

Konsept for forbedret behandling av barn rammet av astma/RS-virus

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Industriell design

Innlevert: Juni 2012

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Norges teknisk-naturvitenskapelige universitet
Institutt for produktdesign

Concept for improved treatment of children affected by asthma/RS-virus

Jonas Asheim

Department of product design, NTNU
Spring 2012

The logo for BLOPP! is rendered in a playful, hand-painted style. Each letter is a different color: 'B' is red, 'L' is yellow, 'O' is green, 'P' is light blue, and 'P!' is dark blue. The letters have a slightly irregular, textured appearance.

A game for improved treatment of respiratory diseases of toddlers
in a hospital setting.



Masteroppgave for student Jonas Asheim

Konsept for forbedret behandling av barn rammet av astma/RS-virus

Concept for improved treatment of children affected by asthma/RS- virus

Masteroppgaven gjøres i samarbeid med BLOPP prosjektgruppes pilot prosjekt "Barns LegemiddelOPplevelser", støttet av Extrastiftelsen. Samarbeidspartnere i prosjektet er Sykehusapotekene i Midt-Norge, Norges Astma og Allergiforbund og NTNU (ved Norsk Senter for Elektronisk Pasient Journal, Institutt for data og informasjonsvitenskap, Institutt for produktdesign, og St. Olavs Hospital). BLOPPs overordnede målsetting er å "utvikle prototyper på nytt legemiddeldesign, informasjons-/instruksjonsvideoer for legemidler og mobile applikasjoner for å

- Lære opp og motivere barn til å ta legemidler som forskrevet av legen.
- Bedre samspeilet mellom foreldre og barn.
- Lære foreldre å legge til rette omgivelsene for riktig legemiddelbruk.

Bakgrunnen for oppgaven er at dagens behandling av astma/rs-virus med forstøverapparater (nebulator), oppleves ubehagelig for mange brukere, spesielt barn. Oppgaven tar sikte på å utvikle et konsept som forbedrer denne behandlingen.

Oppgaven vil omfatte:

- analyse av brukere og brukerbehov, samt informasjonsinnhenting
- konseptutvikling
- evaluering
- detaljering og eventuell prototype bygging

Et underliggende mål er å gi konseptet en karakter som muliggjør levering til design konkurransen «Unge talenter»

Oppgaven utføres etter "Retningslinjer for masteroppgaver i Industriell design".

Ansvarlig faglærer: Ole Petter Wullum (NTNU)
Veileder: Marikken Høiseth
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Utleveringsdato: 16. januar 2012
Innleveringsfrist: 11. juni 2012

PREFACE

In this report an overview of the analysis, process and results from my master assignment in Industrial Design Engineering at Norwegian university of Science and technology, Institute of Product design is presented.

The assignment considers the development of a tool in order to help create a better experience for children undergoing treatment of respiratory deceases at the hospital.

The assignment takes on a very complex group of users and context of use, where design has not had the opportunity to venture before. Through the course of this report the need and immense potential for designers to approach the theme of creating better tools and products for children in a hospital setting should become apparent.

The assignment follows the development of a concept, which is just one of many measures that can improved so as to give the children a better experience of their stay and treatment at the hospital.

Many people have participated in this project, and I would like to especially thank all the children and parents who so willingly let me get a glimpse of their lives and experiences living with this disease and the treatment that follows. The assignment was done in collaboration with the research group BLOPP, (Pharmaceutical Experiences for Children) and I would like to take this opportunity to thank all the group members of BLOPP for their invaluable influence.

SUMMARY

This master assignment is conducted at the Institute of Product Design at NTNU. The subject of the assignment is "Concept for improved treatment of children affected by asthma/RS- virus", focusing on ways to improve treatment of respiratory deceases for toddlers (children between the age of one and four) admitted at a hospital.

The thesis is written in collaboration with the research group BLOPP ("Pharmaceutical Experiences for children") as part of their research into ways of improving treatment of children with respiratory diseases at home and at the hospital. BLOPP provided me with access to the hospital, research lab and expert users.

Respiratory diseases is the main reason for admission of children at Norwegian hospitals. For a majority of these children their experience of being treated for respiratory diseases will be traumatic. Many of these treatments are characterized by having to physically restrain the child in order to complete the treatment.

A total of 8 weeks were used for user observations, in addition to several interviews and workshops, both with toddlers, parents, nurses and professionals.

The workshops, user-tests and observations revealed a vast and complex problem area, with several interesting and valid directions for the assignment. However, based on user insights a concept for a serious

game was developed.

An important part of this assignment has been in relation to gaining insight and an understanding of the complex context at the hospital and the user group -toddlers.

BLOPP is an interactive game that improves the experience before, during and after treatment of respiratory diseases at a hospital.

The game provides a common focus of attention for both parent, toddler and nurse, in addition to being a toolkit in order to help motivate the toddler through the course of a hospitalization.

SUMMARY

Denne masteroppgaven er gjennomført ved Institutt for produktdesign ved NTNU. Temaet for oppgaven er “Konsept for utvikling av forbedret behandling av barn rammet av astma/RS-virus”, med fokus på måter å forbedre behandlingen av respiratoriske sykdommer for toddlere (barn mellom et til fire år), innlagt på sykehus.

Opgaven er skrevet i samarbeid med forskningsgruppen BLOPP (Barns legemiddelopplevelse) og er en del av deres forskning rundt måter å forbedre behandlingen av barn med respiratoriske sykdommer, både hjemme og på sykehus. BLOPP har gitt meg tilgang til sykehuset, brukerlab og ekspertbrukere.

Respiratoriske sykdommer er hovedgrunnen til at barn blir innlagt på norske sykehus. For flertallet av disse barna er behandlingen en traumatisk opplevelse, og er ofte karakterisert ved at de blir fysisk holdt tilbake av sykepleiere for å fullføre en behandling.

Totalt åtte uker ble brukt til brukerobservering, i tillegg til flere intervjuer og workshops, både med toddlere, foreldre, sykepleiere og eksperter. Workshopene, brukertestingen og observasjonene synliggjorde et stort og komplekst problemområde, med flere mulige retninger for oppgaven. Basert på brukerinnsikten ble det valgt å utvikle et interaktivt spill.

En veldig viktig del av oppgaven har vært å få tilstrekkelig innsikt og forståelse for en svært kompleks sykehus-setting og brukergruppe.

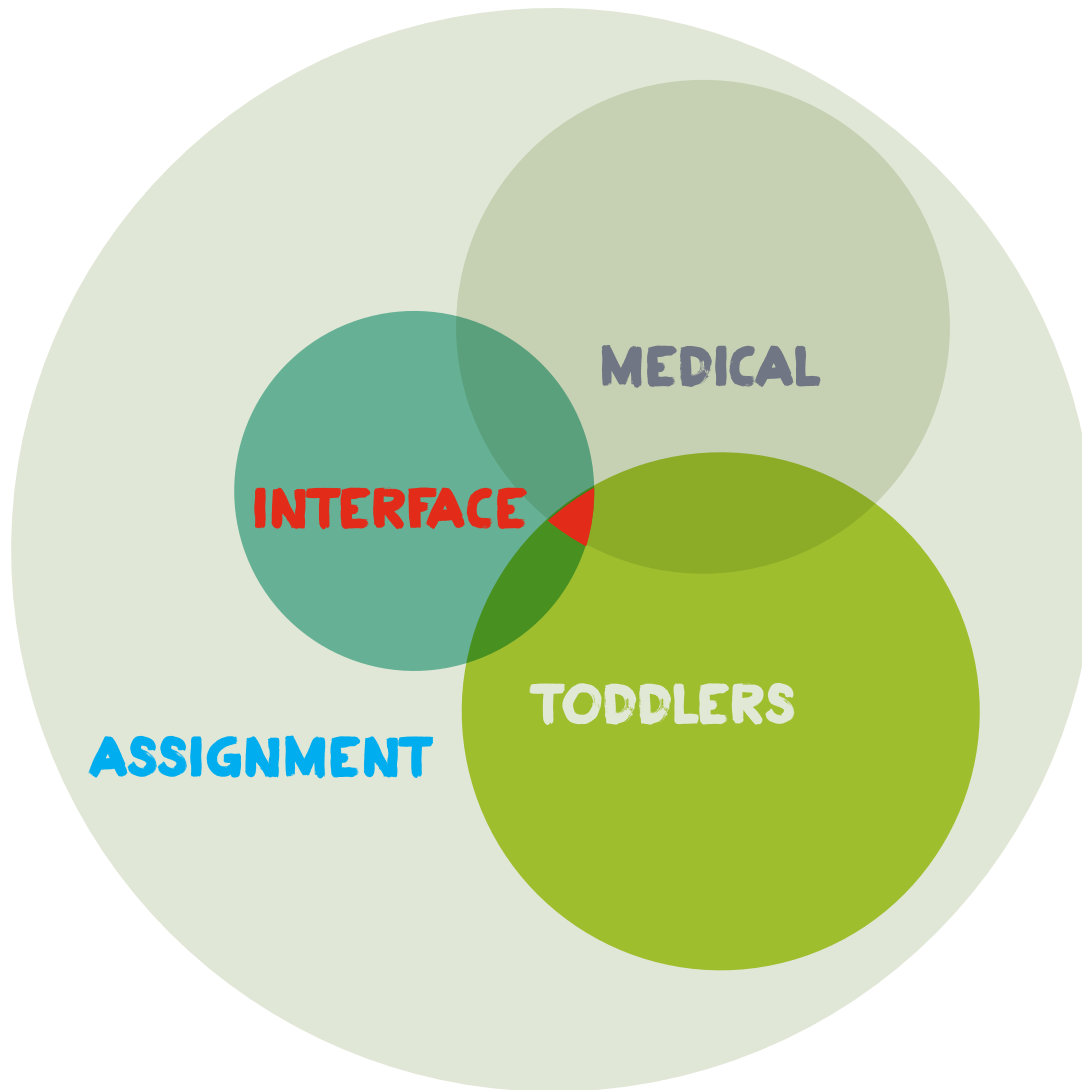
BLOPP er et interaktivt spill som forbedrer opplevelsen før, under og etter behandlingen av respiratoriske sykdommer på sykehus.

Spillet gir et felles fokus for barn og foreldre i tillegg til å være et verktøy for å motivere toddleren gjennom hele sykehusoppholdet.

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INTRODUCTION



ABOUT

PROBLEM DEFINITION

This master assignment presents an interactive game concept for improving treatment of toddlers with respiratory diseases at the hospital. A multi-faceted solution for a problem area where design has rarely ventured before. The assignment includes both looking at design for children below the age of 4, and designing for paediatric treatment in combination with interface design.

Design research regarding toddlers or paediatric treatment beyond medical devices, is scarce and a combination of both nonexistent, especially when considering the emotional and motivational aspects of the two. Consequently a big part of this master has revolved around building the framework for the assignment. In many ways the context of use when considering respiratory diseases and the treatment, can be compared to an extreme situation and the user in this case is not necessarily able to vocalize his or her needs. Acquiring knowledge as to how toddlers react and interact with their environment has been essential in order to complete this project, as well as understanding the nature of the treatment. The assignment therefore relies heavily on a user centred approach. Furthermore, it also required me to research both into psychological and physiological aspects of children, paediatric treatment, design experience and interface design for toddlers. These fields that will be presented briefly in order to establish the framework for this assignment.

During the assignment I consciously chose not focus on one particular

detail or problem relating to the treatment, as I believed the final design to have a greater value if funded on a holistic view. Consequently the solution presented is a system in 2 parts. Secondly, I wanted to end up with a detailed final concept, and dare to constantly make the choices required in order to reach this goal.

PERSONAL MOTIVATION

My motivation for taking on this assignment is in part the challenge presented through the complexity of the problem. Attending the World Design Capital 2008 in Italy and the course line "Active Welfare" spiked my interest in how designers can be used to improve a health care experience. Being very well aware about how time consuming it is to gain access to a hospital, and especially a treatment setting, and then suddenly having the opportunity to do so in the master assignment was almost too good to be true. Having the opportunity to work close with toddlers motivated me even more as I had no prior experience working with these users. Also, I was well aware of how little user centred design with toddlers in mind, have been done in the field so far. I considered it the ultimate challenge and an amazing opportunity for my final assignment at Institute of Product Design.

Lastly, being able to do a project that can greatly improve some ones life quality is indeed a great motivation in it self, and I have honestly never had a more fun, challenging and rewarding experience than this master assignment.

THE ASSIGNMENT

ABOUT THE ASSIGNMENT

One out of five admissions at the children's wards at Norwegian hospitals today are due to acute asthma, making asthma the leading cause of hospitalization of children in hospitals in Norway. (*National Strategy for prevention and treatment of asthma and allergic diseases and the treatment of asthma and allergic diseases*).

Acute asthma is only one of several diseases collected under the generic term "respiratory diseases", together with RS-virus and other types of infections. All by which are treated by inhaler devices which enables medicine to be administered in the form of a mist that is directly introduced to the lungs via a mask. At the hospital this is mainly done by a device called a nebulizer.

Treatment of respiratory diseases is currently a very difficult and even traumatic affair for both parent, patient/child and nurse. The majority of the children admitted react so badly to the treatment that they often have to be physically restrained by parents and/or nurse.

In addition to being an emotional problem, the result also has a technical aspect as children who cries gets less medication through the mask, thus prolonging the duration of the treatment and their stay at the hospital.

This assignment is done in collaboration with a small research group called BLOPP (Barns legemiddel opplevelser - "Pharmaceutical Experiences for children"), supported by the Norwegian Asthma and Allergy Association and Extra Foundation, and the assignment is part of a bigger research project ending in 2013.

The aim of BLOPP is to identify and develop solutions to support medication of children using asthma medication. The group consists of a pharmacist and project manager Elin Bergene, Phd. Student Marikken Høiseth at the Institute for Product Design and Professor Ole Andreas Alsos

from the Department of Computer and Information Science.

COLLABORATING WITH BLOPP

BLOPP integrated me into their project at an early stage, and gave me the opportunity to access the hospital and gave access to a vast network of medical professionals and users.

All the observations and workshops were conducted with BLOPP, and gave me ample time and opportunity to test my ideas and concepts. Having the additional support which comes with a multi- disciplinary team was a truly fantastic experience

The nature of a master assignment, having a short time span combined with my personal goal of ending up with a concrete design proposal, meant that I had to work at a different pace than the project group, making the act of designing and detailing more solitary.

FOCUS - HOSPITAL SETTING AND TODDLERS AGED 1-4

Initially the assignment opened up for working with treatment of respiratory diseases for children from the age of 8 and below, in a home setting or at the hospital. Given that the research group would focus on observations at the hospital this semester, together with a personal interest in designing in a hospital setting, set the theme of the assignment at an early stage. Since the majority of children requiring hospital care in relation to respiratory diseases are from the age of 4 and below the user group was given.

Making an interface based game, however, was decided upon quite late in the process. Consequently, the initial insights and analysis covers a larger problem space than the final concept depends on.

RESOURCES

PROFESSIONALS

Guro Karlhom; Head nurse at the infections ward at the children and womens center, St. Olavs Hospital.

Mads Bøhle; Nurse, St. Olavs Hospital

Jaap den Hetog; Doctor at Rosten legesenter

Rose Lungre; Public health nurse and advisor at NAAF (Norges Astma og Allergi Forbund)

Tove Karoliussen; Hospital clown, St. Olavs Hospital

Department of Child and Adolescent Psychiatry:

Anne Karen Bakken; Chief physician and head of Department, and her team of:

Psychologists, child psychiatrists, psychiatric nurses and clinical pedagogues.

INTERVIEWS

Eva - Mother with prior experience of having children with need of respiratory treatment

Guro - Mother with current experience of having children with need of respiratory treatment

JONAS ASHEIM

BLOPP!

(Barns Legemiddel Opplevelser)

Elin Bergene - pharmacist and project leader

Ole Andreas Alsos - Prof. in usability from Department of Computer and information Science, NTNU

Marikken Høiseeth - Phd. Student and supervisor Institute of Product Design, NTNU

Maria Skaaden - Student Institute of Product Design, NTNU

USER TESTING

General users

7 children ages 1-5

Expert users

2 children age 3 and 4

3 parents

1 sibling

Post evaluations

2 children aged 1 and 3

OBSERVATIONS

8 patients

8 parents

7 nurses

NTNU

Ole Petter Wullum supervisor Institute Product design

Industrial designer - Ida Eriksdatter Brobakke

BACKGROUND

In this chapter a short overview and understanding of the disease, hospitalization and its context will be presented in order to give the reader an insight into paediatric treatment of children with respiratory diseases.

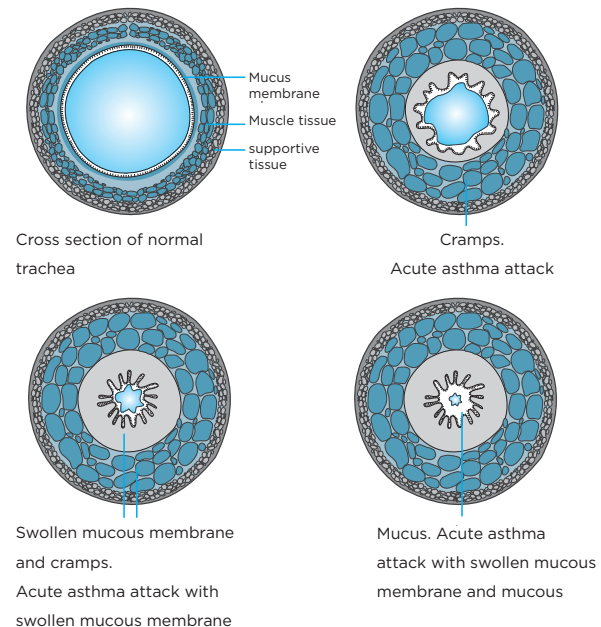
RESPIRATORY DISEASES

Nebulizer treatment at the hospital is mainly used for the treatment of asthma and respiratory syncytial virus (hereafter referred to as RS-virus), where the patient gets severe respiratory distress due to the condition, and thus requiring extra medical care and assistance.

ASTHMA

Asthma is a chronic inflammatory condition and a state of irritation in the airways, that can lead to repeated episodes of coughing, tightness in the chest, wheezing or rattling, especially at night or early morning. The condition varies with time and may come during periods of normal breathing. Low humidity and cold symptoms often reinforces the condition, making winter the toughest time of the year for people with respiratory diseases. Results from the big Environment and Childhood Asthma study at Ullevål University Hospital, which followed nearly 1,000 children in Oslo from birth up to ten years, shows that 20.2% of all children have or have had asthma during the first ten years of life.

About half of people with asthma experiences the symptoms between the age of 2 and 10 years and seem to "outgrow" the disease, experiencing a significant drop in asthma symptoms as they approach the teenage years. However, in many cases, symptoms return in the thirties or even stay with the patient for the entire life span.



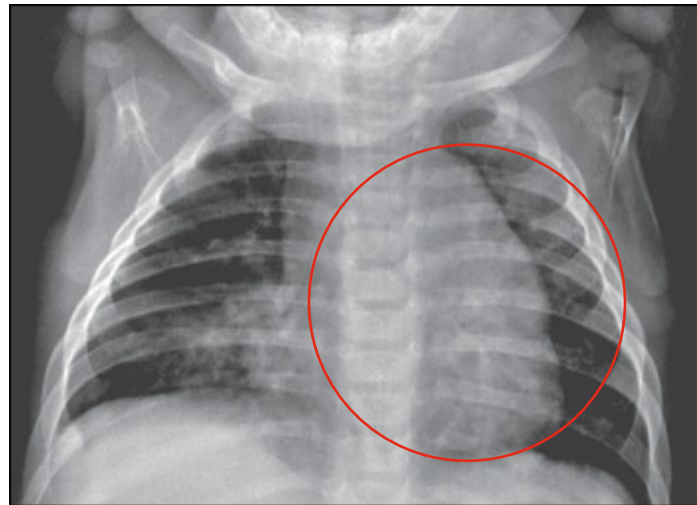
RESPIRATORY SYNCYTIAL VIRUS

RS virus is a respiratory virus that causes infections of the lower respiratory tract and usually begins with a light cold. Small mucus particles plug the narrow tracheal branches located far out and down into the lungs. Causing an infection in the condensed lung tissue of trachea and bronchi, resulting in a condition called acute bronchiolitis.

Symptoms of acute bronchiolitis are very similar to acute asthma with wheezing, rattling, coughing and tightness in the chest.

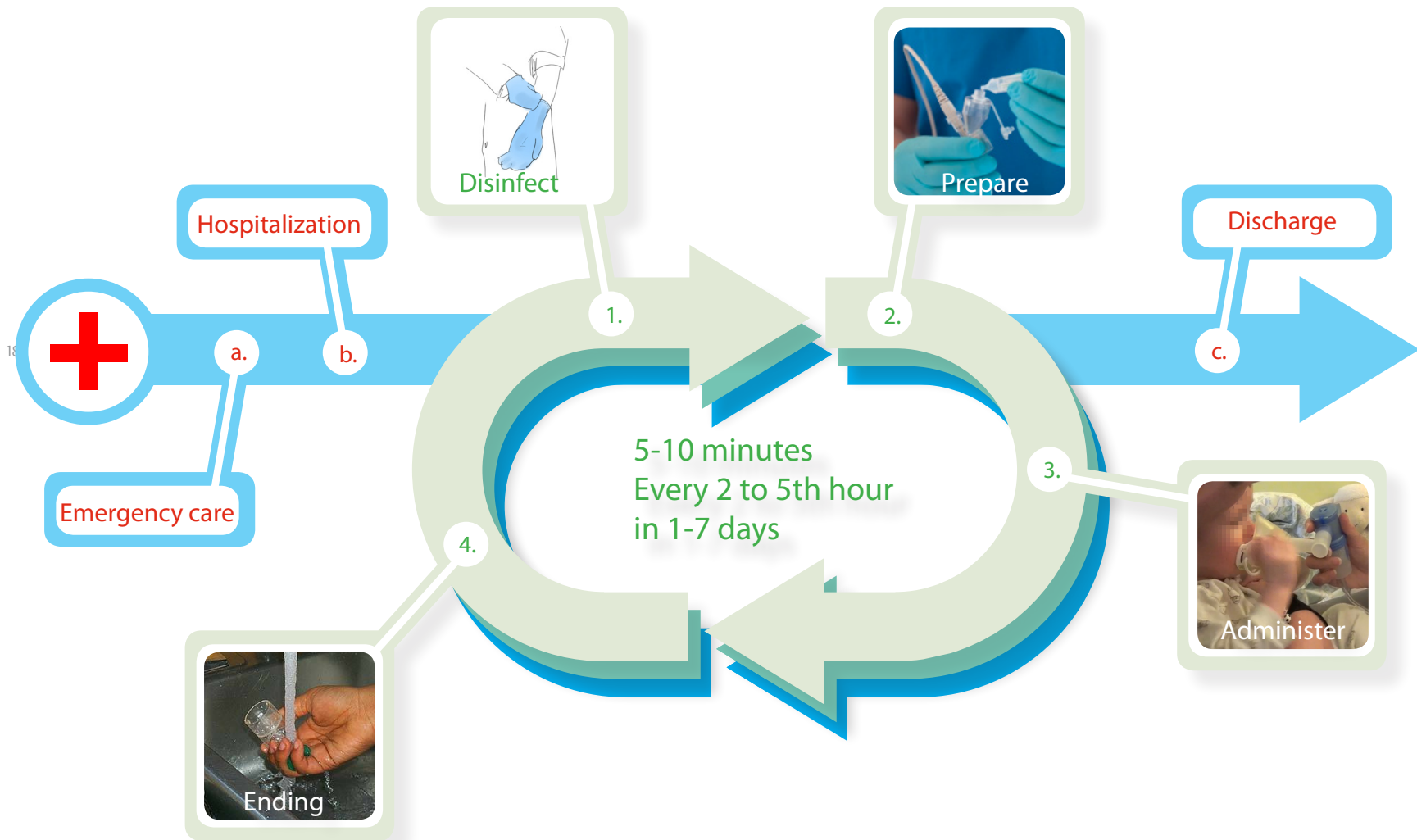
RS-virus is an epidemic each winter and so frequent that everyone is expected to have had the virus during their first three years of life. Luckily only a minority of us experience the condition as something more than a common cold.

Both acute bronchiolitis and asthma can be treated using an inhaler or a nebulizer device at home, but in some cases, the condition is so severe that hospitalization is necessary. At the hospital the child is mainly treated with a nebulizer. However other drugs are also provided in the form of injections and pills, along with oxygen saturated air should it be necessary.



Acute Bronchiolitis

PATIENT JOURNEY



A stay at the hospital for children with respiratory diseases can last from one night to one week, with an average of 2.5 days.

a. At the emergency care

The hospital stay starts from the moment the child is so sick that the parents choose to go to the emergency care. There the emergency care physician determines that the child must be hospitalized at the paediatric ward. The first medication of the patient some times happen already at the emergency ward.

b. Hospitalization

Upon admission the child and parents are welcomed at the childrens clinic, department of infection, they will be confined to a room during their stay. Nebulizer treatment commences shortly after their arrival.

c. Discharge

When the child is well enough, they return home. With them they will often have a nebulizer or an other kind of inhaler device, as they will often have to continue the treatment at home.

Treatment with the nebulizer device lasts between 5 and 10 minutes and will be repeated between two to eight times per day. The timing for each treatment is planned with fixed intervals in relation to schedules and prescriptions by medical personnel and can not be changed.

1. Disinfection (2 minutes)

The nurse enters the lock between the room and the outside world, put on blue latex gloves and a disposable medical coat and disinfects.

2. Prepare (2 minutes)

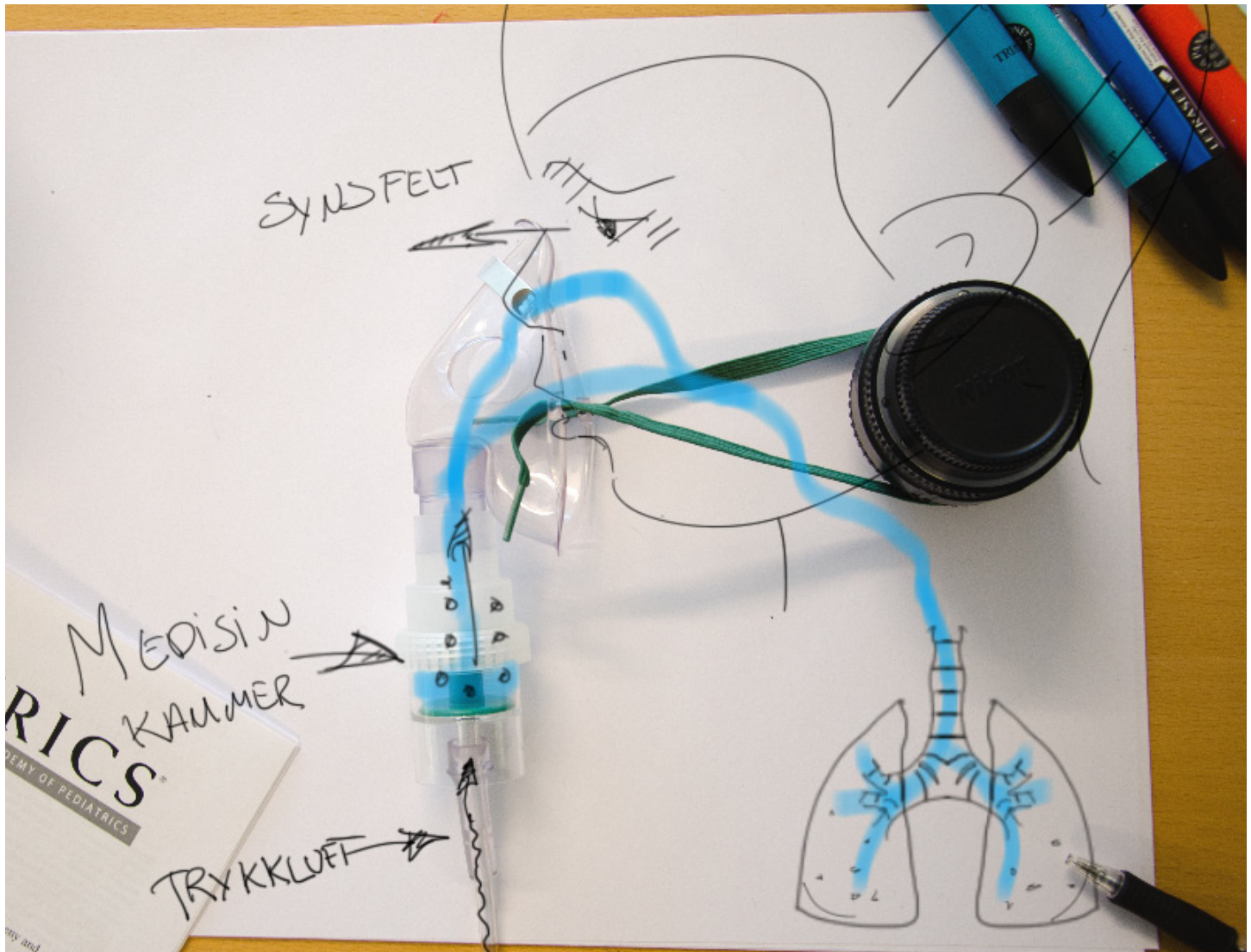
Nurse enters the child's room. As the nebulizer is always found in the room with the child, the medicine has to be filled into the nebulizers chamber and assembled, before treatment can commence inside the room.

3. Treatment (5- 10 minutes)

Nurse turn on the nebulizer device, and positions it over the child's nose and mouth in order to let the child inhale the medicine.

4. Ending (1 minute)

As the treatment is coming to an end the nebulizer starts to make a gurgling sound before going quiet, signalling that the treatment is completed.



MEDICATION

The nebulizer administers the prescribed medication in the form of vapour to the lungs. With asthma and RS virus there are three types of treatment:

Bronchodilators (Ventoline salbutamol and similar) that opens smooth muscle tissue in the lungs, thus making it easier to breathe. In severe cases adrenaline and adrenaline-like drugs can also be used.

Both of these treatments are effective for a short time period and start working within minutes. Bronchiopdilators are consequently used when it is very critical but not too often as the medicine loses its potency.

The second type of medication is preventive drugs called glucocorticoids, a class of steroid hormones that work by suppressing the inflammation of the airways. The main difference between the glucocorticoids and the bronchiodilators is that their effect is not immediate, but more long term.

Thirdly a simple sterile 3% saline solution is used in order to help dissolve mucus, which drastically reduce the duration of the hospital visits. Saline solution is often used in combination with the other drugs as well.

A common feature of all drugs is that they generally give the patient little discomfort or side effects, except for the salty taste of the saline solution.

Concerning medication it is important not only to consider its effectiveness but also the factor of compliancy, meaning the patients willingness to take a drug. Treatment duration is determined by the dosage and type of medicine, but also the child's condition. When a child cries the air goes mostly to the upper portion of the lungs where the stress receptors are situated (Douillard 2003). As a result a child who reacts badly to the treatment, will have to sit for longer period of time in order to get the right dosage. Occasionally resulting in a rather traumatic experience for both child and parent, as the nurses sometimes have to use force to assure that the child receives the right amount of medication.

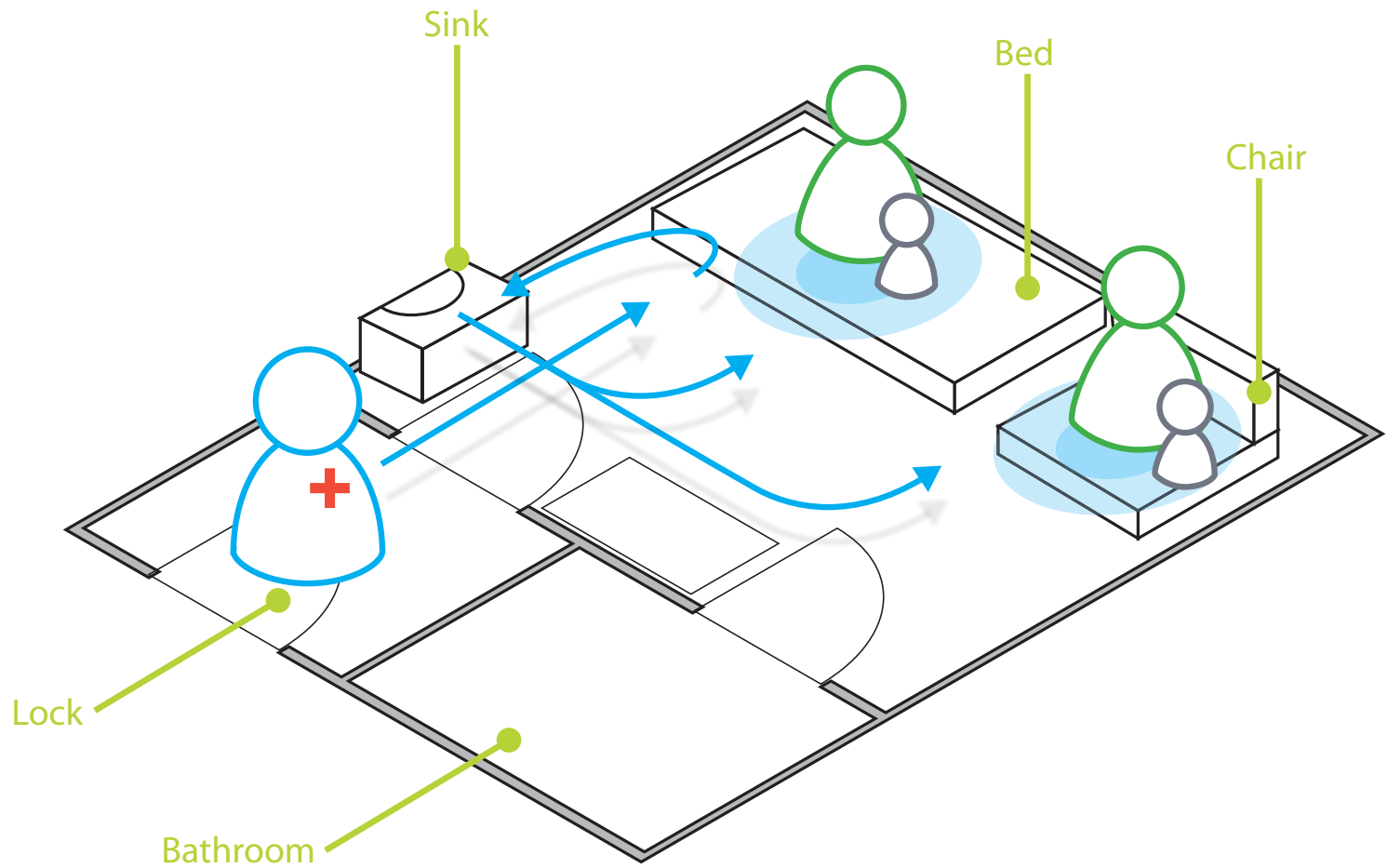


CONTEXT

As these patients/children are both highly contagious as well as vulnerable to other infections, they have to stay in an isolated environment at all times. This means that throughout the hospitalization, the child will be limited to a private room with a size between 6 and 15 square meters, together with one of his or her parents. The parents can leave the room if they want to, but as the child has to stay inside this rarely happens.

A typical room contains a standard hospital bed, a child's cradle, a sink, a chair, various medical equipment, a patient terminal that provides access to TV and internet, and lastly, some toys. The toys are either brought from home or provided by the hospital. In addition, there is a bathroom attached to each room.

Access to the outside is provided through a lock, where visitors and nurse will go through proper means of disinfection before entering the room. The rules in place to keep the environment isolated also means that a person who enters the room can not touch anything without wearing gloves or leave any object, making visiting the patient difficult.



THE NEBULIZER

When children are hospitalized with respiratory diseases the medication will primarily be administered by using a nebulizer. The nebulizer is a device where oxygen, compressed air or ultrasonic waves transform liquid drugs in a chamber into an aerosol form (vapour), which then is inhaled through a mouthpiece or a mask.

For young children the mask will always be used as a way to ensure proper inhalation of the medication.

The most common type of nebulizer is driven by oxygen or compressed air, and is called a jet-powered nebulizer. It is characterized by passing air at high speed through the liquid, converting it into an aerosol.

These devices are known for being loud and make a wheezing sound which frightens a lot of the patients.

There are several examples of compressor powered jet nebulizers for the home market designed to look less frightening by disguising their appearance, however judging from their reviews the effect on the children is not apparent and can even make the child hate objects which it preciously loved.



Ultrasonic Aeroneb Solo Nebulizer manufactured by Aerogen



LC sprint, jet-powered nebulizer manufactured by PARI medical

The second and slightly more expensive version is the ultrasonic nebulizers. These devices use an electronic oscillator to generate high frequency ultrasound waves that vibrates the liquid into aerosol form. These nebulizers are very quiet and therefore preferred by the medical staff and the patients.

At St. Olav Hospital today the jet-powered LC Sprint nebulizer are commonly found in every room at the childrens infections ward. However these are increasingly replaced by the Aeroneb ultrasonic nebulizer



manufactured by Aerogen. The Areoneb is the preferred nebulizer and the device is often moved between the rooms. However, as these patients have to be isolated during their stay and bringing any new objects into a room is problematic, the rotation of the Aeroneb nebulizer only happens after a patient has been discharged and the device is thoroughly disinfected. In addition to the nebulizer, the mask is an important part of the treatment, as it is the only part in close contact with the child. It is made by a soft silicone material and held over the patient's mouth and nose. Several of the masks as the market has a rubber band to keep the mask in place. These are primarily used at Emergency Care, while at the children's ward they use the masks without rubber band. The nurses prefers to hold the mask with their hands in order to have more control if the child react badly to the medication.

In addition to the more clinical looking masks there are also masks with a more entertaining appearance, like the duck mask at St. Olavs Hospital. These masks were appreciated by some members of the staff, however their use would greatly depend on the nurses initiative during treatment. The mask mainly helped the nurse to make the device less scary and had no or only an obstructive effect during treatment as the child can not see the mask, and could possibly want to take it of in order to look at it.

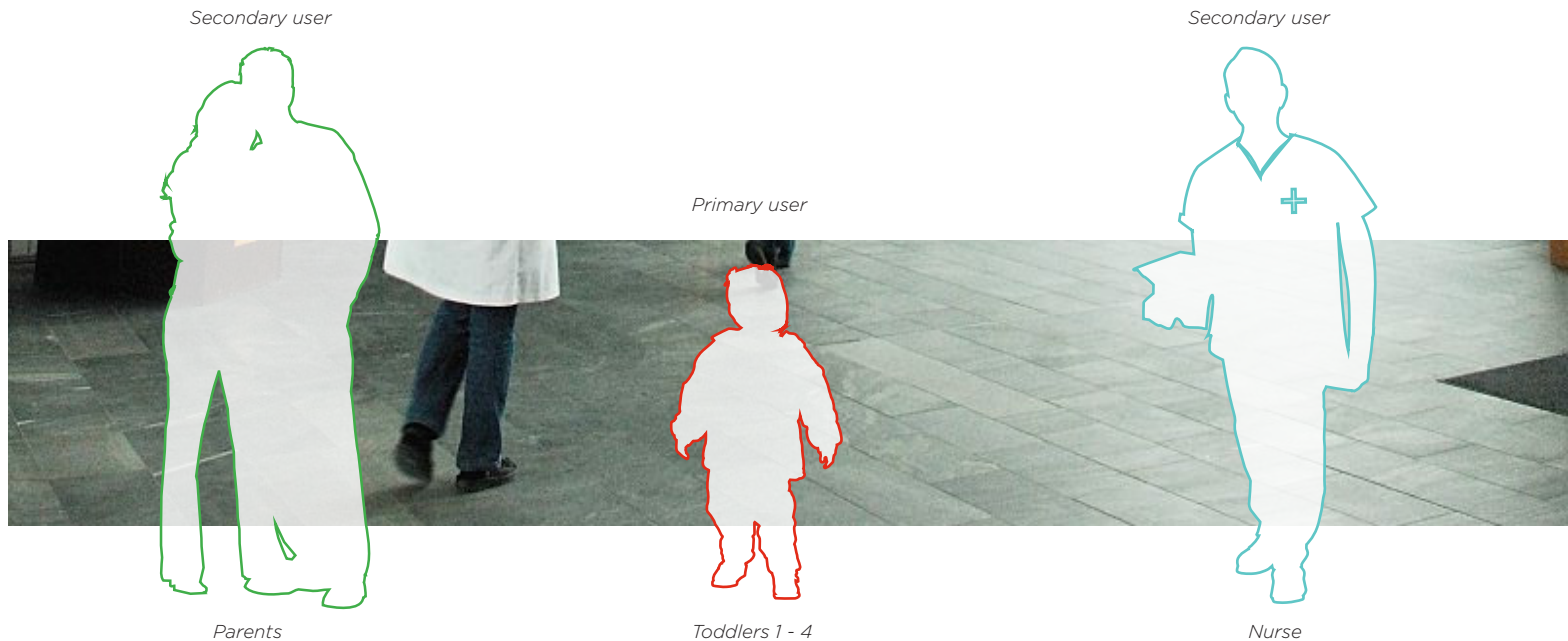


Nebulizer mask



Nebulizer duck mask

THE USERS

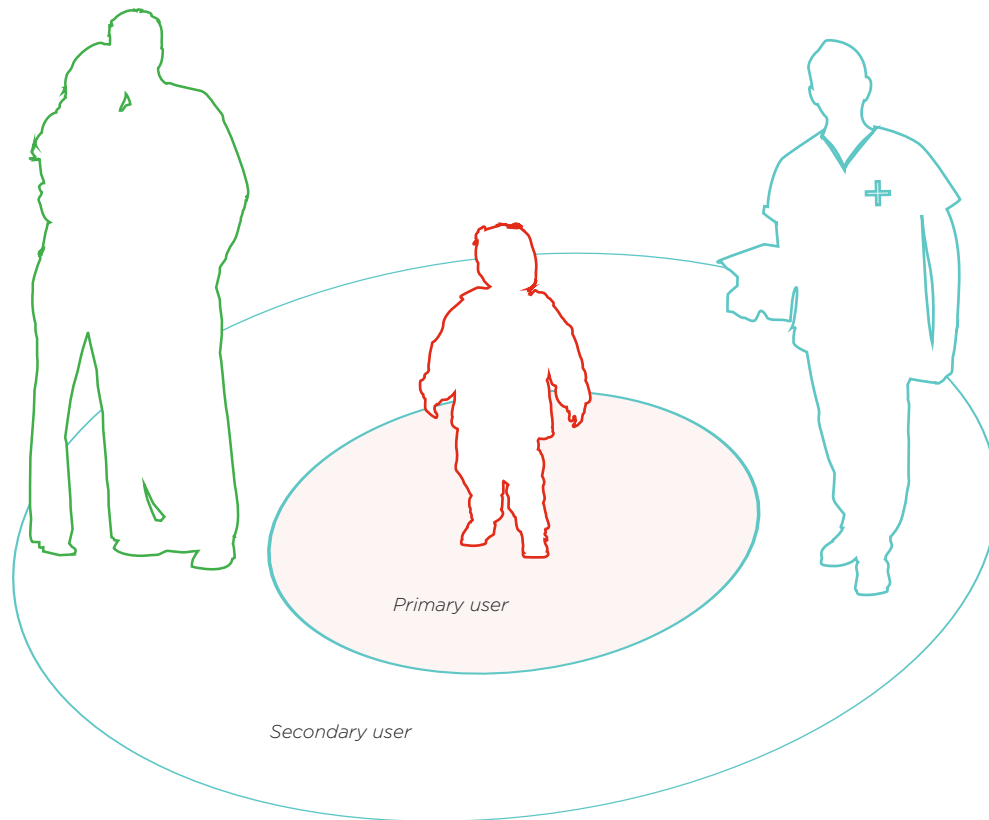


The primary user of respiratory treatment at the hospital are defined as babies and toddlers. The one that receives the treatment and how they react to it will greatly influence the secondary users, namely parents and nurses. The physical condition of the patients varies, from being very sick and tired to just being a little woozy.

In this assignment the focus has been narrowed down to toddlers aged 1-4, as they make up the majority of the children being treated for respiratory diseases at the hospital.

Another important user in this context are the nurses. They are trained medical professionals who are in charge of administering the treatment with the nebulizer. A main characteristic of the nurses is that they often find themselves on a tight time schedule.

Thirdly you have parents of the child. One of the parents will always be present in the room and plays an important role in making the treatment more comfortable for the child by providing security and comfort.



"In many cases if it is a choice between not giving the medication or use force, force is by far the better option" -Doctor at St. Olavs

MAPPING

In this chapter a brief summary of the various ways used in order to gain user insights will be discussed. Including user observation, interviews, workshops and testing. The main insights from these user involvements are presented.

INTRODUCTION

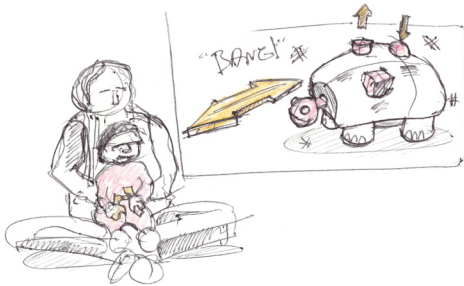
In this chapter a brief overview of my approach for gaining insights into treatment of respiratory diseases at the hospital is presented. As mentioned in the introduction, the project has relied heavily on a user centred approach. First of all I needed a general familiarization with toddlers and their lives, seeing that I did not have extensive experience in communicating with small children on beforehand. Secondly, I needed specific insight into the lives of the toddlers with respiratory diseases, as they are the main focus in the project. Through observations, interviews, dialogues and workshops with both patients, parents, nurses and experts I have mapped out the very complex group of users and user setting. These insights concerning user setting will be presented along side with the main insights from interviews and observations.



EMPATHY

FAMILIARIZING WITH TODDLERS

In this project several theoretical psychology based approaches, observations, interviews and workshops are used in order to gain valuable user insights. Still the most essential way of learning about children is by spending time with them (Markopoulos et al). As a student with no experience with children of his own, it was important to first gain a basic understanding of how toddlers see and interact with their world. In order to familiarize my self and achieve a sense of empathy with the user I played several games, read books and watched T.V- series for children. Additionally I spent a day at Majorstuen kindergarten playing with and observing the children. Even if these insights can not be directly presented and transferred from analysis to final concept they form the basic foundation for the assignment.



INITIAL INSIGHTS

Having your child hospitalized is both stressful and out of the ordinary for parents, as well as the child. Talking to parents about their experiences of having their children treated for respiratory disease gave insights regarding the emotional toll this treatment has on the child and the parents, as well as preparing me for what to expect during the observation.

These interviews gave me a starting point, painting a picture of a treatment that in some cases can be quite distressful for both parent and child.

”.. Felt like I was abusing my child”
-Liv (pseudonym)

In addition to talking to people directly related to the treatment I also talked to people with other professions, for example hair dressers and dentists. These professions also deal with children in situations where they have to do things they don't want to do, like drilling holes.

These conversations equipped me with a general understanding and empathy for the children being in uncomfortable situations. But it also provided insight into how these situations are experienced and dealt with by the parents and other adults. Obviously most people will find that cutting the hair of a screaming child is extremely unpleasant.

Evaluating Children's Interactive Products: Principles and Practices for Interaction Designers

AT THE HOSPITAL

A hospital is a challenging environment for designers to gain access to and work within. Special ethical and technical considerations have to be in place and you have to deal with unforeseen events.

According to the rules for handling patient confidentiality as given in BLOPPs -application to regional committees for Medical and the Scientific Research Ethics (REK), the transcription and videos from these observations can not be published with this master assignment. But these will be open for review by the end of 2012. In addition to the administrative considerations, the contextual environment is unpredictable. You can not plan when there will be patients available for observations and like the staff working at a hospital you have to be prepared and “on call” at any time. Where you at one point can have quiet conversation with the staff, they can suddenly receive a call and have to leave. Meaning that time with the medical staff had to be savoured and greatly appreciated.

A certain amount of training was important for the observers, including me, in order to ensure the patient safety. In the case of respiratory diseases the patients are held in an isolated environments as they are vulnerable to other infections as well as being highly contagious. This meant that prior to an observation we had to follow the proper procedures for disinfection before entering the room. We had to wear a special robe and could not touch or leave any objects with the patient. Consequently we could not leave a



- Treatment at St. Olavs Hospital

camera or other recording equipment. We always had to be present in the room in order to make the observations, and our presence in the room most likely had an effect on how the patient responded to the situation. Luckily we often became a new source of interest for the child and probably effected the situation in a positive way. Each observation sequence was conducted by filming a treatment session, followed directly by an interview with the nurse administering the treatment and the parents of the child.



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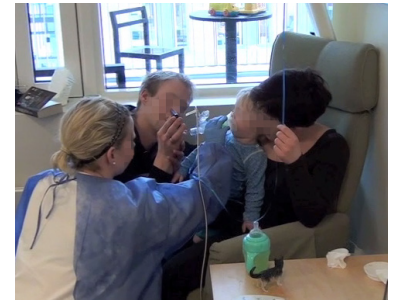
It is also important for a designer to reflect upon the hospital environment and the experiences people have in a hospital. Being sick or having a sick child is by obvious reasons an unwanted experience for everyone involved. As it is both stressful and gives a feeling of vulnerability. We were asking to attend an uncomfortable, tense and in some cases extreme situation, which required a lot of discretion. Making an objective observation came last on a long list of priorities. Our goal was to minimize the extra discomfort for patient and parent and to be out of the way for the nurse. As it is an important medical treatment it was a criteria for our observation that we did not have a negative effect.



USER SEQUENCE

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User sequence based on observations



As the nurse enters the room she greets the patient before stating to prepare the nebulizer.

After assembling and filling the nebulizer chamber with the correct medication, the treatment is ready to begin.

At this point the child is already crying

After receiving instructions from the nurse the mother places the child in her arms.

The nurse turns on the nebulizer and it starts making a wheezing sound.

The nurse goes down on her knee beside the mother in order to be at the same level and the child.



3.

The mask is put over the child's mouth and nose and the treatment commences. During treatment the nurse will actively use a toy in order to distract the toddler



4.

The child's reactions vary. Some accept the treatment and remain calm, while others plunge into hysteria as the mask is forced into their faces.



5.

The child receives an award when the treatment is over

INTERVIEWS

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One of the major benefits of working in close connection to a group of researchers is that in addition to participating, I also had the opportunity to read the transcripts and watch videos from observations I was not able to attend personally. Throughout the project 14 observations were conducted by the research group and I participated in five, in the period January to February. In this assignment material from eight of these observations have been used. A series of interviews with parents and nurses were conducted at the hospital as a follow-up after each observation

MAIN INSIGHTS FROM NURSES:

- children often start crying only by seeing one of the medical staff, because they are not able to differentiate between the nurses that will execute the treatment, and the nurses that only come in to say hi.
- it is not necessarily easier for children who use nebulizer at home and how receptive they are of the treatment at the hospital
- Nurses often talk to the children about the treatment, because they feel it is important for the child to be able to understand what is going on.
-however this was mostly done with children who are able to vocalize, from the age of four and up
- the children are most reluctant around the age of two

- it is important that the child sits close to the parent, and that the parent remain calm and help motivate and distract the child.
- During treatment the nurse works hard to multi task between distracting the child and administer the treatment

*it happens that the parents react [badly] as well ... that is awful..
as we feel it is just as bad our selves.*

-Nurse X about how bad he feels treating a difficult child



MAIN INSIGHTS FROM PARENTS:

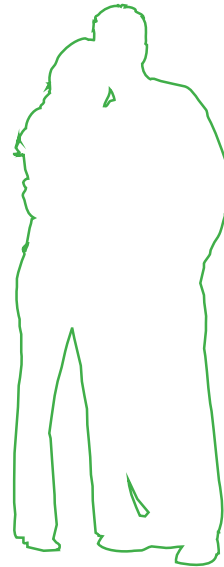
- Parents do little in order to prepare the child for the treatment
- The parents did not believe that the children were able to understand the meaning of the treatment, as there would rarely be an immediate change in the child's wellbeing.
- They empathized with their children having to sit in an isolated environment and forced to use the nebulizer. Some of the parents thought that because the general situation at the hospital was boring, being treated and forced to sit still was extra difficult for the child.
- Some parents felt that they had little to contribute with during the treatment
- Some parents emphasized that using physical contact, sing and smile helped to calm the child

When asked about ways to improve the treatment, both groups emphasized having more colors, lights and sounds brought into the treatment would help to distract the child.

If it's ["the distraction"] fun and make noises it's almost like it does not matter. I think I can push any kind of mask on him

-Mother Y about the potential for a distraction

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I contacted clinic manager and chief of medicine at department of Child and Adolescent Psychiatry (CAP) at St. Olavs, Anne Karen Bakken. She invited me to hold a short presentation of my project at the department of CAP for a group of ten people consisting of experts within child and adolescent psychiatry, pedagogics and psychology.

In the presentation I gave a general overview of the treatment, along with the analysis made so far. I also presented two treatment concepts, which lead to a discussion of the project in relation to psychology.

MAIN INSIGHTS FROM PROFESSIONALS

- The smallest children (up to two years) understand more than we think, and it is important to attempt to explain properly how the treatment is conducted even to the preverbal children.
- Medical device/treatment and the motivational object should be separate but have a correlation. At the same time one should be careful and not include too many features which are unfamiliar to the child
- When working with sick children in bewildering treatment settings at the hospital, anxiety can occur and it is vital to give the child a feeling of control and overview of the situation
- A sense of security can be formed by providing routines or rituals.
- Parents should actively interact with the child during the treatment



WORKING WITH CHILDREN

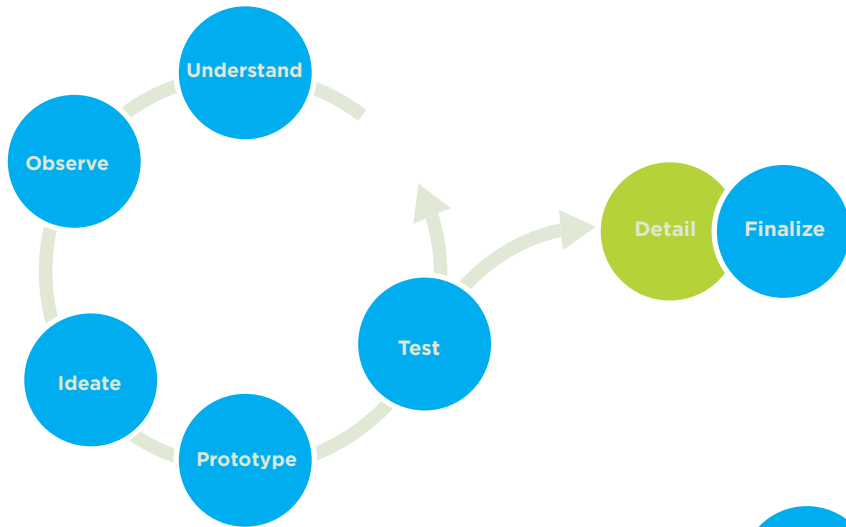
Children and adults view the world differently and understanding what they like or want in a product is not apparent. Using children actively was therefore important in order to gain insight. Two planned workshops were conducted. These workshops were divided into two parts; one for testing concepts and one for general insights through playing with and around the theme of medication.

Involving children in the design process requires a different progression than a regular design process. Children do not respond well to abstract concepts where functional and aesthetics are left to the imagination -as for example with paper prototypes. Children require a more complete representation of a concept, this meant that the level of detailing had to be higher also in the initial tests. Thus making the process of performing user tests more time consuming.

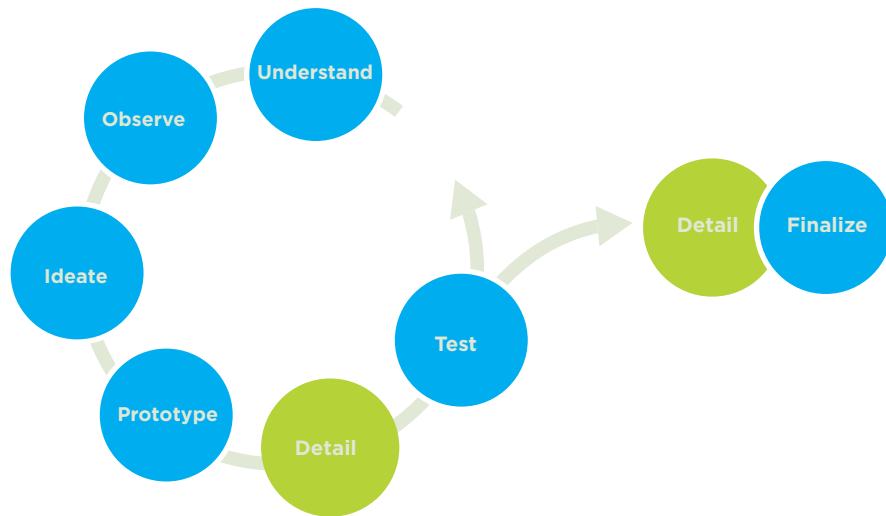
Initially a controlled workshops with children was conducted at the usability lab at Norwegian Research Centre for Electronic Patient Records (NSEP). The first workshop was conducted with 5 children aged 1 - 5 without prior experience with treatment of respiratory diseases.



- Using an asthma inhaler to "treat" Mulle the penguin



-Regular design process



- Designing process with children

WORKSHOP WITH PROFESSIONALS

A multi- disciplinary workshop with four professionals was conducted at the NSEP Lab at St. Olavs, in order to brainstorm around ways to improve the treatment situation for the children based on four categories derived from the initial analysis based on observations: prepare, motivate, distract and reward.

The five participants experts were:

Doctor Japp Den Hertog, general practitioner with over 20 years of experience and actor in the theatre group "Teater Fusentast"

Mads Bøhle - Nurse at the childrens clinic and special appointed nurse for wellbeing ([www. treamtrivsel.no](http://www.treamtrivsel.no))

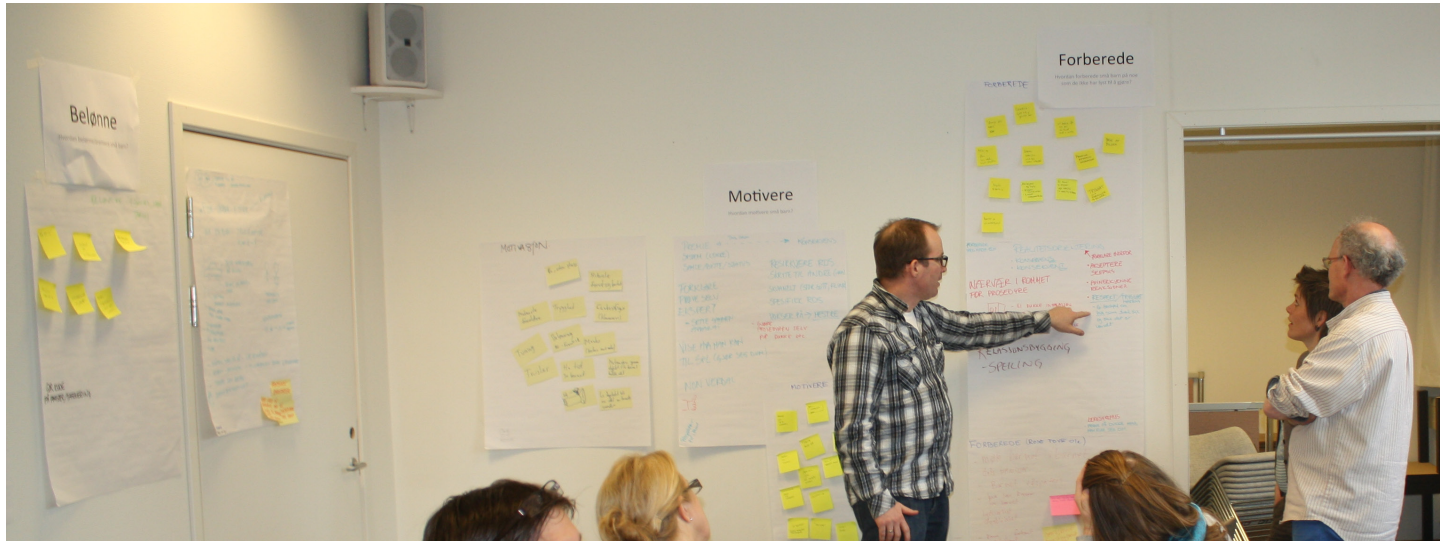
Tove Karoliussen - Also know as Beate Kræsj Pling, hospital clown at St. Olavs Hospital

Torill Stølan Hafsmo - leader of the information technology program in Trondheim municipality and teacher at Granåsen kindergarten

Rose Lungre - Public health nurse and advisor at the Norwegian Asthma and Allergy Association



- Beate Kræsj Pling at St. Olavs Hospital



MAIN INSIGHTS

- Let the child experience a sense of achievement, control and mastery
- let child and parent learn about the treatment beforehand, in a calmer setting
- use fantasy and humour to avoid the standard “hospital” experience
- integrate rewards and praise during the course of the treatment, and not only at the end
- create togetherness by including everyone present during the treatment (nurse and parents)
- children respond well when seeing others, preferably other children, perform the same action as they have to

INSIGHTS FROM THEORY

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In addition to being fun and a good way to avert boredom, play has an added value in a hospital setting because children explore, learn and communicate through play. Compliancy seen from a clinical psychology perspective includes not only that the patient gets the right medicine at the right time and the right dosage, but also that he gets it in the “right way” - with as little distress as possible. Play has on countless occasions been proven to help this kind of compliancy in children, according to several clinical psychologists. (Armstrong and Aitken, Tai 2008).

No research can be found regarding the use of play or distraction during nebulizer treatment in order to increase the compliancy seen from a clinical psychology perspective.

However, several studies on treatment methodology for children undergoing clinical anaesthesia can be found. These cases show that children are prone to develop phobias or even post traumatic stress disorder as a result of fear and anxiety in relation to the treatments. The children will often fight the medical personnel. This forces the doctors to keep the children under unnecessarily heavy sedation in order to complete the medical procedure. Consequently, most hospitals today have special psychiatric units dedicated to ease and treat children who reacts especially bad to different forms of treatments, and in particular if they had to be sedated.

Through my insights on nebulizer treatment of children, I found several similarities with theory describing other forms of treatment on children at hospitals. In general, the feeling of loosing control and being in an

unfamiliar environment is, naturally, stressful to children during any kind of treatment.

Several studies related to children and anaesthesia have shown that relevant play, or serious games, and information prior to medical or surgical procedures make the children adapt and recover more quickly after the treatment. Furthermore, they remain calmer and more cooperative during the procedure, compared to children with no prior relevant play or information (Armstrong and Aitken 2000, Aydin et. al 2007).

According to Tai, play help communication between the doctor/nurse and the child. Especially when considering preverbal toddlers who are unable to vocalize, and also: “Carefully structured therapeutic and directed play may help to inform the child of the procedure and increase cooperation with treatment, choice and consent.” (Norma Jun Tai, 2008)



-left: Rasmus på sykrhus
right: mask used in
all founded method within
anaesthesia

clinical psychology. It uses cognitive and behavioural interventions in order to alter negative thinking related to anxiety about a medical procedure, and replace them with positive beliefs and attitudes (Barlow 1999).

Interestingly my observations and the results of the interviews are very much verified by this theory. Moreover, CBT encourages use of visual and sensory prompts. The CBT theory describes several tools in order to improve the treatment of children and categorizes them in to two categories: cognitive and behavioural interventions.

Cognitive interventions

Cognitive distraction - shifts attention from the procedure using agreed or spontaneous activities (e.g. nonprocedural related talk, bubbles, counting, music).

Imagery - child-led guided imagery empowers the child to construe an image that is pleasant and one he can control (e.g. walking along a beach). Visualization allows the adult to use suggestive prompts and to join in.

Preparation for procedures gives information about a procedure through visual and sensory prompts. For example, showing photographs of the process involved in surgery (including the theatre gown the child will wear), theatre trolley, uniform of theatre staff, recovery room, alongside the sensory experience of touching and trying on an anaesthesia mask.

Parent training decreases parent distress through engagement in cognitive

strategies, which in turn benefits the child.

Behavioural interventions

Behavioural distraction shifts attention from the procedure using agreed or spontaneous activities (e.g. interactive books, specific toys and games).

Modelling includes demonstration of positive coping behaviours during a mock procedure by another child or adult (e.g. watching a DVD of a child having a plaster cast removed, or a child going into theatre).

Desensitization can be gradual systematic exposure to the feared stimuli. This may be graded exposure to each part of the procedure which leads to the rehearsal of the event, including the child's choice of cognitive/behavioural intervention.

Positive reinforcement can include providing positive statements and/or tangible rewards as the child achieves agreed goals for the procedure (e.g. star chart, stickers, toys, certificates).

In addition to solidifying the importance of play in relation to the clinical treatment of children, one can easily imagine the immense opportunities of combining CBT with design as a way of providing tools to help medical personnel achieve similar goals in less extreme settings outside the realm of clinical psychology. -like nebulizer treatment for children.

Wicked problems

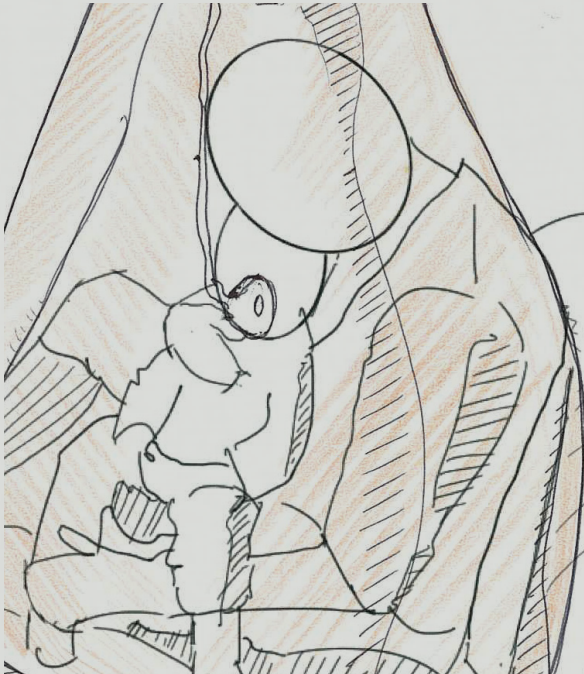
"a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize" C. West Churchman introduced the concept of wicked problems
"Guest Editorial" of Management Science (Vol. 14, No. 4, December 1967)

ANALYSIS

In this chapter an analysis and processing of the insights from the mapping chapter will be presented. Starting with a narrative that summarizes our impressions and followed by diagrams that aim to clarify the relation between the different users and contexts.

NARRATIVE

There are a lot of emotions involved in relation to nebulizer treatment. Through the observations and the interviews we were able to gain a greater sense of empathy with the user, and insight into how the treatment is experienced by the child. This short story is a way of processing and analysing some of these insights.



"A little boy sleeps on his mother's lap. Her arms are tenderly placed around him; she strokes his head and back and observes him with a loving glance. He lies calmly with one pacifier in his mouth and another pacifier in his hand. They sit in bed. Some stuffed animals and a soft little ball lie in bed with them. The father closely observes his wife and child from the end of the bed. It is quiet. The room is tiny; just enough floor space for a bed, a chair, a little table and a sink. On the wall there are a number of sockets, plenty of wires. Two screens are in the room, one is on the wall and the other one is mounted on a solid arm and hangs over the bed. A loud beeping sound disrupts the peaceful atmosphere once in a while. A nurse enters; she wears a long white coat and blue gloves. She nods gently to the parents and starts preparing medicine for the nebulizer. The boy has an infection and needs respiratory treatment several times each day. He has a fever and is very tired. The family has been living in an isolation room at the hospital for three days; they are not sure how long they will have to stay in this room.

The nurse makes a comment about the boy being asleep. She small talks about how small the room is and the mother replies by saying that they manage to reach everything from the bed. The nurse acknowledges this positive way of viewing it. She tells the parents that the boy will get saline because of the good effects this has given previously. Then the nurse connects the nebulizer to the oxygen outlet and the room is filled with a noisy wheeze-like sound. She gives the device to the mother who places the mask over the boy's mouth and nose. The boy moves a bit as he notices something close to his face, and then he starts coughing. The nurse asks

the mother to sit up more straight so that the device can be held in a more vertical position. The boy starts to rub his eyes. As he leans back against his mother's chest, the mother is not able to position the mask close enough to his face. The nurse shows the mother how she can sit more up straight. The boy wakes up. He whimpers and pushes the mask away. The mother tries to place the mask in his face. The mask is pushed back and forth; it becomes a struggle. The boy looks up at his mother with an expression that suggests questioning and frustration. The mother asks him if he wants to hold the device. He replies by pushing it away. The mask is being held at a distance from the boy's face now; the mist is blown in his face. Suddenly the beeping sound is back. It catches his attention. He is given a third pacifier for his second hand. The boy closes his eyes and the mother is allowed to place the mask on his face again. She praises him and strokes his foot. The nurse says to the father that it would be better if the boy did not use a pacifier during treatment but that it is even more important that the boy remains calm. The boy closes his eyes and sits with the mask on for more than a minute, still with the pacifier in his mouth and one pacifier in each hand. The father is talking to the nurse and now the mother also engages in the conversation. When the boy starts to cough again the pacifier falls out of his mouth, he turns his head and pushes the nebulizer away. Then he takes one of the pacifiers he was holding to his mouth. He gives signs of protest when the mother tries to place the mask onto his face. He is given the pacifier back so that he once again has a pacifier in each hand. He accepts the face mask for a little while. The mother is singing quietly to the boy while stroking his hands. He shows more and more clearly that his patience is growing thin.

The mother says that they are almost done. She cuddles with him and says that he is feeling warm. At this point his patience has gone. He demonstrates this by turning away with his whole body while whimpering and calling for his dad. He starts to cry and kicks with his legs. The nurse tries to assist by holding the mask to the boy's face. He heavily protests. The mother tries to explain that this is good for him. The nurse grabs his ball from the bed in order to attempt to distract him. The boy gets furious. The nurse says that maybe it was a mistake to take his ball. The mother and the nurse are now both pushing the mask on the boy's face. The boy pushes the mask, kicking and crying. At this point he is really upset. Again the boy calls for his dad and the father decides to place him on his lap. Both the mother and the father are now holding the mask to his face. The boy still keeps pushing the nebulizer away. The mother then holds the mask with a little distance from his face. The damp stops, the treatment is completed. The mother says to the boy that they are all done and asks if he wants to look at the device. The boy turns away and leans close to his father."



FOR CHILDREN?

Children's roles as the "real" patients will often be neglected by doctors (and

Barn og ungdoms rolle som de "faktiske" pasientene/legemiddelbrukerne blir ofte neglisjert av leger (Tates K., Meeuwesen L. 2001)

Looking at the treatment of respiratory diseases at the hospital it is evident that very little is designed with the children in mind.

The nebulizer is primarily designed in order to be easy to assemble, provide the optimal rate of airflow, and be low cost. Toys provided by the hospital are ordinary toys and the

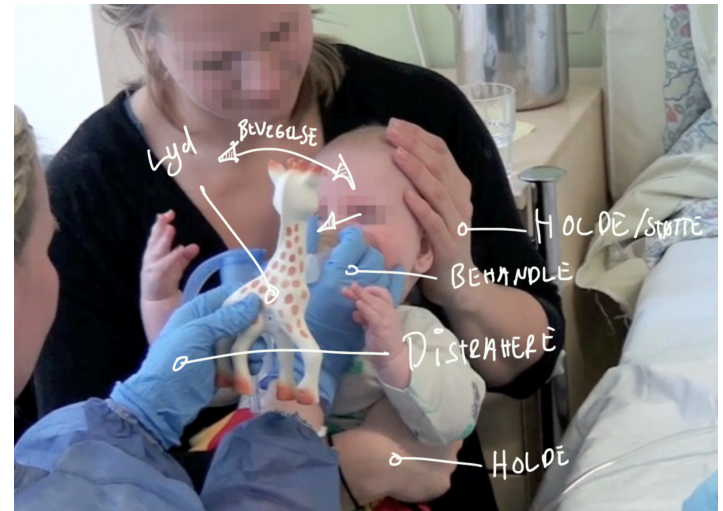
there is very little of it that is designed with the toddlers in mind. The nebulizer is optimized for being low cost, easy to clean and achieving the optimal flow of drugs through the mask, and all toys present are generic toys for toddlers.

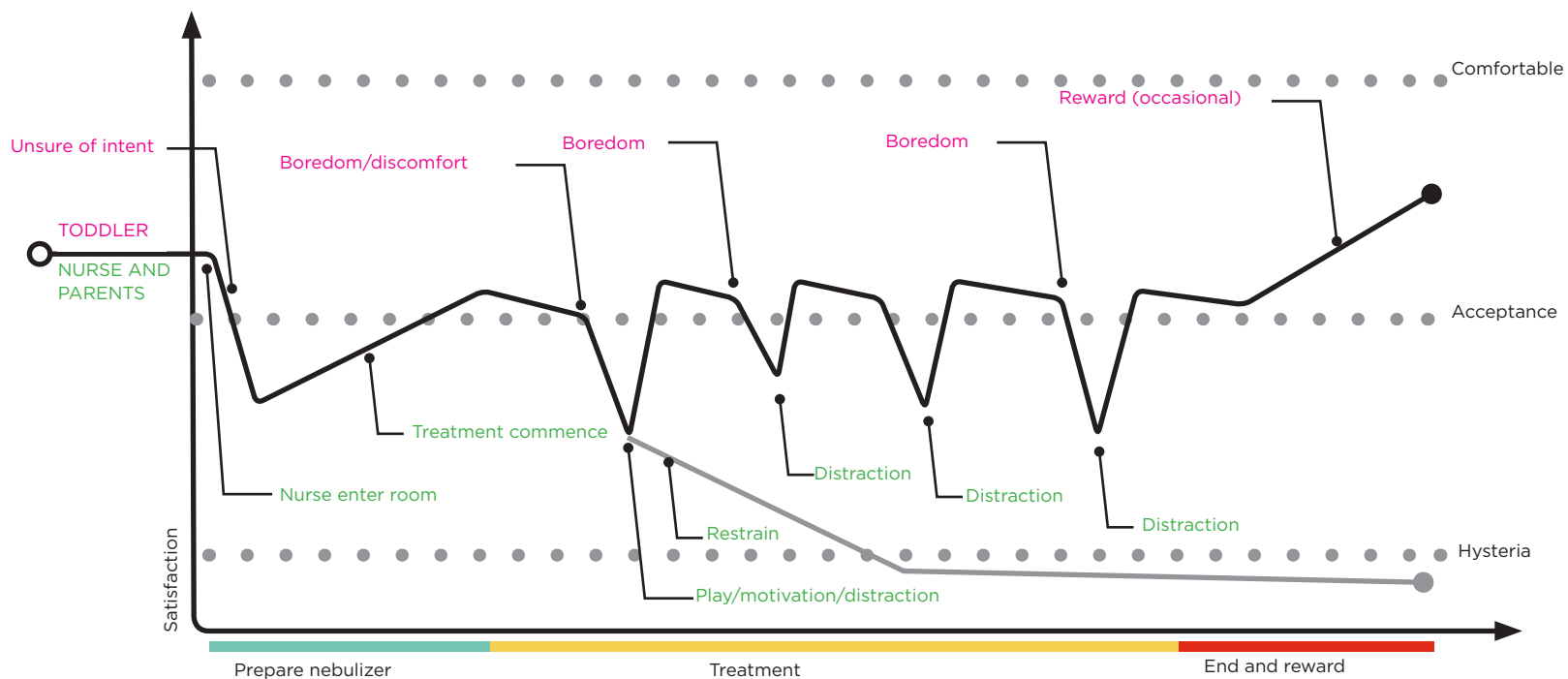


TREATMENT JOURNEY

During the observations we frequently saw that the mood of several patients would change repeatedly during the course of one treatment. Both from interviews and observations it is clear that the toddlers get anxious when the nurse enters the room. For several children the anticipation related to not knowing what is about to happen seemed worse than the actual treatment.

With some comfort and attention the toddler would relax. Surprisingly the children would not necessarily even respond negatively to the nebulizer the moment the mask is put over the mouth and nose, but rather a few minutes afterwards. During the course of the treatment the nurse, and some times the parents would use a toy in order to take the toddlers attention away from the treatment. When the toddler became anxious the toy was used extra vigorously. However, as soon the toy achieved its purpose the nurse would go back to focusing at the treatment, resulting in the toddler becoming anxious again. This went back and forth through out the treatment entire treatment. This was a clear indicator that for several of the cases the problem was not necessarily the mask and the nebulizer alone, but had also to do with having to sit still for five to ten minutes without the proper stimuli. The toddler was simply bored.





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Figure : This figure shows the toddlers reactions and the actions of the nurse and parents, and how these results in different experiences for the toddler ranging from hysteria, acceptance or a comfortable experience.

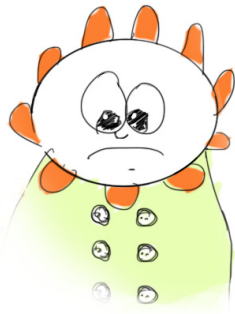
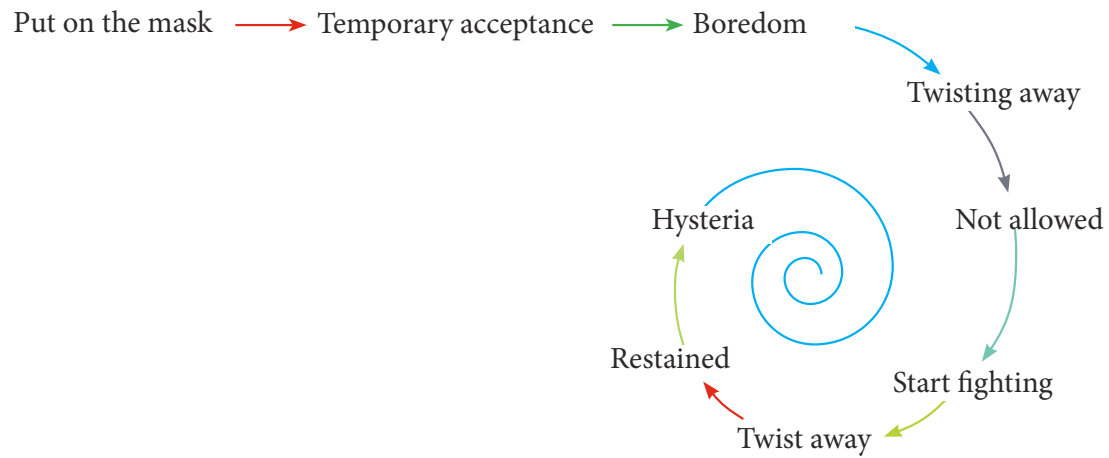


Figure X : Every step in the spiral above provoce a stronger and stronger reaction, causing childen initially showing signs of relative acceptance be classified as difficult.

ROLES

The professionals emphasized interpersonal relationships as the foundations for a good treatment, often focusing on how the nurse approach the child and how the parents motivate during the treatment.

PARENTS ROLE

From the observations and interviews both the nurses and the other medical professional said that integrating the parents in the treatment was essential for providing motivation and sense of security to the toddler. It was clear that the parents are the main source of comfort and security for the children, making them an essential part of a successful treatment. At the same time, parents would find them self helpless as to how they could help in the situation, and some would even leave the room.

Some parents would engage themselves and participate a lot during treatment, but how much information about the treatment, or how they can help the child during the treatment depended on how much guidance and advice the parents received from the nurses.

THE NURSES ROLE

The nurses are often on a tight time schedule and will not necessarily have the time or the energy to provide information to parent and child. How the nurses would motivate the children or use the parents is also very much left to the skill and knowledge of each individual nurse.

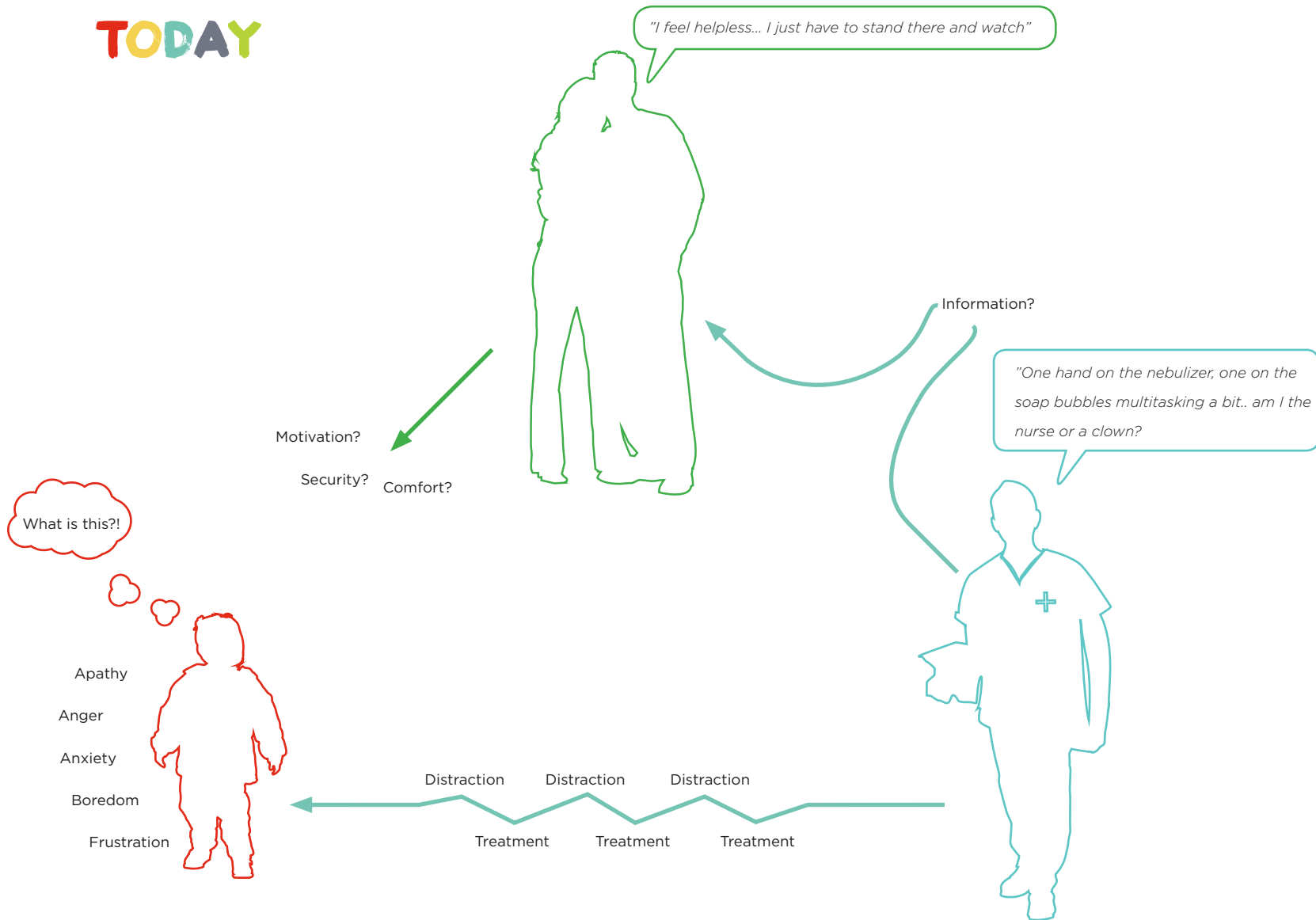
The nurses will generally both administer the medication and distract the toddler at the same time, or as one nurse put it "both nurse and clown". As most toddlers get anxious the minute the nurse enters the room, this mix of fundamentally different roles is problematic.

THE CHILDS ROLE

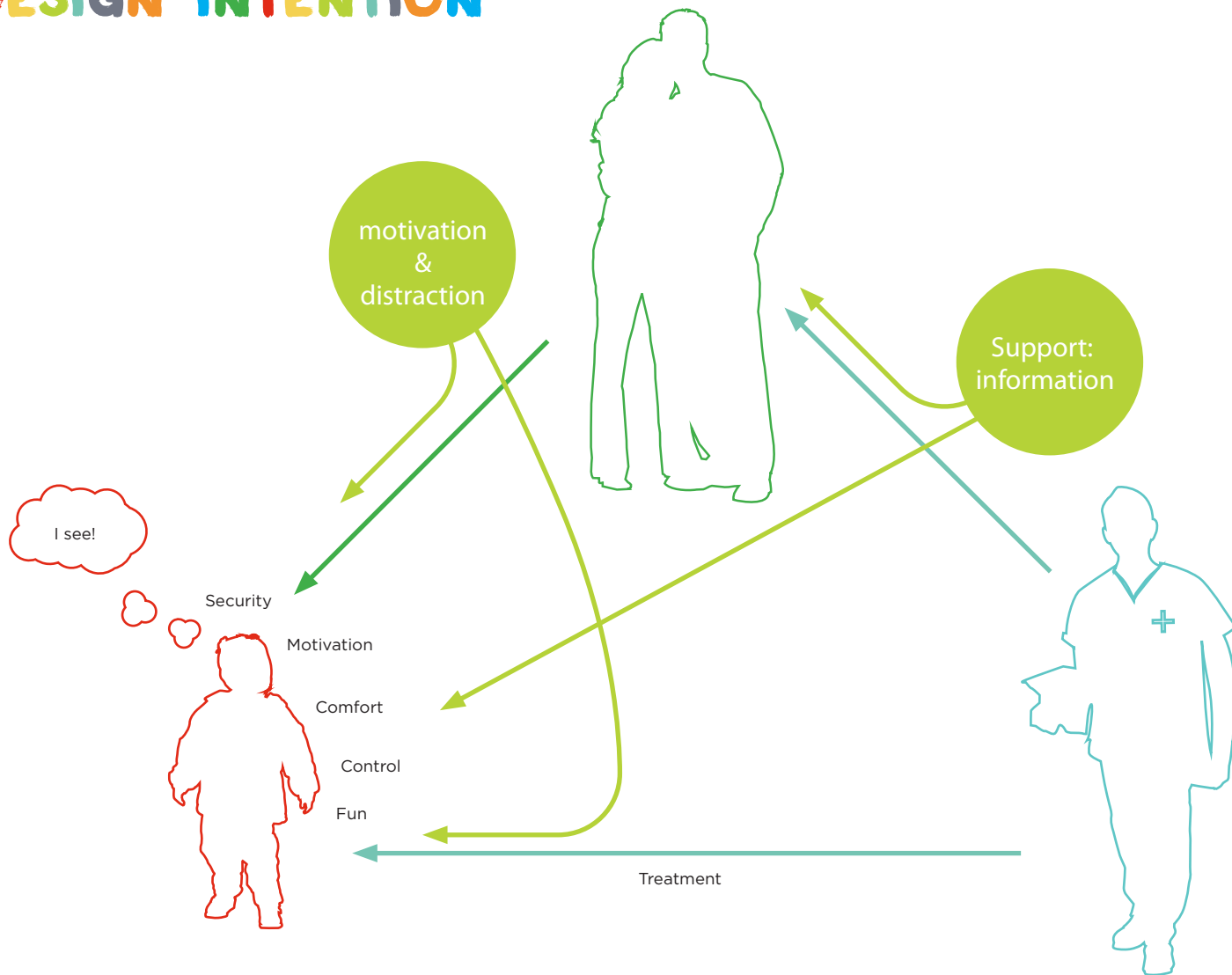
The child needs appropriate information in relation to the treatment. From the main insights it was apparent that whilst both nurse and parent often judged the child to be too small to understand anything of the context, clinical psychology and its professionals clearly emphasize that the pre-verbal children need to be taken into consideration by providing a source of information a child can understand -preferably through relevant play.

TODAY

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DESIGN INTENTION



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- Parents need support in order to motivate, and the nurse needs a more clearly defined role as the administrator

CONTROL & MASTERY

From the workshop the professionals emphasized the childrens need to experience a sense of achievement, control and mastery in relation to the treatment as a way to feel motivated.

In many ways talking about control might seem in stark contrast to the nature of the treatment. Being treated is not an option and the timing and the length (dosage) are given by the doctors prescription.

On the other hand providing a sense of control does not necessarily have to be directly connected to treatment specifics. Creating the sense of control for a toddler can be achieved by providing something as simple as a choice. From the observations we saw that the children that responded best to the treatment were also the ones given simple choices.

By giving the toddlers few simple arbitrary choices the nurses provide the child with and opportunity to approach a situation on his own accord, making the treatment situation less threatening. Looking at how the treatment is conducted today it is evident that the majority of the children are rarely given any say in anything during the treatment.

"A sense of security can be formed by providing routines or rituals, control by giving choices"

BUPP Project group





TIME FLIES WHEN YOU'RE HAVING FUN

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The ability to organize life within the framework of time is not innate in humans, but requires to be learned and developed from infancy (Lewin 1938, Piaget 1946). The western world has a linear perception of time, organized by the spacial visualization like for example that of a calendar and the movement of a dial on a watch (Michon 1972). Whilst in other cultures time does not move from past till future, but is rather experienced as an "eternal present" or visualized circular with the cycles of nature (Bergadaà 1990).

Small children are believed to have circular perception of time where only the qualitative cues are relevant to how time is experienced (Friedman et. al 1992). In other words; "time flies when the toddler is having fun".

In relation to the treatment of children with respiratory diseases time perception is a key factor for designing a better experience and can be transferred to the treatment by looking at three main factors: Information/control, motivation and experienced time.

INFORMATION/CONTROL

The concept of the term "7 minutes" will be completely abstract for a toddler. As a result the patients will have no idea about how long the treatment session will last, once it starts, as no aids for visualizing time in a manner which the toddler can understand is provided. Given the

uncomfortable nature of the treatment, not knowing when it will be over will surely make the situation more stressful.

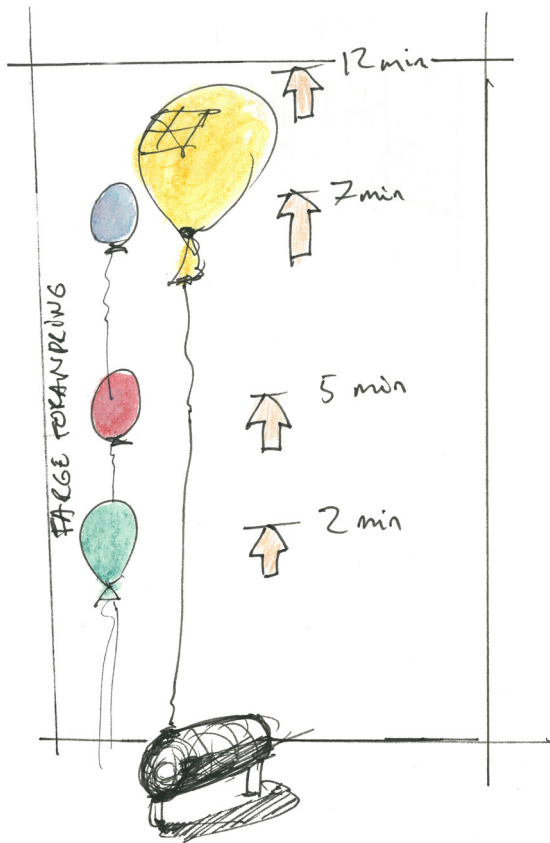
MOTIVATION

In close relation to the information/control aspects, time is also a source of motivation. And the nurses would often count down from 10 when the session would be coming to an end as well as promise a prize at the end of the session. Even if this was an efficient way to motivate the toddler, it could only be used in the latter stage of the medication.

From the observations we also noticed that both parents and nurses often would use the term "soon finished" which have no motivational effect on the child as the concept of "soon" is both relative and abstract. Also the in reality "soon" could be as much as 5 minutes away. Being able to communicate time through a visual representation will also provide a great motivational aid for parents and nurse to talk about with the child.

EXPERIENCED TIME

Lastly, providing a more entertaining environment or qualitative cues for the child will have an intrinsic effect of making the time it takes to go through one treatment session seem shorter.

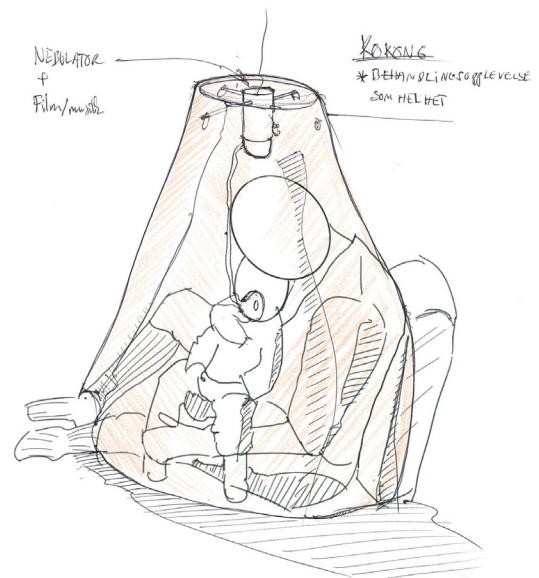
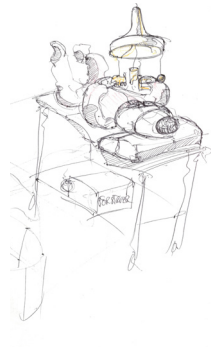
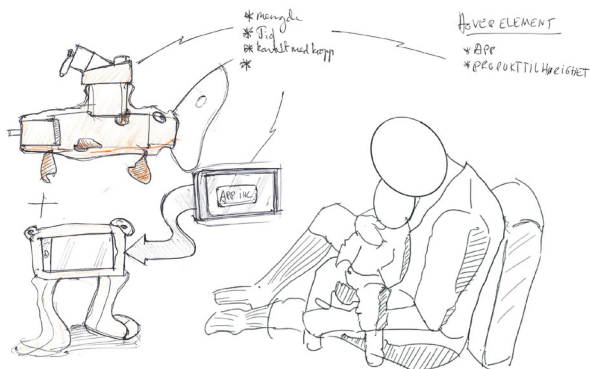
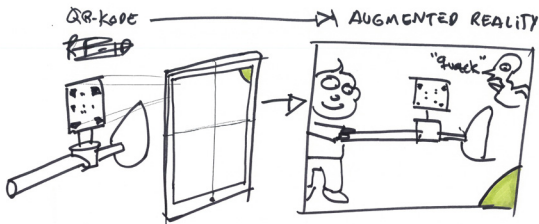
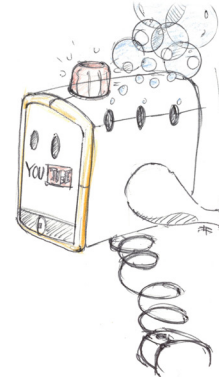
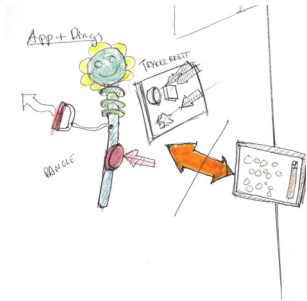


PHYSICAL TIME

Both saying the session will "soon be over" and counting down from 10 lack the physical dimension of time. When researcher Daniel Casasanto and colleagues at the Aristotle University of Thessaloniki and Stanford University (Casasanto, Fotakopoulou, Boroditsky 2009) showed children (4-6) movies of two snails racing along parallel paths for different distances or durations and asked them to judge either the spatial or temporal aspect of each race, they found that children use physical distance to measure time passing. Whilst having no problem ignoring time when judging distance, the snails that moved a longer distance were judged to have traveled longest time. Even as these children in this study were between the age of 4 and 6, children below the age of 4 are likely to have the same understanding of time, thus providing a physical representation of time of the given session became a core requirement for the final design.

IDEATION

EARLY SKETCHES



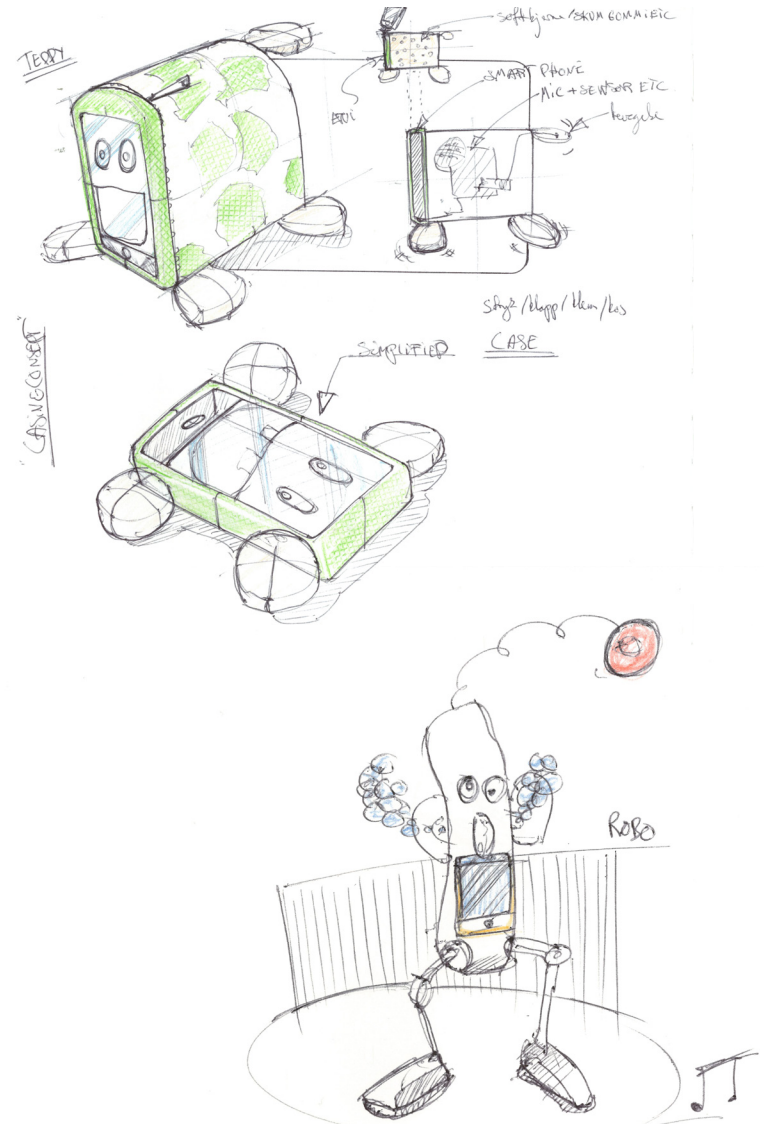
SQUARE ONE

From day one I started an intensive ideation. Initially the main focus was to familiarise my self with the user and the context. As I had no prior experience with designing for children I had to begin with investigating ways to captivate and motivate a toddler. Asking myself questions like: How does a toddler communicate and relate to objects? And how much can a toddler comprehend of the world?

As a result many of the early concepts were about how to distract or entertain the toddlers and derived directly from what we had seen used at the hospital and my experiences from spending time and playing with toddlers. However, as I got deeper into the context it became clear that the children needed something more than just basic entertainment. As the analysis progressed the nuances in the situation became clearer. The essential role of the parent, how to motivate the toddler in addition to only distraction, ways to visualize time and the need for relevant play began to emerge.

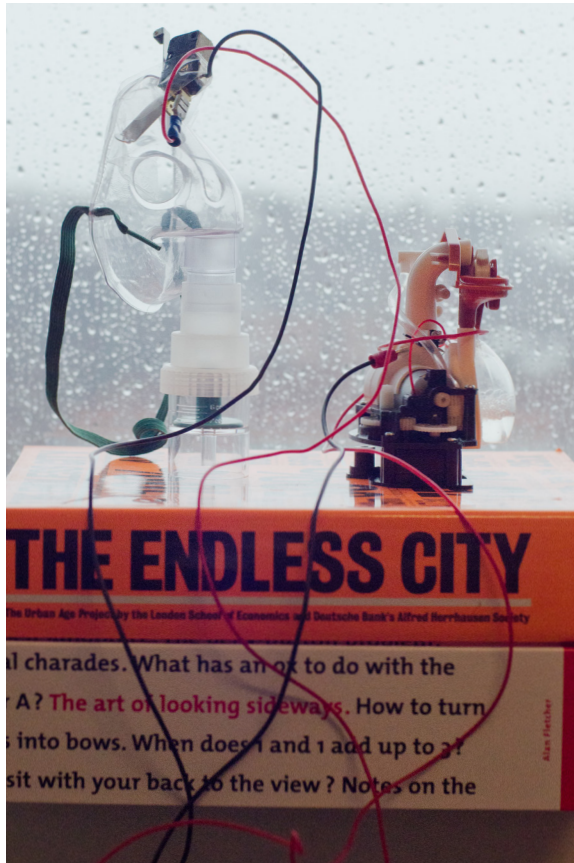
As I was fascinated by tangible interactive objects, many of early concepts was a combination between interface design and physical objects. With and idea of creating the "ultimate distractive experience", combining the best of both tangible and interface interaction. For example a bubble robot prototype was tested at the workshop with the children.

From the ideation two main concepts were created: the "toy" and the "game".



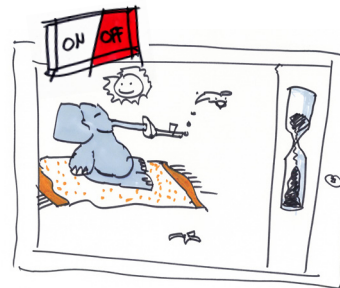
FEEDBACK & MOTIVATION

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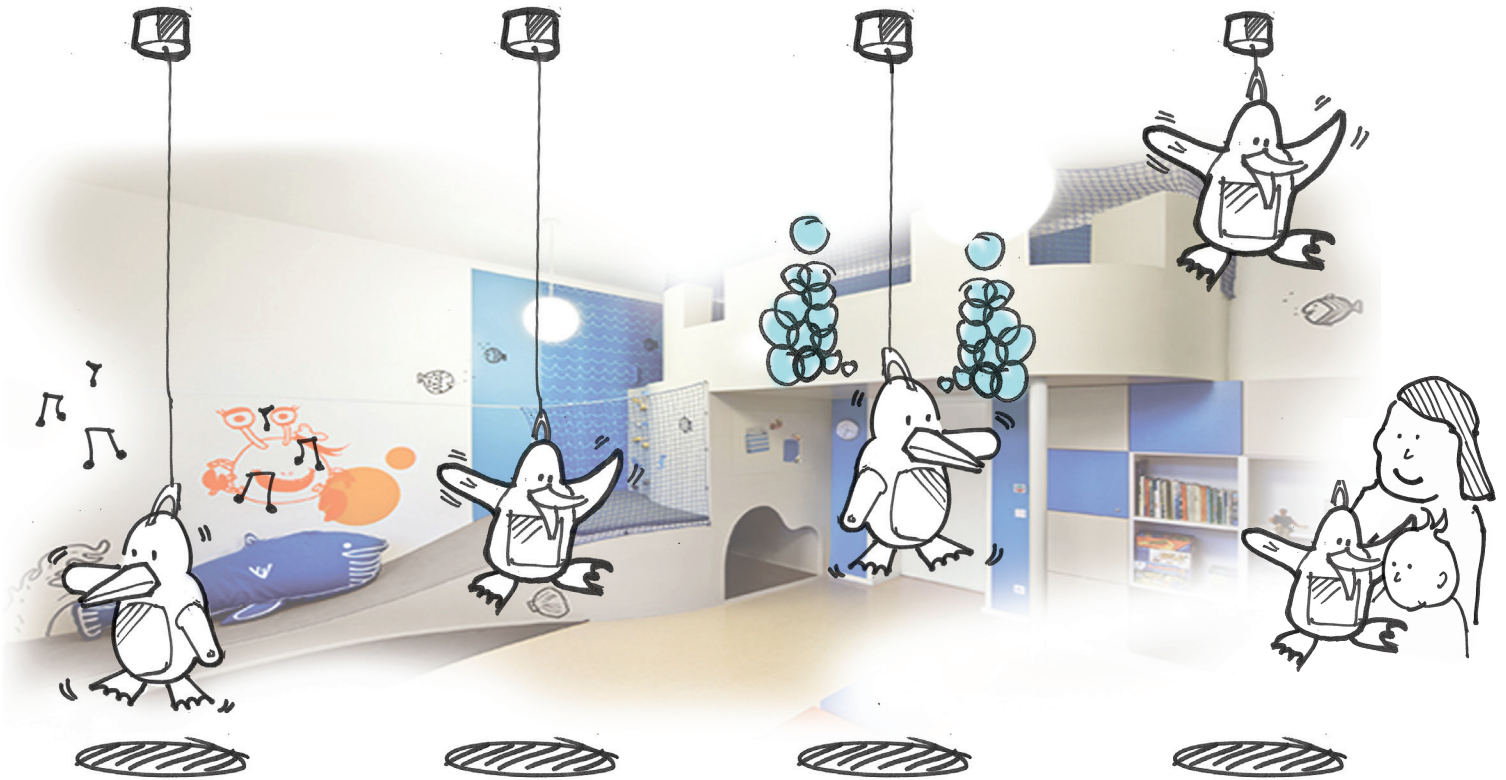
From the ideation both concepts had a direct connection with the mask. Based on an idea that children would be more motivated to undergo the treatment if a direct incentive for using the mask was given. -In other words the child uses the mask he/she would get a reaction from the game or toy. This idea originated from the very first workshop with children, where a soap bubble robot would turn on when the children had their masks on and off when they removed it

Any real test of this concept of direct feedback was yet to be tested, and as the insights from the department of clinical psychology indicated that a “Medical device/treatment and the motivational object should be separate but have a correlation” the need to test the validity of this concept was apparent.



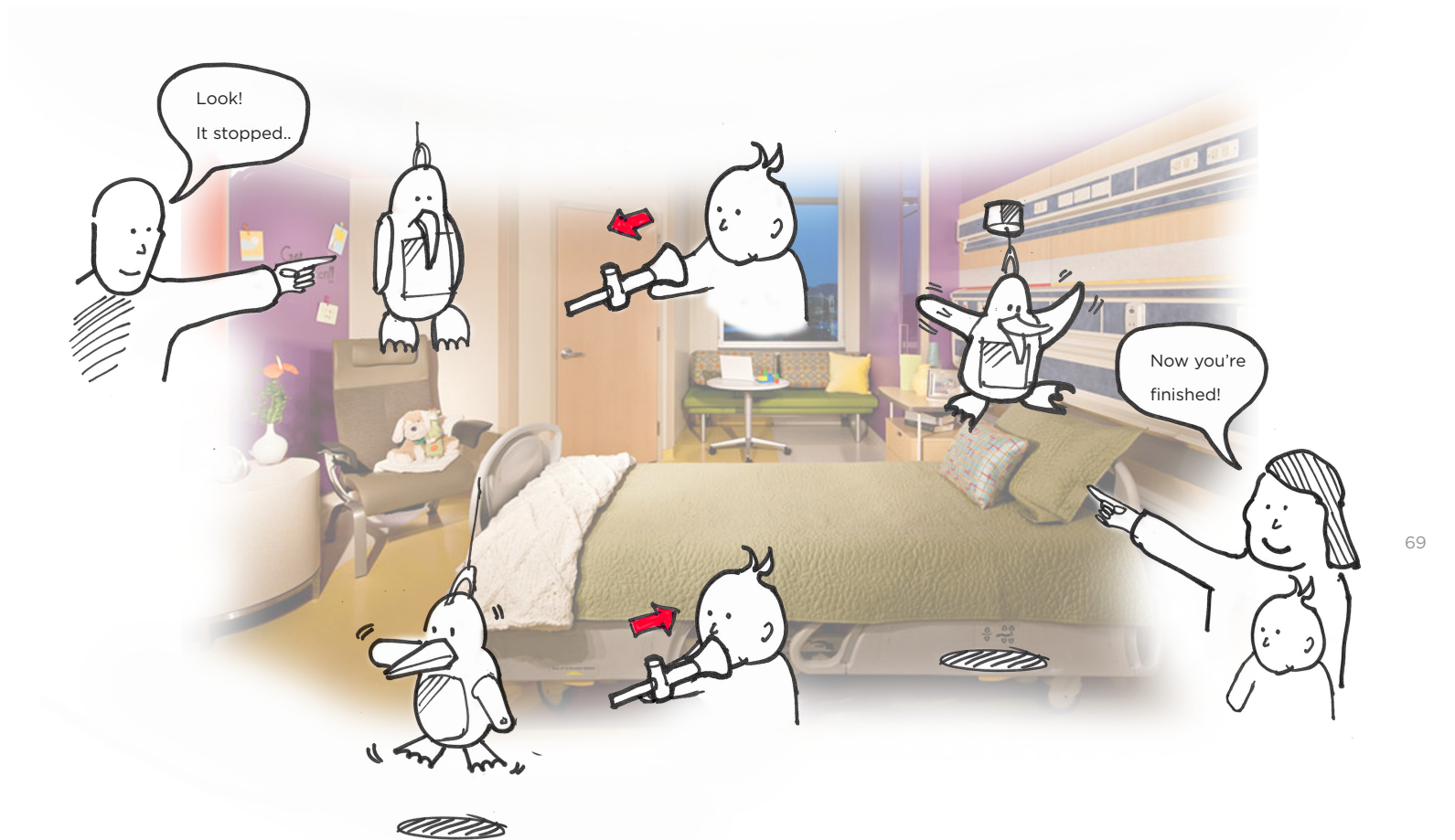


CONCEPT 1 - TOY



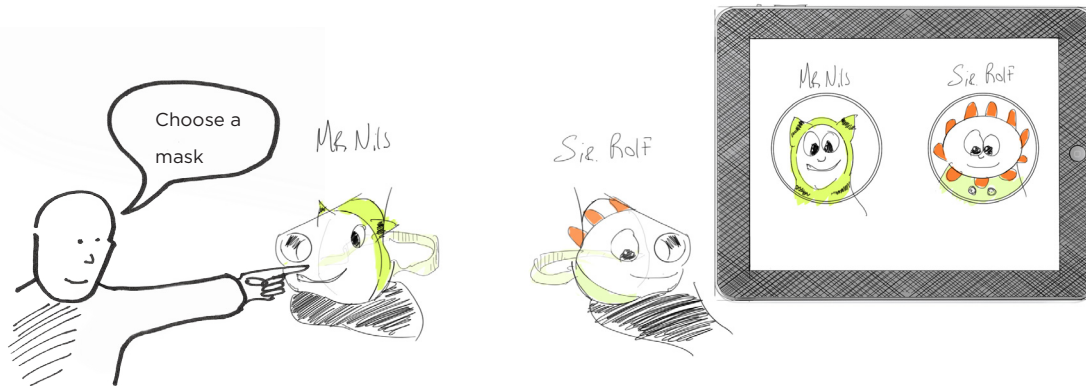
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- In this concept a toy moves up a string for the duration of the treatment, singing, dancing and making bubbles as it moves along.



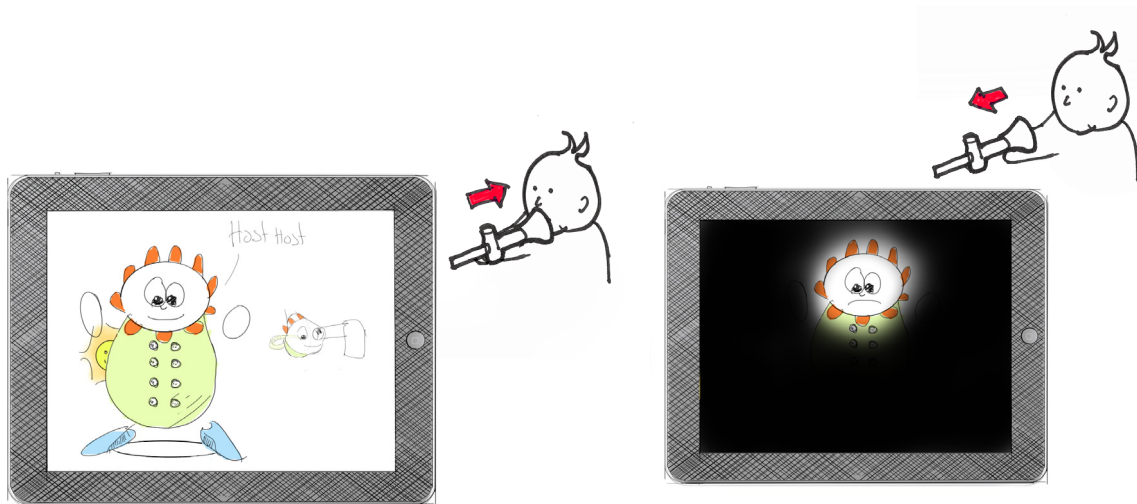
- A sensor on the mask stops the toy as when it is removed, giving an immediate feedback to the toddler.

CONCEPT 2 - GAME

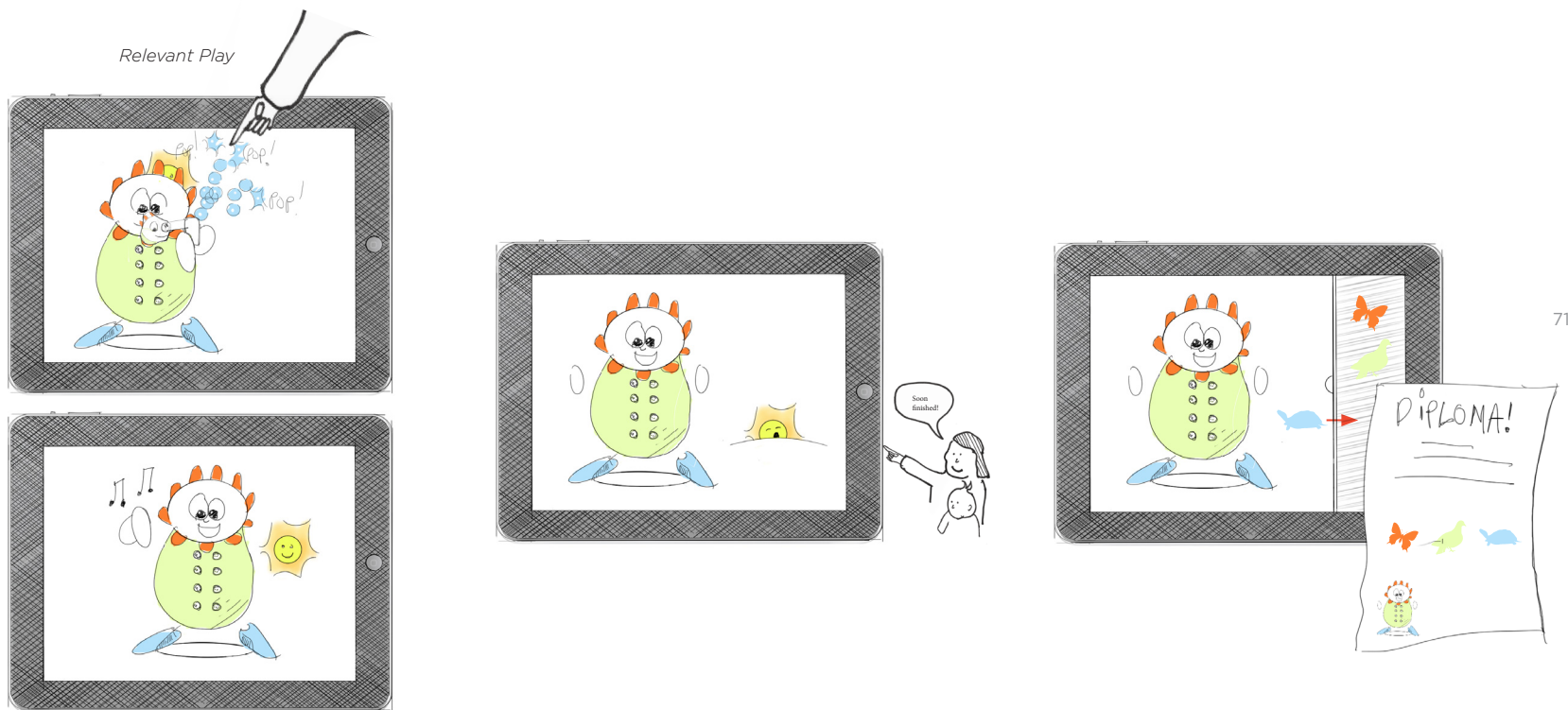


- In this concept the toddler would be able to choose a mask, which corresponded to a character in a game

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- If the toddler remove the mask the game would stop



- An interactive game is played through the session. A sun going from sunrise until sun set indicate the duration of the treatment, and as it ends the toddler gets a reward, which is printed on a diploma when the stay at the hospital is over.

FINDING A DIRECTION

Based on the two concepts I decided to develop concept two, and create a game in relation to nebulizer treatment, because a game could fulfil more of the insight gained from the analysis, interviews and observations. For example the discoveries mentioned below:

- a sense of control to the toddler could be provided by giving them a choice of mask and main character
- a connection between treatment and the game could be achieved by the mask feedback
- relevant play could be provided by having the character do the treatment with the toddler, which also would mean having someone do the treatment together with you.
- a relevant reward system which would follow the toddler through the entire stay at the hospital
- The way of visualization time from concept 1 could easily be implemented into concept 2, and developed further

Also implementing an interface into the setting would provide more flexibility considering size and interactivity. Lastly the cost of a game would be less than manufacturing a robotic toy, and more easily implemented in the hospital setting.

DEVELOPMENT

In this chapter a brief overview of the development stages of the concept development will be presented. Starting with a short summary of new theory directly related to games. Continuing with the different elements and stages of the game development.

INTRODUCTION

Choosing an interface based concept prompted a series of new questions leading up to another research phase -focusing on games and screen based entertainment.

At the same time, the second workshop was conducted in order to test elements of two concepts. Insights from these tests were directly applicable to the final concept.

The development of the final concept was done as an iterative process, done in parallel with user testing. Obviously the development phase was not a linear one, and the different parts are presented separately in this report for clarity, but in the project the different qualities of the game were developed simultaneously. Therefore, parts of the final concept will be presented along with the development and tests leading up to the final solution.

HOW?

TABLET

A multitouch tablet device, mainly apple iPads, were chosen as the preferred medium for the game early in the development. The main reason being that through the introduction of multitouch devices a more intuitive and natural approach to navigating through an interface could be developed. Tablet devices opens a new world to a wide range of new users - amongst them toddlers. Children as young as 9 months old have been shown to be highly capable of using multitouch interfaces, and by the age of 2 some of these children manoeuvre the iPad without difficulty. Looking at the commercial aspects of iPad games verifies this.

“Over 80% of the top selling paid apps in the Education category of the iTunes store target children.” - Shuler, 2012. iLearn’II An Analysis of the Education Category of Apple’s App Store

In the hospital setting a tablet device is also very applicable in relation to its mobility and size. The treatment can happen in various positions depending on where in the room the toddler might be the time when the treatment arrives.

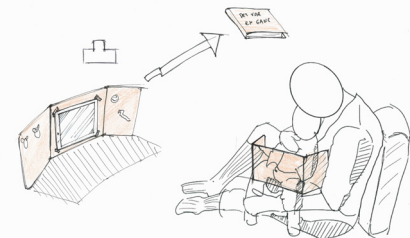
With a tablet you are also able to create a close enough proximity with the device and the toddler, thus enabling the toddler to interact with the screen during the treatment.

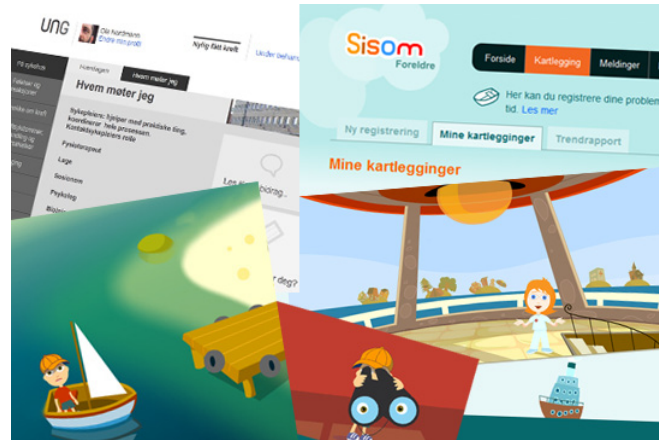
WHAT KIND OF GAME?

The goal of making a game aiming to help and support during nebulizer treatment, differs greatly from other “traditional” games. Whereas a normal game seeks to provide the ultimate entertainment experience for its user and captivate the audience as much as possible, the goal of a game made in order to help and support nurse, child and parents, is beyond entertainment. Thus falling well within the category of serious games

“Serious games are concerned with the use of games and gaming technology for purposes other than mere entertainment or “fun”. Such purposes include education, training, health, etc.” - Susi et al., 2007 (Susi, T., Johannesson, M., Backlund, P., 2007. Serious games-An overview. Skövde: University of Skövde (Technical Report HS- IKI- TR- 07- 001).)

As derived from the insights the goal of making the game will be about balancing the entertainment/fun value with the need for more and better information. Moreover, the game aims at ways to improve patient-nurse - parent interaction, and should be considered more as a tool that can emphasize the communication and social bonds between these users.





Sisom, an interactive game that helps children communicate their needs in relation to serious illnesses



Nighty night - bed tim app to help toddlers turn off the lights at night

CHILDRENS ENTERTAINMENT

When designing a game for toddlers another important aspect to consider is how does one provide screen based fun and entertainment for this user group? Looking at literature it is clear that the value of entertainment is rarely taken into consideration when discussing toddlers and visual information (television and games). There are hundreds of articles discussing the development and learning in relation to the subject, especially from an inherently negative starting point. A lot of these discussion is a result of the premier of the worlds first T.V entertainment designed especially with toddlers in mind -Teletubbies.

The Teletubbies and the Night Garden are two children's television created by producer Anne Wood and cognitive psychologists Andrew Davenport for the BBC children's television. The programs were amongst the first specifically design with children between the age of 1 and 4. Being amongst the worlds biggest commercial successes within childrens

entertainment, is a testimony to their approach, making it a relevant case for this assignment.

"Playing is an important thing to look at in child development. Child play tells us a lot about their cognitive and social development.

- Andrew Davenport (cutoday.net)

Teletubbies was Wood and Davenport first program together and produced between 1997 and 2002. The program has been broadcasted in over 120 countries, translated into over 40 languages and has an estimated revenue of half a billion Norwegian kroner on advertising and rights alone (in addition to products, games, music etc.).

Teletubbies are characterized by the 4 colourful main characters, Tinky Winky, Dipsy, La-La, Pooh and Noo Noo the vacuum cleaner, in their sunny dream world.

REFLECTING THE CHILD

The basis for the Teletubbies success is that Davenport consciously developed the story line, pacing and characters in the series in order to fit the childrens cognitive levels and physiology. In addition Davenport and Wood used a method very similar to user centred design by validating their concept through qualitative observations and user testing.

In order to better reflect its audience the Teletubbies proportions, movements and response patterns are built on that of small children.





The environment is set in the visually engaging fantasy world "Teletubby land", that combines fantasy elements with elements which a child will be able to familiarize with. A prime example can be found in how the sun in teletubbyland have a child face that always smiles and laughs.

The main characters communicate with a sort of gurgling baby language which reflects the developmental stage in this age group having the ability to understand language, but the difficulty of vocalizing it.

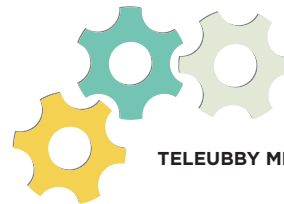
At the same time a calm male narrator drives the story forward

SEGMENTS AND PACING

Each episode is divided into eight independent segments so the audience does not require constant concentration on what is happening on screen, but can follow the fragments (Howard et. Al 2002)

Within each of the eight segment is the story based on a number of repetitive actions where the progression in the story only approximately in 1 minute intervals corresponding to the target group's ability to maintain focused attention (Ruff and Lawson 1990).

will repeat a short nursery rhyme continuously for one minute, then the story progresses by introducing a second character and the two repeat the nursery rhyme for one minute until the next character arrives, and so on.



TELEUBBY MECHANICS:

- Familiarity mixed with fantasy
- children enjoy repetitions within 1 minute intervals
- Main character are based on the developmental stage of toddlers.

REQUIREMENTS

With the last insights combined with the insights from Mapping and Analysis, a complete list of requirements were made:

THE GAME IN RELATION TO THE TODDLER:

-The game needs be fun, colourful and entertaining and may follow the “teletubby mechanics” of repetition, pace and characters according to the toddlers developmental stage

-at the same time it should Include elements relevant to the treatment situations, as a way to make these less threatening to the toddler,

- be able to see other characters/people use the nebulizer is an important factor in order to prepare, motivate and increase compliance in relation to the treatment. Mirroring the childs actions is essential for the game.

- Have a continuous reward system that motivates the toddler through the treatment and follows the toddler throughout the entire duration of his/her stay at the hospital

- Provide a sense of control by giving the toddler basic choices in relation to the treatment

- Time and progression should be visualized in a way that a toddler can better understand.

- Also provide relevant information through play in order to familiarize one self with the treatment

-In order not to loose its potential as a source of distraction and motivation the treatment part of the game should not be accessible in other settings

-using interactive principles so that the toddler can use and understand the game

THE GAME IN RELATION TO PARENT AND CHILD:

- Parents are the primary source of comfort and security. The game should enable parent and child to do and experience something together, and support interaction between the two.

- the parents also need information in order to know how they can better assist their child during treatment, the game should be a source for this kind of information

THE GAME IN RELATION TO THE NURSE

- Enable the nurse to focus more on administering the treatment by providing a better and continuous source of distraction for the toddler

- enable the child to easier know the nurses intention of conducting a treatment as she enters the room

THE GAME IN RELATION TO NURSE AND PARENT

- the parent and nurse should be able to motivate the child at shorter intervals, and let the game do part of the distracting and entertaining

- The game should leave room for and support social interaction between the three users; nurse, child and parent

EXPERT USERS

As mentioned earlier, the initial scope of the assignment was quickly narrowed down from looking at treatment of respiratory diseases both home and at the hospital, to only focusing on the hospital setting. However we were restricted to only observing hospitalized children as it is not possible to involve these users actively. Therefore, in order to be able to test and actively involve users, we invited children using inhalers and nebulizers regularly at home to the user lab.

possible for us to actively include relevant users and at the same time avoid ethical restrictions.



These two situations are comparable as there are many similar problems in relation to the treatment at home and at the hospital. At home the treatment is either done by using a portable nebulizer or an inhaler (an inhaler is a portable aerosol powered device that contains smaller and fewer dosages of the same medicine as the nebulizer). Toddlers at home often use a mask very similar to the ones used with the nebulizer at the hospital. The use of both nebulizer and inhaler requires assistance from an adult, usually being a parent or a teacher at kindergarten.

Treatment of respiratory diseases at home is less critical and hectic than in the hospital setting, and part of a daily routine lasting from a couple of months or even throughout life. Also, the users of respiratory treatment at home often have previously experienced nebulizer treatment at the hospital. Children being treated for respiratory diseases at home are more accessible for testing and seeing that they have experience with the treatment situation they were our expert users in a workshop. This made it

WORKSHOP 2

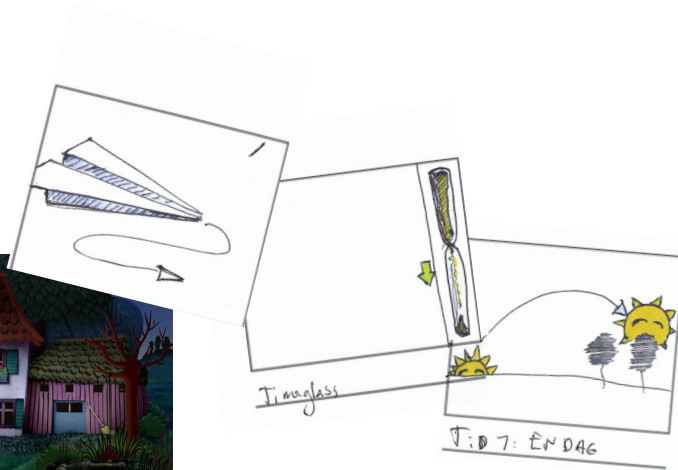
In advance of the second workshop two tablet based prototypes were developed in order to further investigate both the relationship between the mask and screen, different models to visualize time and reward systems. These two concepts were tested on a group of expert users, along with their parents and the brother of one of the children.

Prototype 1 is a tablet based game without a given narrative, where several interactive objects and characters appear and disappear on the screen in seemingly random order. The game provides no control over the user, and invites the user to interact with the elements on the screen by touching it. Instead of having a on/off mask function, the main character asks the player to "put the mask on and press the screen" at the beginning of the game. Time is represented by a progress bar and the final reward is given by text.

Prototype 2 is a narrative game where you together with the main character travel by train through a fantasy world, with objects and characters appearing as you move along. The player can not directly interact with the screen, instead the train moves forward when the mask is put on, and stops when it is removed. Time is represented as a train moving along a winding dotted line at the right, with an X marking the goal. At the end of the session the player is rewarded with a star.

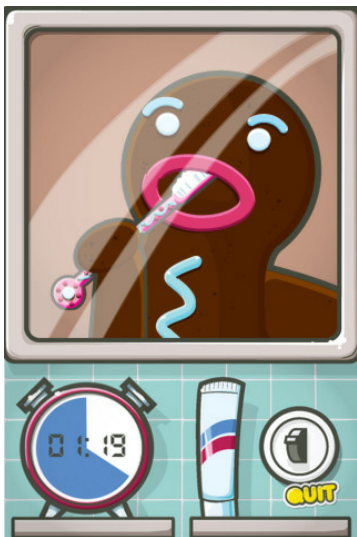


TIME MODELS



Progression told through the narrative

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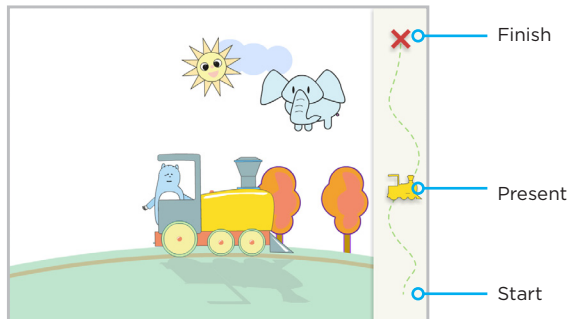
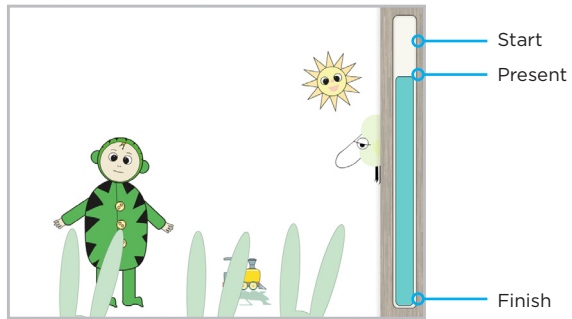


Progression told through graphical and numerical watch

Time models help the children understand their progression through the game, and is essential in order to motivate the children during the nebulizer treatment. A wide array of ideas were produced, and the visualization of time in other games was investigated.

As most games don't want you to stop playing the few relevant examples found are in the serious games category. Nighty night is an app designed to help children turn off the light when they go to bed by letting you turn off the lights to several of the characters in the game. As you will not be able to turn a light on again once it is turned off, time or in this case progression is displayed by the light left in the windows of game..

Star teeth is an app to help children brush their teeth for as long as it is recommended, and visualizes time by filling a clock with color.



From the first workshop a concept of time representation was made by Ole Andreas Alsos, one of the members in the BLOPP project group. In his test the children were asked to use inhalers for the duration of the time it took for a butterfly on a screen to move through a maze towards a flower. This test provided an early idea about how time could be represented for the children. However, the butterfly was quite slow and as the only source of interest on the screen, the children would quickly lost interest.

At the second user testing two time models of 5 minutes each were tested on the expert child users. Prototype 1 had a simple progress bar, while in prototype 2 the time was represented by a train moving along a path towards a goal, thus relating to the theme of the game.

From theses tests it became apparent that visualizing time in relation to the story line proved most effective based on how the toddlers read them. In addition, when the time was visualized in this way it was much easier for parents to talk and motivate the child during the session, especially as one could count the time by using the bends along the line.

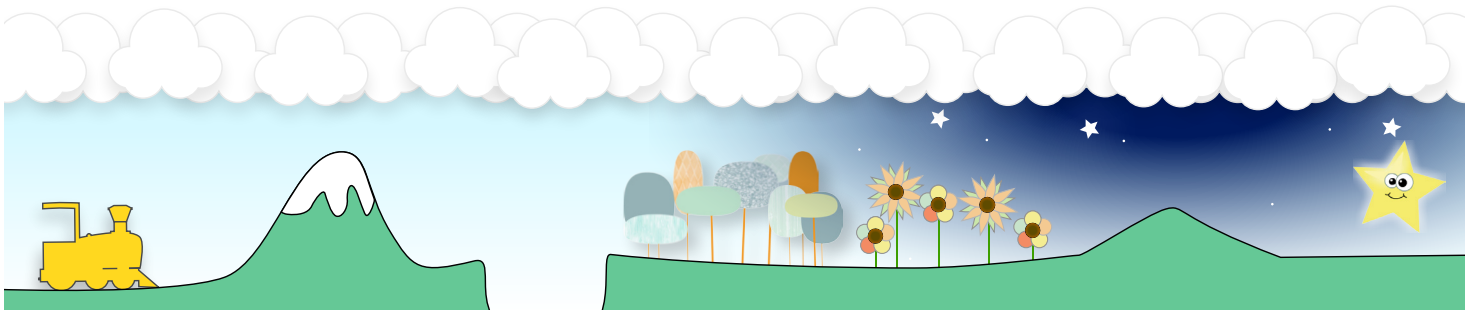
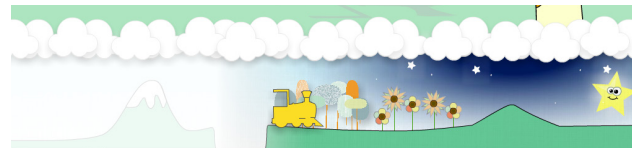
TIMER

In the final concept the timer is designed with three principles

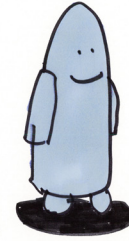
Firstly, it is a narrative timer, that follows the story line. A train moving from start to finish. The connection between the main story and the time line makes it easier for children to follow and understand the correlation between the two, and that the star is the goal of the journey.

Secondly, the progress bar is implemented by a white opaque shade that follow the train as it moves along the path. This works as a subtle way of focusing the child's attention forward, and gives a clear indication of how much is left of the treatment.

Thirdly, the timer enables the nurse and parent to motivate the child through the treatment by being able to use the different landscapes as cues or goals along the way - "look you almost made it to the top of the mountain!"

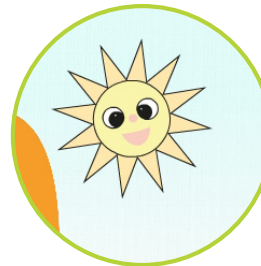
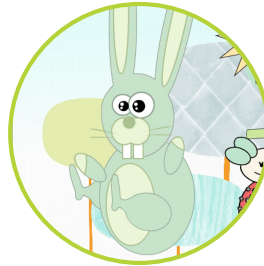


CHARACTER CREATION

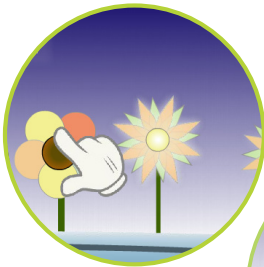


Characters for the final game was created in order to both captivate and interest the toddlers. The main characters were made in order to look similar or familiar to children.

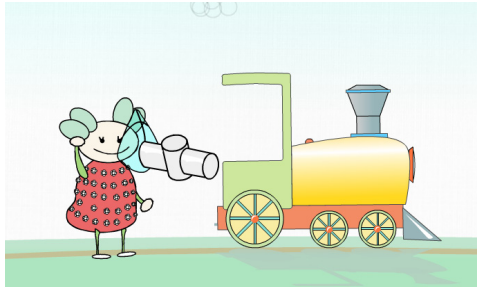
INTERACTIVE ELEMENTS



These characters form the basis of the interactive element in the final concept. Through the variety of interactive elements appearing throughout the game the toddlers keep their focus on the screen. Some will be indicated by a hand inviting the child to touch the object, whilst others are left unnoticed as "easter eggs" so that the toddler can notice something new each time.



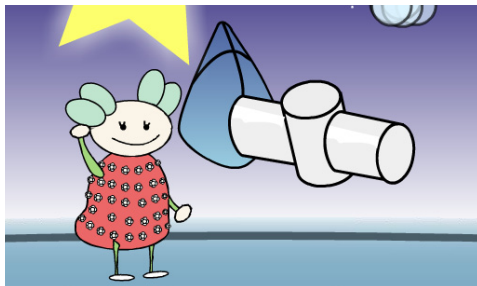
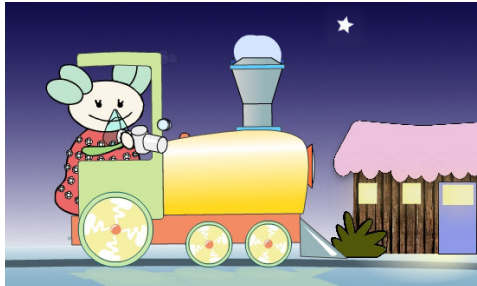
MIRRORING



In order to motivate the toddler along the way, several of the characters will appear in order to either have the treatment too, or cheering the child on.

Mirroring the toddlers actions is an important motivational factor that is frequently used throughout the game. Doing so in accordance to the childrens developmental stage is a way to also create familiarity, and interest around the game

In the final concept this is mainly done by Mulle; a child like character that follows the toddler during the course of an entire treatment.



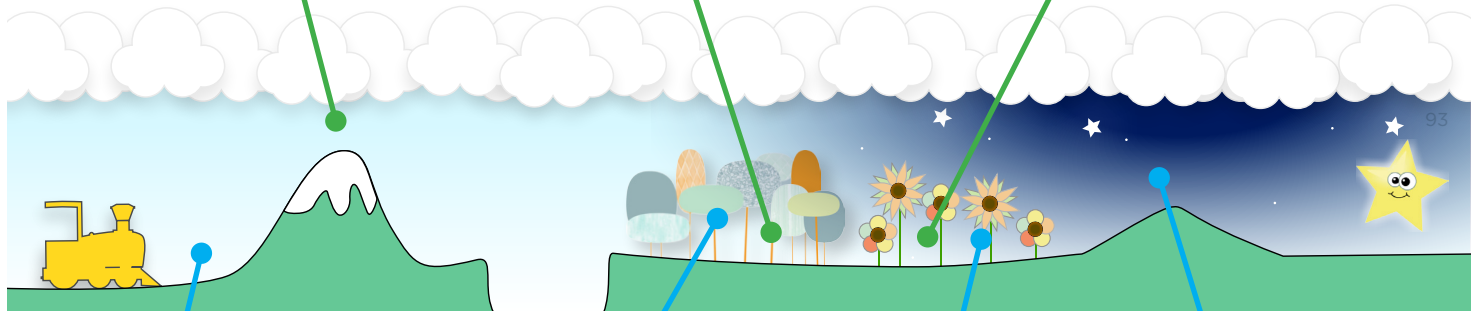
The main character Mulle mirroring the toddlers behaviour

Cheering you on



Look! we are already half way to the star! You must be the nebulizer world champion!

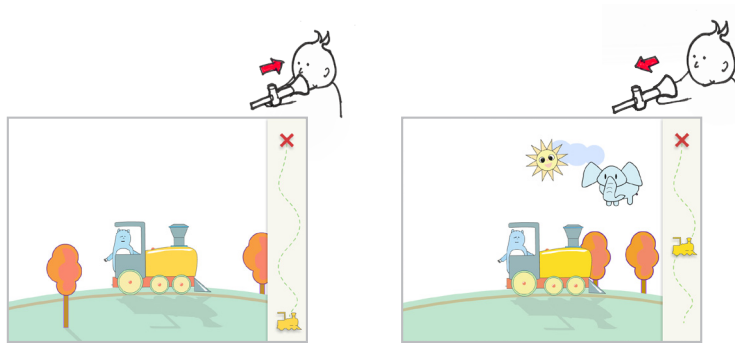
High five!



Doing it together



CONTROL

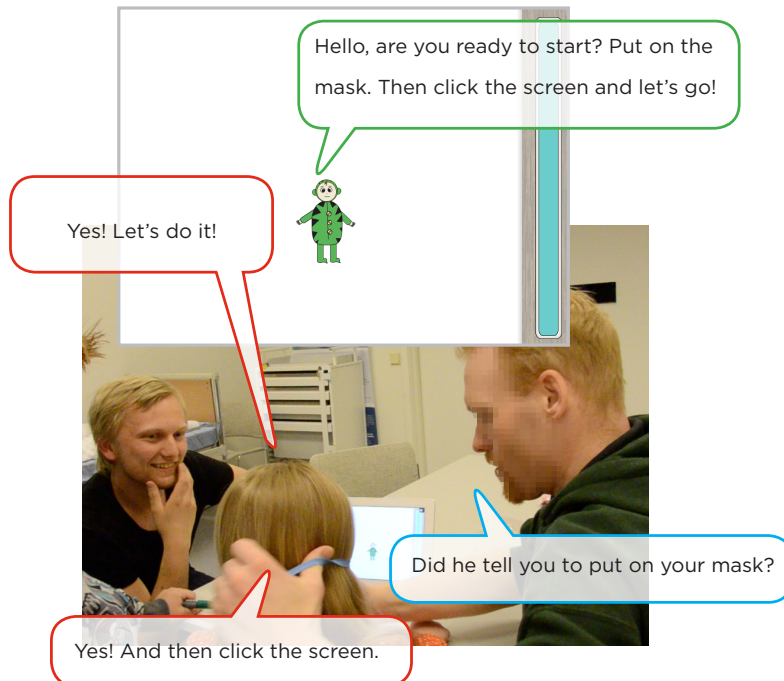


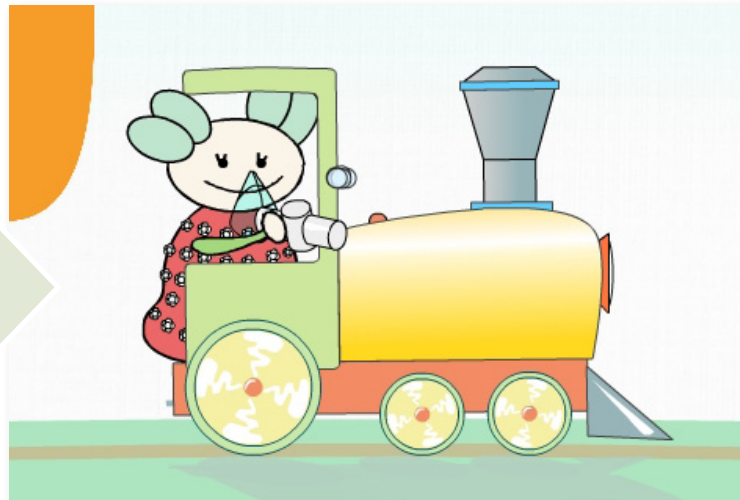
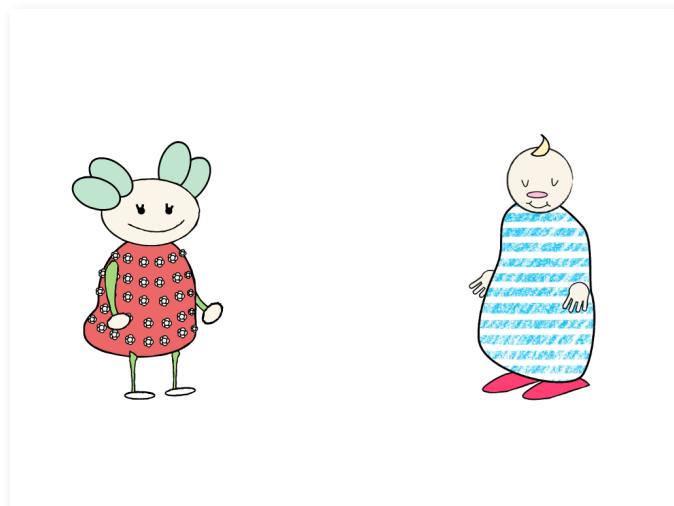
From the ideation followed an idea of providing control through immediate feedback between nebulizer and game. This concept was tested with the initial prototypes.

From the tests it was clear that the toddlers did not understand the connection between mask and screen.

More interestingly, having the character in the game asks the child to use the mask, proved to be a really effective way of motivating the child to use the nebulizer and put on his/her mask. This meant that the initial idea of a direct feedback with the mask did not work, and the best way of getting the toddler to use the mask was to invite them to use it on their own accord, and create an emotional connection rather than a functional connection with the user.

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This sense of control was consequently imported into the final concept.
 By providing the toddler with the simple choice of playing together with one of the two main characters, "Mulle" or "Sulle" the toddler will be able to enter the treatment on his own accord.
 By providing the toddler with this simple choice a sense of control in relation to an otherwise very restricted treatment is achieved.

In addition providing an interactive experience where you are able to manipulate a variety of interactive elements will also add to the sense of control, as you are able to get direct feedback from your actions

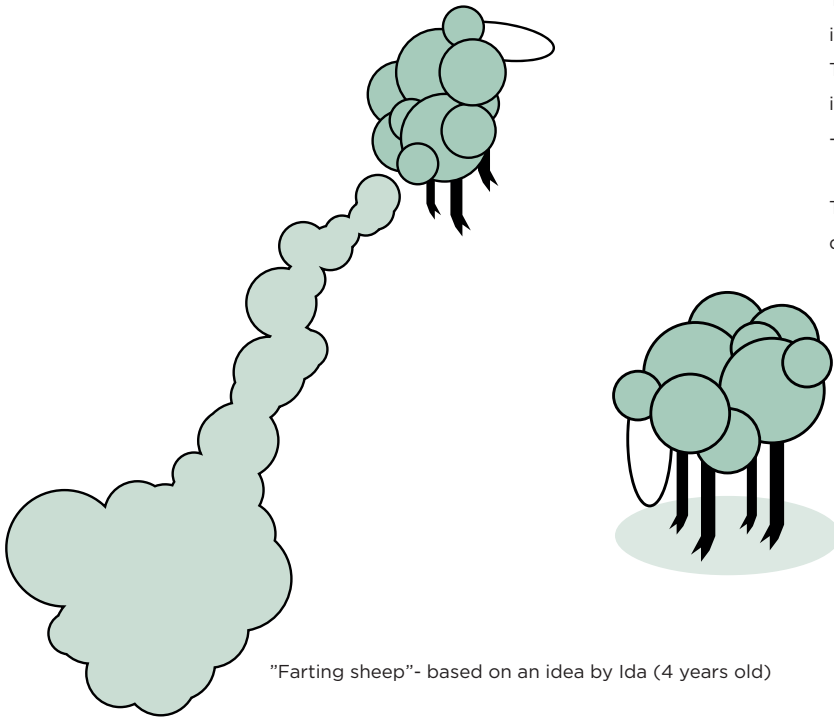


ABSURD REALITY

"[We must] provide a form of absurd reality that helps children cope with their environment"

This quote by Tove Karoliussen, hospital clown at St. Olavs sums up a really important part that it is easy to forget when designing a serious game. Treatment of respiratory diseases is by no means fun or pleasant, making it the more important for the design to have elements of fun, wittiness -creating an absurd experience

The farting sheep are one of the most memorable features in this game, and directly influenced by one children that participated in our workshops.



"Farting sheep"- based on an idea by Ida (4 years old)

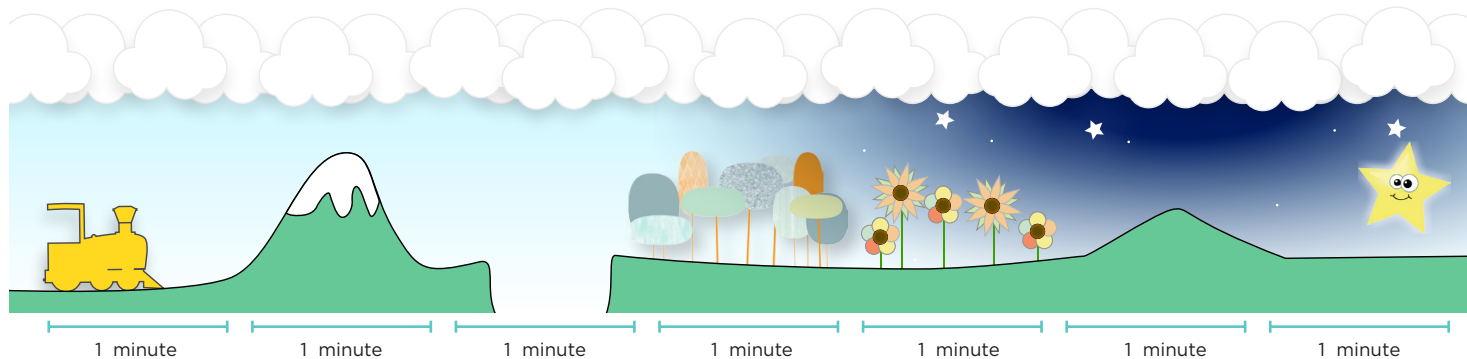
REPETITIVE PLAY

REPETITION AND PACING

The pacing of the game has been designed according to the principles used in Teletubbies and developmental psychology theory. Each segment lasts for the duration of a toddlers attention span - which is approximately one minute

Within this one minute elements like characters or actions repeat themselves, before changing the scenery and introducing new elements in the next time span. As children love repetitive elements each theme has one main character you can interact with. For example as the game start

the first minute will be a repetitive session of sheep farting as you press them, while in the forest rabbits jump around when touching them.



Repetitive elements:



GUIDANCE

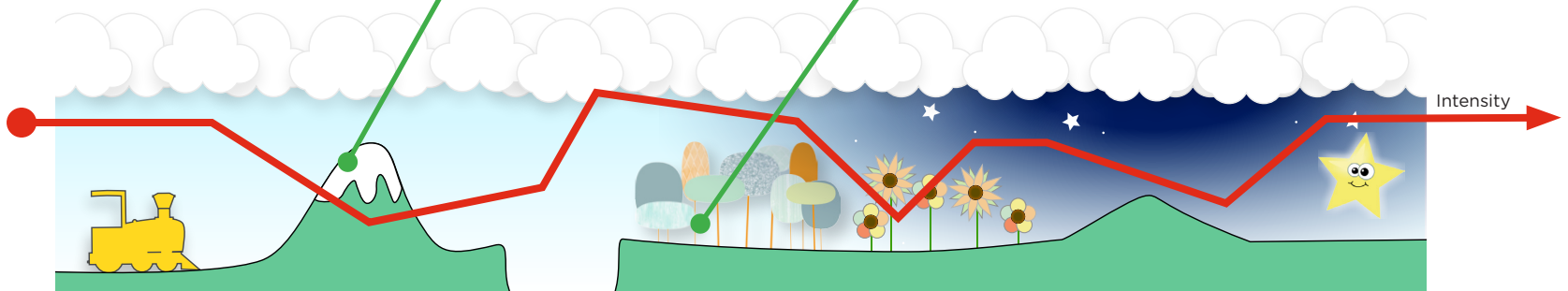
The intention of the game is to become a common focus away from the treatment in it self. In relation to this it is important provide room and guidance for the interaction between toddler, parent and nurse. Consequently, some parts of the final concept is specially designed to be a bit calmer, without the same interactive intensity as other parts. This is meant as opportunities for the parent or nurse to engage with the toddler in relation to the game.

For example during the climb up to the top of the mountain, there are few interactive elements compared to other places. Still the plot of going up the mountain is easy to talk about.

In addition the narrator will some times indicate ways to use the time line as a que, exemplified by the quotes below.

*"We have to take a deep breath
in order to reach the peak"*

*"We are in the woods already!
How good you are at using the
nebulizer!"*



REWARD SYSTEMS

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One of the main insights from the workshop with the professionals was that the game need to “integrate rewards and praise into the experience”

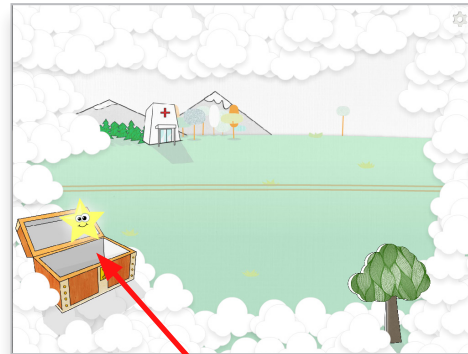
Two different reward systems were tested within the second workshop.

In the first model a star appeared along with the sound of cheering when the treatment was finished. This proved very effective as the children would jump and sing when they saw it.

In the second model the reward was made by lettering only, in order to see if it was possible to actively engage the parents in telling the child when the treatment was over, and rewarding them with words and encouragement.

The star worked much better compared to the lettering. With the lettering the parents would only tell the toddlers what it said quite a long time after the treatment was really finished. When the star appeared both children that were tested started dancing around.





Within the game it self a star or other symbols were also implemented in the final concept and introduced as the final goal of each treatment journey. The goal is visible at all times in the time line as the train moves along, and comes into the scene when the journey is over. Afterwards the star is placed in the treasure chest in the main menu. There the children are able to see previous rewards.





The development from ideas to concepts were made primarily in Adobe Flash. This tool is flexible and efficient for producing prototypes, however there are several limitations as well. As the concept is developed and made by a single designer without any support from programmers, gesture functionality could not be tested or implemented in the prototype.

As the main question of this assignment is how we can engage the toddler through the entire treatment session, it was important for the final concept

to last the actual time it takes. The only way to ensure that the concept works, will be by being able to test it in its entirety.

User testing on the Apple iPad also has its limitations as it does not really support flash. However a way around can be found by using third party software, but a mayor drawback here was a small delay in the prototype, making it a little less responsive for the children.

INTERACTION

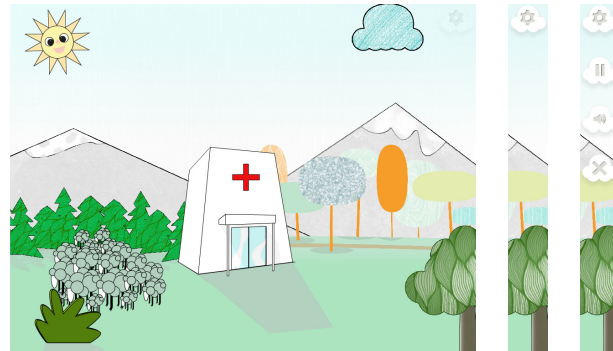


Parent and child: As the information area of the game is intended to be both for parent and child, and the part of the game always open,

The interactive design principles have not been the main focus of my design, but is still an factor that has been naturally integrated throughout the process. There are not much written about interaction design for toddlers, however a lot of inspiration and knowledge could be distilled from various forums and blogs on the internet ([name blogs](#)).

The voice plays a major part in narrating throughout the game, leading almost a dialogue with the child. Furthermore, icons like colourful circles indicate the elements as the narrator mentions them. Moreover, a white hand helps to indicate which objects are touchable. The hit area on the different interactive elements is big, requiring less fine motor skills.

Also, a hidden menu prevents the child from accidentally altering the settings, but at the same time allows the parents or nurse to overrule the game should it be necessary.



Parent and nurse: three touch hidden menu in order to hinder the toddler from accidentally entering the settings menu, put in top right corner, furthest away from the toddlers reach

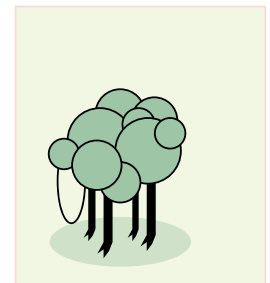
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*Toddler: point indicator
(pulse rainbow)*

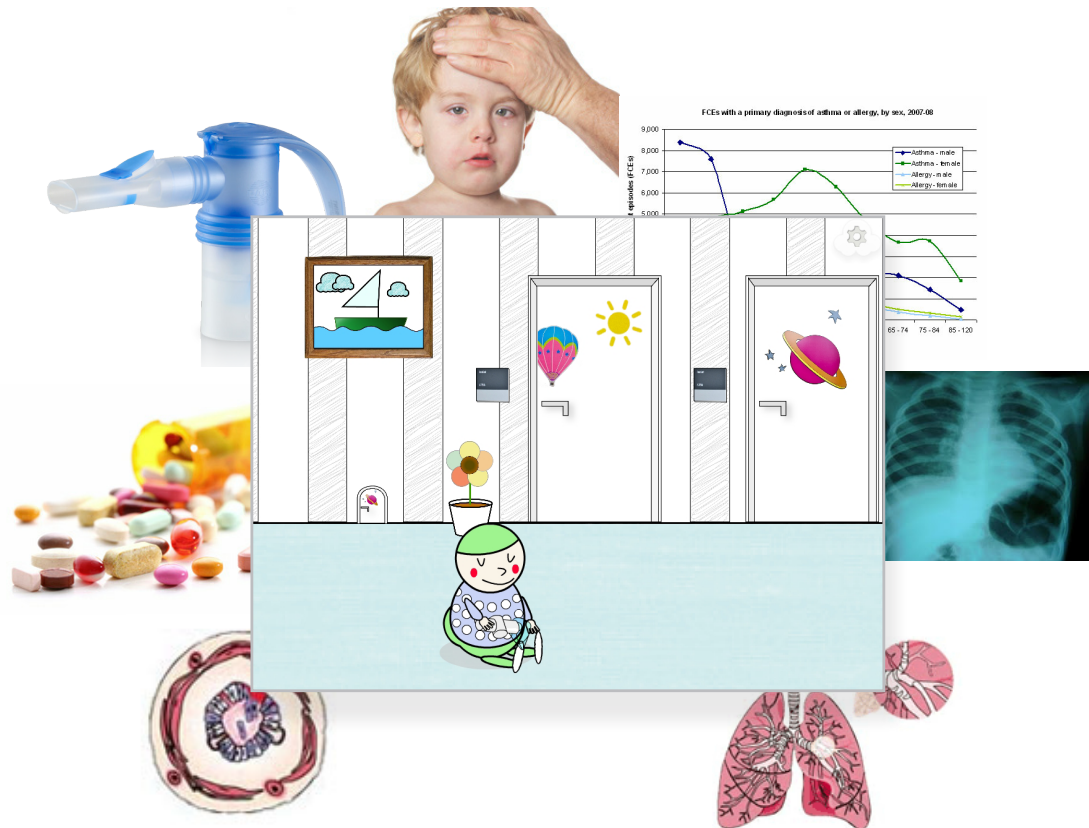


Toddler: touch indicator



Toddler: Wide hit area in order to require less fine motor skills

PLAY PREPARATION



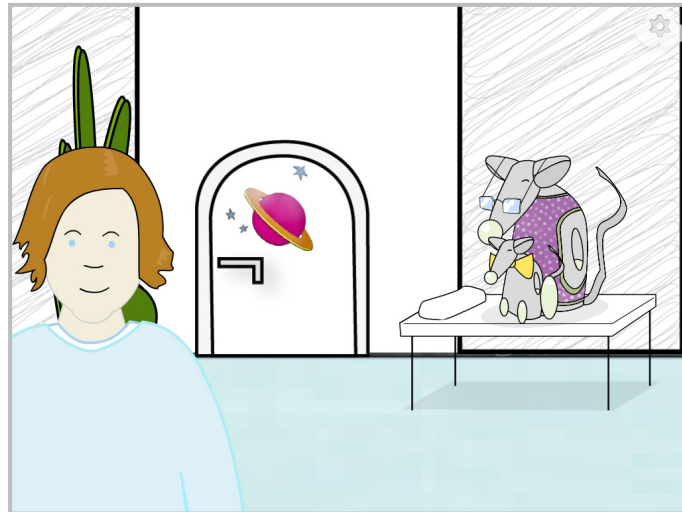
INFORMATIONAL PREPARATION FOR BOTH CHILD AND PARENT

From extensive research it was clear that play preparation for the toddlers would also be a key factor, in order to encourage learning and coping with the treatment.

Encouraging a play preparation meant that a secondary system which the toddler could use outside the treatment in the self needed to be developed. The idea behind this “informational” part of the game was to create a platform in order to provide not only relevant play to the toddler, but also relevant information to the parent.

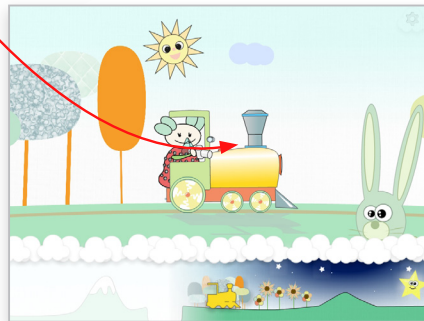
The information is presented through interactive story telling -where parent and child together can browse through and explore the hospital and different treatment settings. The information provided is intended to be mainly about the motivational aspects of the treatment that both parent and child can benefit from. However, for the toddler the most important aspect of this part of the game will just be to familiarize one self with the treatment setting. Another aspect of this part of the game is to provide a natural transition between informational part of the game to the treatment game.

This part of the final concept is only a demonstration of a concept, as the relevant information should be provided by medical professionals and teachers



PHYSICAL DIMENSION

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A physical dimension was also added to increase the child's sense of control. When the nurse enters with a card the child is able to understand that this time it he will receive treatment, reducing the stress all the times the nurse come in to check on other things.

Also the card is used to separate the treatment part of the game from the information part of the game. The cards is the key that starts the game by the use of picture recognition technology.

Before the nurse enters the room a card is chosen from a deck, and the card is to be used as a key for the specific treatment.

As she enters the room the card is given to the toddler and he can scan it in front of the iPad camera and the "treatment setting" of the game, thus opening it.

The picture on the card will become the reward by the end of the treatment. In addition to collecting the rewards in the treasure chest, the child can collect these cards during the treatment and bring them home in the end.

AESTHETICAL DIMENSION

As well as having making a treatment concept that would be evaluated through the time it would take to

HIREARCHY

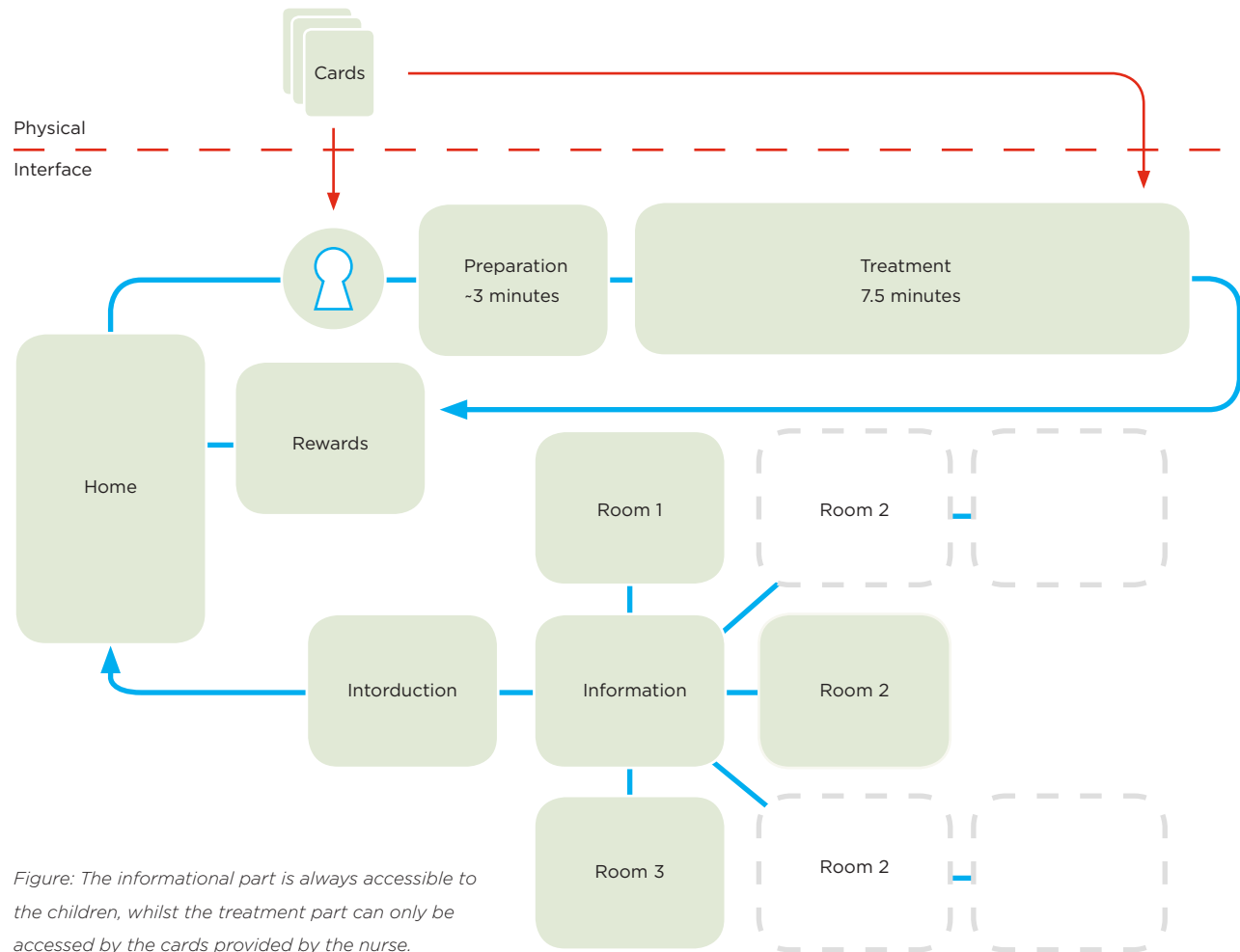


Figure: The informational part is always accessible to the children, whilst the treatment part can only be accessed by the cards provided by the nurse.

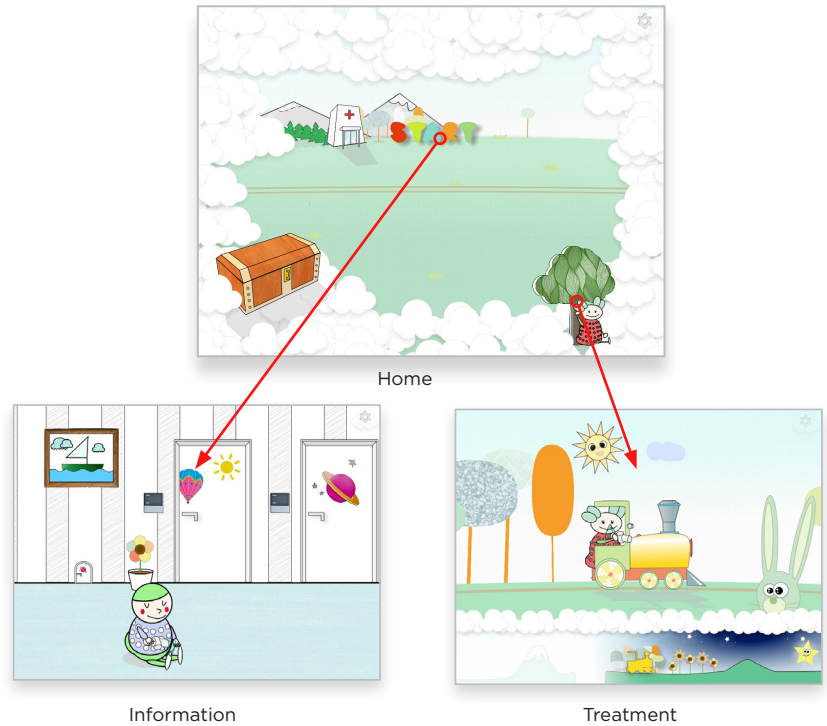
OVERVIEW

The hierarchy of the entire game shows the different “places” or scenes of the game.

The informational part is always accessible through the main menu, whilst the treatment part is “hidden” and can only be opened with a key, namely the card.

The timing of the treatment is divided into 2. First comes the preparation/ introduction to the game. This will take about 2-3 minutes. Approximately the time it take for the nurse to prepare the nebulizer, thus minimizing the anxiety of having to wait for treatment.

The treatment in it self is at a fixed length of 7.5 minutes. This fixed length was chosen as it would simplify the design, and is derived from the average time a treatment takes. Knowing the exact length of the treatment on beforehand is difficult as it depends on nebulizer, dosage as well as the childs reactions.





INFORMAL TESTING

In order to evaluate the concept along the way, informal tests were performed. Two tests of the final concept, mainly focusing on the treatment part of the game, were conducted in order to get a sense of how the users would respond to the game.

Testing on a one year old, was particularly interesting, as we were unsure as to how much she would be able to relate and interact with the game. However she seemed to be fascinated especially by the colours, movements and sounds of the game, and tried repeatedly to press on the train. Judging how much she understood of the story and the meaning is as always difficult. But on the other hand, it confirmed the notion that so young children have limited fine motor skills and are still early in their development. And that the parts of the game where things move and make sound without the child's touch are important for the youngest toddlers.

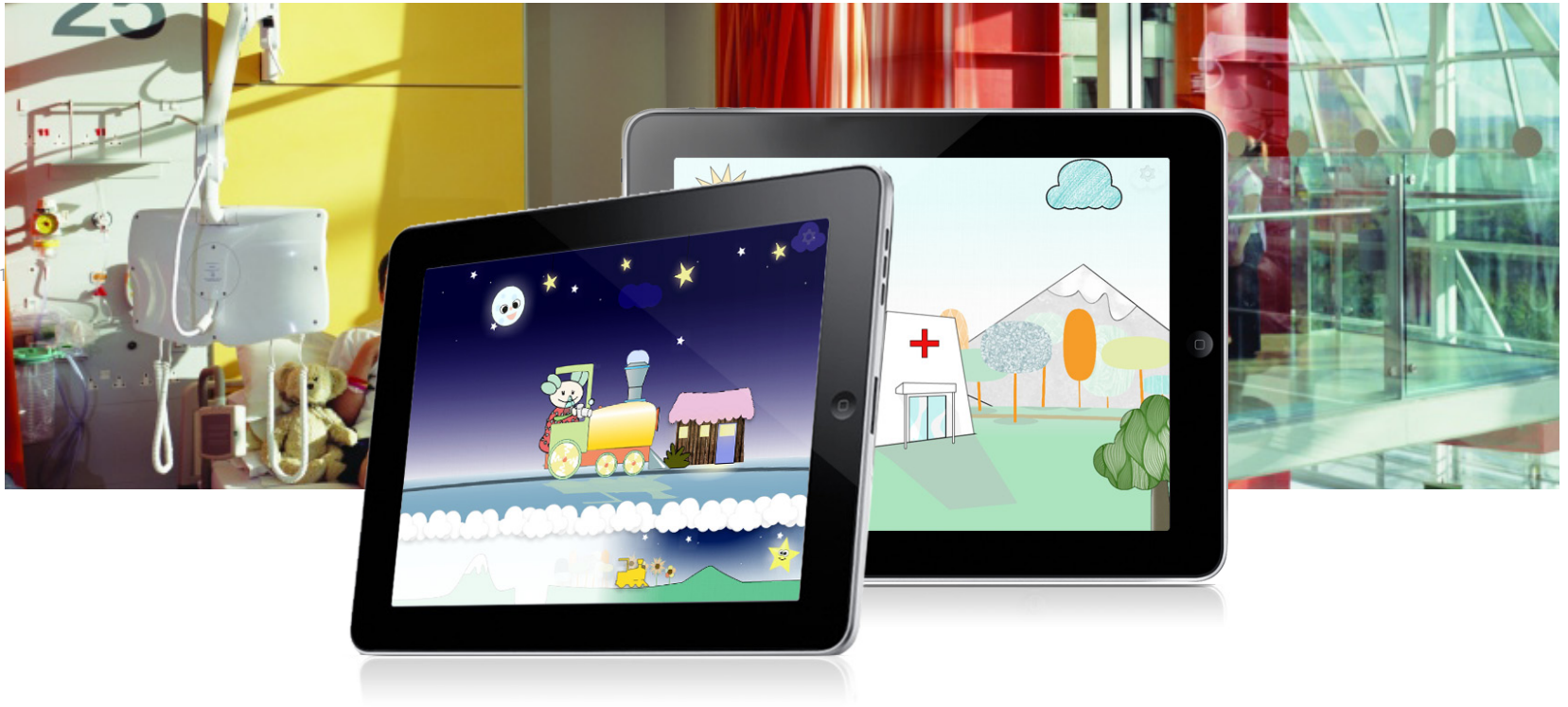
With the three year old, the game was a major hit, and consequently played 3 times in a row. Especially the boy that high fives proved to catch the eye of this toddlers, as well as the farting sheep.





BLOPP THE GAME

A game for improved treatment of respiratory diseases of toddlers in a hospital setting.



INTRODUCTION

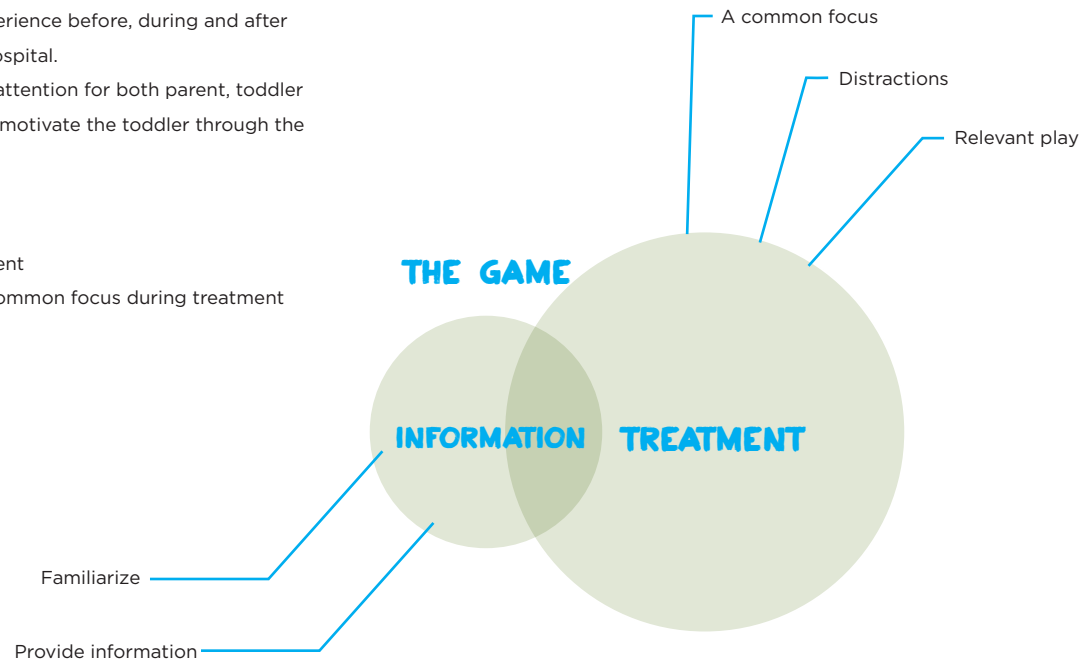
BLOPP is a game that improves the experience before, during and after treatment of respiratory diseases at a hospital.

The game provides a common focus of attention for both parent, toddler and nurse, and a toolkit in order to help motivate the toddler through the course of a hospitalization.

What does it do?

Familiarize the toddlers with the treatment

Provide distractions, motivation and a common focus during treatment



TREATMENT



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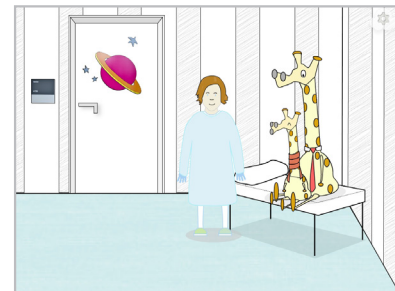
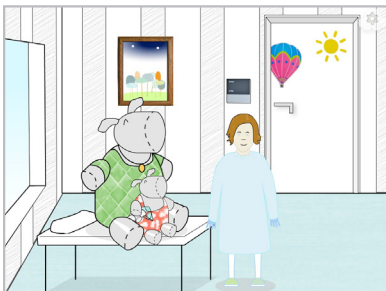
BLOPP is a game in two parts:

In the information part the toddler and the parent can familiarize themselves with the treatment of respiratory diseases through an interactive story - providing an easier entrance into the actual treatment setting, and providing a way to process past treatment experiences.



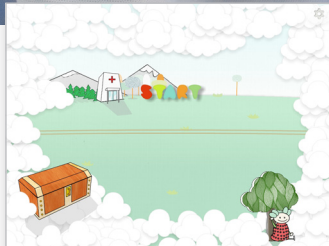
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Through the interactive story the mother and toddler are introduced to different treatment settings at the hospital



TREATMENT

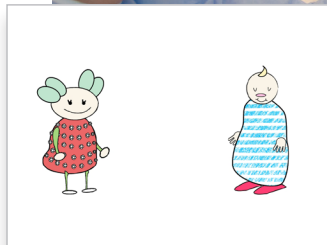
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Nurse picks a card and enters the room



The toddlers gets the card and scan it



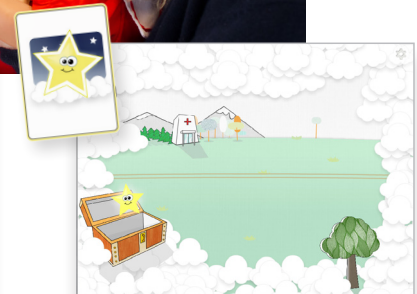
The toddler chooses a character and the treatment begins

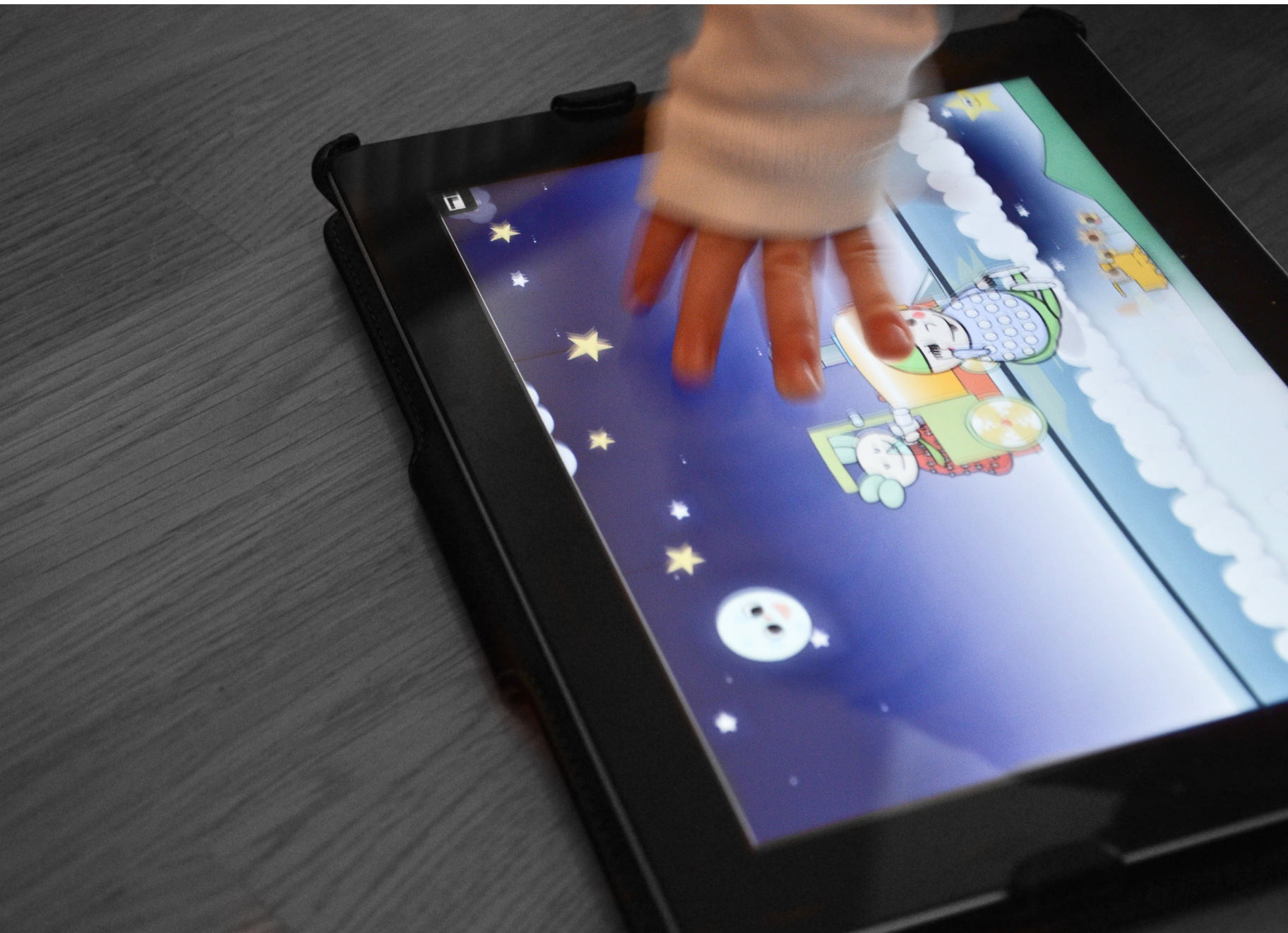


The toddler, nurse and parent play the game together



Rewards are received at the end





EVALUATION

EVALUATION

In this thesis the BLOPP game have been designed and based on insights from a user centred design process. Games is a field that industrial designers rarely venture into, however considering serious games the potential of using design and design methodology is immense.

In the course of the project a final concept was detailed and tested. The final tests ensured the validity of the project.

The final concept might seem finished, however there are several steps needed to be taken in order before the design can be finalized.

Within the game there is a great potential in adding interactive gestures as well as working with the timing of the story and its elements.

Most essential for the further development of this concept will be to test it within a in the context of a real treatment.

The final concept was presented to Guro Karlhom; Head nurse at the infections ward at the children and womens center, St. Olavs Hospital. They were so positive that design that it will be implemented for testing with the patient terminals at St. Olavs in the fall of 2012.

Working with BLOPP has been a very rewarding process, and I can only thank them for giving me the ultimate master thesis





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Bløpp in patient terminal at St. Olavs Hospital fall 2012

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