oder



### **Session 5 - Evening Story Screens**

### **Session 5 - Morning Education Screens**





Dieser Tiefschlaf findet hauptsächlich in der ersten Hälfte des Schlafes statt. Ihre Menge ist stark vom Schlafverhalten abhängig: Bei Schlafentzug hat man mehr davon, doch ein Mittagsschlaf führt zu weniger Tiefschlaf. Ideal ist es, ein ausgewogener Schlaf mit allen Schlafphasen zu ermöglichen.









Nach dem Sport ist die NREM-3 Phase besonders wichtig, denn sie verhindert Verletzungen: Die Heilung der Muskeln wird beschleunigt und der Körper wird mit neuer Energie für den nächsten Tag versorgt. Aus diesem Grund ist es empfohlen, dass man sich nach einer körperlichen Anstrengung gut ausruht und schläft.

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### **Session 6 - Evening Story Screens**

### **Session 6 - Morning Education Screens**





Ich bedanke mich beim Kapitän und wende mich dem Meer zu. Laut meiner Information befindet sich der REM Phasenleser am Grund des Mittelmeeres, südlich von Italien, In einem Schiffswrack, dessen Standort ich nur grob kenne. Ich hole meinen Rucksack hervor und stöbere nach meinem Taucheranzug.

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Wasser und schwimme zum Abgrund hinunter. Fische huschen an mir vorbei. Am Meeresboden finde ich nach langem Suchen endlich das alte Schiffwrack, dessen Holz völlig mit Korallen überwachsen ist. Im Schein meiner Taschnelampe weckt ein Glänzen meine Aufmerksamkeit.



1/7

Aufgeregt berge ich den letzen Phasenleser vom Schiffwrack. Ich kann es nicht glauben, ich habe alle gefunden! In diesem Moment werde ich plötzlich von hinten gerammt. "Tut mir leid," ruft der Delfin aufgeregt, "aber ich wollte dich was fragen, bevor du wieder weg schwimmst: Stimmt es, dass ihr Menschen träumt?"





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Delfine träumen nicht. Ich habe aber gehört, dass es schön sei." Ich starre den Delfin verblüfft an. "Was. ihr träumt nicht? Wieso denn das? Ich dachte, das gehört zum Schlaf."

"Nein, ich glaube, es hat was mit dem Schwimmen zu tun", überlegt sich der Delfin. "Beim Träumen wird der Körper lahm gelegt, sodass man den Traum nicht ausübt. Doch wie können wir Delfine dann noch Luft holen?" Wir plappern noch ein bisschen über das Träumen, bevor wir uns verabschieden und ich zum Segelboot zurückkehre.



←  $\leftarrow$ Kapitel 6 **REM Phase** Wenn wir im Schlaf träumen, dann passiert das in der REM Phase. Damit wir unsere Träume nicht ausüben, wird unser ganzer Körper lahm gelegt. Nur die Augen bewegen sich unter den



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Es gibt einen Grund wieso wir träumen: Die REM Phase hilft der Kreativität und der Lösung von Problemen. Im Traum werden neu gesammelte Erfahrungen vom Tag mit unsere Erinnerungen verbunden, um

neue Verknüpfungen zu erzeugen.



Morgen, von was man geträumt hat. < 5/5



Nur weil du dich nicht mehr an einem Traum erinnern kannst, heisst das nicht, dass du nicht geträumt hast. Die REM Phase findet immer statt. Oft vergisst man einfach am nächsten



### **Session 7 - Evening Story Screens**

### **Session 7 - Morning Education Screens**



#### $\bigcirc$ Wie du nun weisst, besteht dein Schlaf aus fünf verschiedenen Schlafphasen: NREM-1, NREM-2, NREM-3, REM und die Wachphase. Diese sind in

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gleichem Masse wichtig. So helfen sie dir im Schlaf bei der Erholung oder beim Lernen.



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Schlaf ist ein wichtiger Teil unser Lebens und hat einen grossen Einfluss auf unseren Alltag. Nun da du weisst, wie spannend Schlaf ist, wie wirst du in Zukunft schlafen...?

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Mit deiner Schlafbehandlung haben wir deinen Schlaf eine Woche lang gemessen. Der Schlaf-O-Ton hat nun von einer Nacht jede Phase in einen Ton verwandelt. Zusammen ergeben sie deine eigene Schlafmusik.

Die Musik, die du nun hören wirst, ist von deiner letzten Nacht.





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#### 5.8.1 User Journey

To give a greater understanding of how our concept comes into play, we find it fitting to offer a short overview of the user journey (*Fig. 68*). Our focus lies on the future "standard of care", meaning we were investigating how the experience could look like after having completed the current medical research.

The treatment is initiated by a concussion which may cause sleep disruptions. At the hospital, the severity of the injury is assessed by a doctor. If necessary, the child hospitalised for a 24h observation. When discharging the child the next day, the doctor would prescribe the sleep treatment for at home. The child is then introduced to the device by a medical assistant who gives instructions in using the app and the sleep device.

Over the course of the seven day treatment, the child would have to use the sleep device and answer a ment which would have been agreed on in advance. medical questionnaire. In the evenings, while getting At their check up appointment, the progress of the ready for going to sleep, they would select the first evening chapter of their treatment. With the help of treatment would be reviewed together with the doctor. the AR guide, the child would easily know where to If no complications are found, the patient is considcorrectly place the electrodes on their face. If further ered to have recovered, thereby having successfully help is required, they can quickly access it through the completed their journey to recovery. help menu in which more detailed instructions and further medical and technical support can be found.

After having put on the sleep device, the child would have to answer the evening questionnaire before unlocking the first chapter of their story.

By the morning, the child would be notified of the success of the night's sleep tracking. When opening chapter one from the morning screen they would be nudged to recharge their device in order to have it ready for the next night. Furthermore, they would have to answer the morning questionnaire before being able to unlock the educational segment which would give them their first introduction to sleep.

By the end of the seven day treatment, the child would reach the end of their journey. In the last morning chapter, they are presented with the audio memento of their sleep data. Here, they would be the choice of sharing it with friends. After quitting the final chapter, the app would remind them of their follow-up appointment which would have been agreed on in advance.

#### USER JOURNEY: TREATMENT AS A JOURNEY CONCEPT

Combining SleepLoop's Treatment with Story







### **5.9 Project Communication**

#### 5.9.1 Concept Video

With the coronavirus having caused the cancellation of the physical exhibition, the concept video for the Bachelor project became even more important.

With it we wanted to demonstrate what we've achieved if we were responding to interview questions. For this as interaction designers. For this reason its focus lies on communicating our process and the final project. it also became appropriate to be speaking in Swiss Our intention is to continue our collaborative process German. In order for us to reach an international within the style of the video by animating children's audience, we added English subtitles. drawings (Fig. 69). This idea reinforced itself after having watched the animation "Why Children's Draw-We decided to use no music for the video. Instead, ings Matter" (Burrus, 2016) whose aesthetics we we resorted solely to sound effects to emphasise the liked for being very playful and friendly. visuals. Some of these we recorded ourselves, others we took from the ZHdK sound library.

For the animation, we used the children drawings that we had collected from our various workshops Overall, we are very pleased with the final outcome (Fig. 68). Furthermore, we sent out some drawings of the video. We've managed to create a causal requests to the children we had met throughout our narration and a good overview of the project and the process. To our disappointment, the response rate process. Based on the response from friends and was very low. We believe this was due to our inconfamily, we could tell that it was well received too, with venient timing because our request was sent out in comments saying it was fun, friendly and clear. the same week as the schools reopened from the coronavirus lockdown. This meant that parents and children were preoccupied with returning to normality again. Nevertheless, we managed to collect enough drawings, by the additional means of returning to our own collection of childhood drawings from 15 years ago.

As our intention was to focus on our process, we found it suitable to introduce ourselves within the video. In a mentoring session with Nicole Foelsterl and Matthias Kappeler, we were advised to have ourselves narrate the video in a casual dialogue - as



## Journey to Recovery

MAKING A SLEEP THERAPY MORE MOTIVATING, ENTERTAINING AND INFORMATIVE FOR CHILDREN.

Interaction Design Bachelor Project by Claudia Buck & Randy Chen



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#### 5.9.2 Showcase Website

While having to prepare for the online exhibition, we realised that we simply couldn't showcase our project to its full extent and as we liked. In particular, we felt that the process couldn't be communicated properly. For this reason, we decided to create our own showcase website independently from the Zurich University of the Art's online exhibition.

Above all, we found it important to offer a concise summary to the reader: they should quickly be able to get a good overview of the context, our process and end results. In addition to that, we added a segment in which we addressed a frequently asked question: why an app? With this, we wanted to clarify why this decision was made. Compared to the online exhibition, we also selected different images which displayed other screens from our app or insights into our collaborative approach.

Our showcase website can be found under: http://journey-to-recovery.ch/.

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### **6.1** Conclusion

The conclusion of our thesis deals with giving an overview of the entire process and developments of the last four months. It starts off concluding our design context, then continues describing our process and how it changed over time, our lessons learnt and what our contribution and future steps are.

Over the course of four months, we have been collaborating with SleepLoop to investigate how we could create a more child appropriate and motivating experience in order to uphold adherence to their sleep treatment. We recognised early on that our investigation required sensibility towards our target audience and an understanding towards the medical context. For this reason we set out on a collaborative journey, visiting primary classrooms and conducting both online and offline workshops with children and our partners along the way.

Initially, we were focusing on children aged between eight and 17 years old. Yet, based on our findings from our background and field research we found it more suitable to narrow it down to the age group of eight to twelve. This decision was made based on the realisation that we would not be able to accommodate the interests and abilities of an eight year old child alongside those of a 17 year old teenager.

Returning to our first research question "How can we create a positive experience that motivates, entertains and informs children throughout their sleeping treatment?", it is fascinating to observe how our approach changed over the course of the thesis. Initially, we set out with the hypothesis of using personal feedback as a non-punitive and positive reward to foster motivation, having found in our background research that exposing people to their own personal data can produce a motivating environment. We were also of the opinion that these patients have the right to see their progress and that from our own personal experience with the sleep device there was a lack of transparency towards what was being collected.

Yet, in our process we quickly learnt that the development of a solution is very much dependent on its context. Personal feedback may be effective in a physiotherapeutic therapy for example, however, within the context of sleep it will most likely lead to unwanted consequences: with our partner SleepLoop, we came to the understanding that a fully transparent representation of the patient's personal performance could cause additional stress, leading the children to have problems falling asleep. This leads to a reduced amount of rest which is crucial for their recovery. It became clear that we had to follow in this medical context certain feedback ethics in order to deliver the most appropriate experience.

It was then collaboratively agreed that a narrative story could act as a motivator in the form of unpredictable, variable rewards: these take advantage of our human attraction to the unpredictable (as in wanting to know what happens next).

With each evening, a new chapter can be unlocked, whereby the children have something to look forward to whenever they need to put on the sleep device. When it came to the plot of the story, we turned to children and took inspiration from their ideas and creativity, thereby creating a storyline which is aligned to our target audience's interests for adventures and absurdities.

Our collaborative process enabled us to approach our What's interesting about our development is that we research questions from a completely different angle had initially decided to focus solely on one age group. as we had initially intended. Alongside researchers, Yet, now, we are of the opinion that our story based sleep experts and children, we've developed a promexperience could actually work really well with people ising concept for encouraging adherence and motiof other ages too. Naturally, the content and delivery vation. In spite of having usertested our prototype, of the plot would have to be adapted in accordance we are however of the opinion that our solution has to the interests of the age group, however, the idea of yet to be entirely proven. We believe that it requires to taking advantage of people's attraction to the unprebe usertested over a period of seven days, according dictable could work for younger and older individuals to the duration of the therapy. Preferably, in order to too. Perhaps one could go a step further and wonder make the investigation the most informative, we think how a medical therapy could look like if it were to be that it should be tested alongside the sleep treatment. combined with services such Netflix or Audible, of-Nevertheless, our initial feedback from our usertests fering patients entertainment while adhering to their indicate that we are on the right track and that the doctor's advice - a provocative combination to debate children show interest in continuing their journey. on to say the least.

Regarding our second research question "How can we encourage children to properly and consciously use a medical wearable at home?" we have found means to ensure the sleep device's proper usage with the help of Augmented Reality. For SleepLoop's current development of their sleep device, the patients can visually see through their front camera exactly where to place the electrodes. In this context and based on our observations from our usertests, Augmented Reality works really well for communicating instructions. We can most definitely imagine that in future this technology could be used to simplify the appliance of other medical devices too.

### 6.2 Reflecting on Our Process

Looking back on what we wanted to achieve at the beginning of our process, we find that we were successful in developing our project through co-creation. In fact, our role as designers was even more important in this collaborative setting because we had to constantly take the needs and ideas from the children and the sensibility from the medical treatment into account. As designers, we had to constantly navigate between what should be done and what shouldn't be done.

We are also of the opinion that we managed to uphold the medical appropriateness within our project: by separating the entertainment from the medical tasks, as opposed to our initial intentions, we believe that we do not interfere with the seriousness which the treatment deserves. With the addition of the sleep facts in the morning, the experience supports the idea of improving sleep behaviour by means of education. It would be wrong to not mention the coronavirus within our conclusion. Its spread and resulting lockdown had a big effect on the world and lasted for the majority of our thesis. Generally, we think we handled the sudden change of events pretty well, although we did initially feel a bit lost, having wanted to conduct workshops with children in person. Nevertheless, we guickly found a way to overcome this social distancing by using online communication and collaboration alternatives. By being flexible and adaptive, we were still able to work collaboratively.

Furthermore, with the physical exhibition being cancelled due to coronavirus, thereby moving the presentation of our Bachelor project online, we had to ensure that we could communicate our project properly. With abstracts of a maximum of 120 words and photos that should only demonstrate the final results, we just couldn't see how we could bring our collaborative process across. For this reason, we wanted to emphasise this aspect by animating children's drawings in our concept video and by setting up our own showcase website. In retrospect, we think that putting the extra effort into a website of our own was the right decision to have made for it acknowledges our work and that of all those who helped us.

Reflecting on the past four months, we've recognised effort in presenting our case to these ex-patients by that our process has become a substantial part of our preparing an info sheet and then having SleepLoop Bachelor project. Overall, we are rather happy with it pass on our message alongside their call for particbecause we could make use of our intended collabipants. This might have convinced someone to join orative methodologies in order to give all parties a our cause. In any case, it is something worth keeping voice. From working with our partners to visiting priin mind for another time. mary classes and conducting both online and offline workshops with children, we managed to use a vast For another, it would have been good to have had an external person - someone with no affiliations spectrum of tools to progress.

to the project - accompany us in the workshop with It emerged in the process that all features from our SleepLoop. This would have brought a completely concept - the story development, the AR inclusion, different, unbiased voice to the conversation and the audio memento - require a lot of time and atmight have resulted in perhap more diverse ideas. We tention. We have taken the first steps for the audio are by no means unhappy with the results from the memento and the story-based AR implementation, workshop, but on reflection, the majority of the ideas did share some similarities with each other. Neveryet we couldn't explore them properly to their full potential. In reference to our thesis and its focus of theless, we managed to counteract this outcome by investigation, we had set our priorities on completing including a vast variety of children throughout our and fine-tuning the story. This alone already offered development whose imagination always offered us new forms of inspiration. a solution to our research question, the others work as an additional bonus from which the children could definitely find some more motivation.

There are some aspects of our process which we might have liked to have done differently: for one, we still think it is unfortunate that we were unable to speak with SleepLoop's ex-patients. Due to their research ethics we could not directly contact them and had to therefore wait for someone to reach out to us instead. In retrospect, we could have made more

### 6.3 Learnings

Working solely on one project for a duration of four months can be described as an emotional rollercoaster: we've experienced many interesting, fun and challenging moments, but sometimes simply frustrating ones too. We've gained some great experience and knowledge from our work which have most definitely enriched us and made us feel more confident as interaction designers. Above all, we could reinforce our knowledge of user experience design and collaborative methods. The last three years at the Zurich University of the Arts have introduced us to various approaches and tools, yet only now in the Bachelor project do we feel like that we had the opportunity to perform these properly.

On the topic of co-creation and collaborative design, we probably learnt the most, simply because we've not yet had the possibility to practice these to such an extent. With the occurrence of the coronavirus we could not only gain experience in conducting workshops in person but also online. Both environments allow co-creation, but we could observe that with children the online workshops were more tricky to perform: using the finger or mouse to draw or write was considered at times too difficult for them.

In particular when working with children, we have learnt that we can always expect one thing from them: to be surprised. Whenever we sat down with the children, in search of specific answers, we were

always surprised to be presented with completely different outcomes. For example, with our storytelling workshop we had hoped to be able to come up with specific storylines which we could directly insert within the app and which were related to sleep. However, we ended up creating a plot about zombies or a boy and his dog. None of these had any relation to sleep or were even too adventurous for a story before going to sleep. Nevertheless, their imagination and creativity helped us to identify what content children do enjoy.

We also came to experience ourselves how easily influenced children are. It was at times a real challenge to guide them without biasing them. In this context, there is a question of including their parents when collaborating with children as we could observe how they often turn to them for guidance. We've seen the pros and the cons from this setting and have concluded that it really depends on the intentions of the designer, the relationship between parent and child and the personality of the child. Only the former can be specifically influenced by designers. Within a creative environment when ideas and imagination are sought after is it best to have the parent be absent from the collaboration. From our own experience, it is astounding to see what wild, raw and creative ideas resulted from this while otherwise, the inputs were more often mediated by their parent. On the other hand, when conducting usertests we realised

that it was of advantage to have a guardian on site. The child was able to understand the context more quickly and felt more relaxed about making mistakes when having their parent present.

Overall, being able to talk and listen to all these different children, parents and experts was a really fun and rewarding experience. We saw ourselves how much our collaborators appreciated being able to have a say in our work. Resorting to co-creation is something we both will definitely do again and look forward to in future.

### 6.4 Contribution

With the proliferation of mHealth treatments and an increasing demand for patients to complete their therapy at home, away from a medical clinic, it is time to reshape the experience in order to make it as engaging and appropriately entertaining as possible. Especially for children whose inherent curiosity and desire to have fun, it makes sense to give them an entertaining incentive which aligns to their innate nature.

With our thesis, we are presenting an example of how a medical treatment can be engaging and entertaining for children. Our findings contribute to the general discussion of bringing UX design together with medicine. In particular, we are presenting a foundation from which further work and investigations can be built upon. Because we are of the opinion that there are still improvements to be made and boundaries to be pushed. Foremost, our suggestion gives our partners SleepLoop the opportunity to make their sleep treatment more engaging for children. Its effectiveness of encouraging motivation can however only be properly proven once our prototype is tested alongside the sleep device.

As observed in our usertest and in one of our workshops in which we assessed our narration alongside a child, our sleep chapters seem to encourage children to reflect on what a healthy sleep is and how their behaviour towards it is. For instance, we had received the feedback from a child, after having experienced our storyline, that she now realised that there is no need to worry about not being able to fall asleep. Already with our cultural probes, we saw that certain children were fascinated to document and observe their sleep behaviour, saying that they had never really consciously done so before. Generally speaking, it seems that there is an interest towards sleep and what makes it healthy because sleep is so relatable and inevitable.

This idea of raising sleep awareness is not at all novel, it is one of the most important goals of sleep experts. For example, in his book "Why We Sleep", Matthew Walker underlines his ultimate intention of sleep education as follows:

"The goal would be twofold: change the lives of those children and, by way of raising sleep awareness and better sleep practices, have that child pass on their healthy sleep values to their own children." (Walker, 2018, p.332)

By including sleep education within the experience, we are giving the children the knowledge and opportunity to understand what the benefits of a healthy sleep are and how they may change their behaviour. This sleep awareness can have an impact on the children beyond the treatment, once they have fully recovered, and encourages a future in which people can enjoy a more healthy night's rest.

### **6.5 Future Steps**

With our Bachelor project we have established a supporters of. Within our framework, we searched for foundation from which several developments could a chance of implementing it within our project, yet, be pursued in future. For one, there is the audio within our medical context, it was difficult to do so memento which is, with the current outline of the due to the fact that a lot of content is medically given story, an essential part to the experience. The idea and can not be deselected. Nevertheless, for a future of receiving this abstract representation of a night's development we see a great opportunity of including sleep at the end of the treatment is something that autonomy by means of offering children a selection of stories: on beginning their treatment the children children, parents and SleepLoop like the sound of. would be able to to choose from a variety of narra-However, more time and attention is required for the translation of the raw sleep data and the memento's tions one to their liking. Thereby, they can feel more sound design. This is a feature that could be worked involved in their journey. Or alternatively, the stories on more closely with SleepLoop in future. could become more interactive, meaning that the child would be able to decide the outcome of the story.

As mentioned earlier, there is a need for further usertesting, one which is done alongside the sleep device, To conclude, the most attractive part of this concept for the full duration of the seven week treatment. of using stories is, in our opinion, its variety: a story For this we are of the opinion that it might be best to may last a week, but if the treatment were to continue have a more functional app. By continuing our initial beyond that, a new story could be introduced and advancements with the Unity click-dummy, we could experienced without having the enjoyment wear off. apply the unlocking feature of each chapter, thereby Because we humans have an innate attraction to ensuring that the child isn't instantly exposed to the stories. The content of a narrative medium is interentire content of the app. Furthermore, we could changeable, meaning that the treatment could continue to entertain indefinitely as long there is always a thereby refine the AR feature and properly observe how well it works for the electrode guidance and the new narrative journey to follow. story. Only by usertesting our prototype alongside the treatment, would we be able to really tell whether the The telling of stories has always been an integral adherence and motivation towards the sleep device part of our lives and it will always remain so. We have stays consistent over the course of the seven days. simply shown that by altering its method of applica-From our background research, we came across the tion, we can help a child on their journey to recovery. topic of autonomy which we were - and still are - big



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### 7.2 Figures

Fig. 1 – A Woman Wearing SleepLoop's Sleep Device and Looking at Her Smartphone. Reprinted from SleepLoop, Retrieved June 2nd, 2020 from https:// sleeploop.ch. Copyright 2017 by SleepLoop.

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Fig. 12 – Collection of Children's Illustrations from the 2nd Class Depicting How They Would Like to Be Presented as an Avatar [Scans]. (2020, February). Copyright 2020 by Claudia Buck & Randy Chen.

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