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Human-Centered Design Considerations in Healthcare Contexts:

Young Children as Users of Medical Products

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Abstract

Human-centered design represents an overall perspective wherein *people* are at the core. However, a general challenge lies in applying human-centered principles to groups of people and situations that are somehow distant to designers. This thesis focuses on a user group that has received limited attention in design, namely young children. Young children represent a group that can be perceived as difficult to reach for designers. This research has been carried out in order to develop knowledge around young children as product users in healthcare contexts. The overarching goal of this thesis is to support the human-centered designer who is concerned with young children in healthcare contexts and as users of medical products. Another goal is to stimulate debate and raise awareness about user groups that are commonly overlooked and perceived as difficult to reach. In order to address these goals, the thesis focuses on the following three questions that relate to human-centered design principles about gaining understanding of users and the context of use as well as user-centered evaluation:

- How can the view of people as competent human actors be upheld when designers address young children?
- How can theories and methods support designers to gain understanding about experiences of young hospitalized children and their caregivers?
- How can design (as product) foster cooperative interactions between young children and their caregivers during medical treatment?

These questions have been explored by examining theories and concepts that are considered relevant for human-centered design, applying methods and eventually constructing themes and design considerations. The thesis builds on the specific case of hospitalized young children who receive medical treatment for respiratory diseases. The work is based on two periods of field study conducted at the children's ward of a hospital in Norway, where qualitative methods were used. At an overall level, the research approach belongs to the interpretivist/constructivist research paradigm, which resonates with underlying principles of human-centered design. The theoretical background draws on the disciplines of design, social science, pedagogy, and philosophy. The questions are addressed through the synopsis, which presents the research approach and related research, and four included articles.

The contributions of the thesis are a set of considerations that are expected to be useful for designers involved in practice as well as research, addressing young user groups, healthcare contexts, and medical product design. Theoretical concepts that can be used to acknowledge people—young children as well as adults—as competent human actors are explored and applied. This can support designers to reflect on the importance of manifesting a human-centered view through methodological consistency. Moreover, existing approaches to the concept of experience in design have been addressed, and limitations have been highlighted. The thesis contributes to knowledge about how an interpretivist/constructivist approach fits human-centered design principles and the concept of experience. Selected theories and methods have been applied to gain understanding of experiences related to medical treatment of young children. The thesis also provides a set of themes and design considerations that, together with the theoretical concepts, can support designers in the process of improving and evaluating products used during medical treatment as well as serve as inspiration for exploring new design spaces aimed at promoting cooperation between children and caregivers in healthcare contexts. Finally, the thesis contributes to supporting the design community by presenting suggestions for further research.

Acknowledgments

I feel extremely privileged to have had the chance to carry out a PhD project. Working on the project has enabled me to ask many questions that I previously would not have considered much less could imagine having attempted to reflect on. I would like to thank everyone who has contributed to my research journey.

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Marikken Høiseth   Trondheim, July 2014

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Part I: Synopsis

1. Introduction

"Humans do not see and act on the physical qualities of things, but on what they mean to them" (Krippendorff, 2006, p. 47).

This programmatic sentence represents an approach that started to take root in the design community during the 1960s, namely the increased consideration of *the people* who use or are future users of products and services (Bayazit, 2004). While function and technical requirements used to drive design, the common practice nowadays is that people (as users and potential users of products) represent the starting point for the design agenda. In other words, a contemporary designer is concerned with the idea of adapting technology to people rather that the other way around. This is confirmed by a wide spectrum of human-centered design approaches, which represent an overall design perspective wherein people are at the core.

Human-centered designers have various tools and methods at their disposal to gain understanding of people and their needs. However, despite the desire to devote special attention toward people, existing tools and methods may fall short when designers address people and situations that appear hard to reach and relate to. Consequently, a number of groups in society are misunderstood or even ignored as product users. A general challenge thus lies in applying underlying human-centered principles to groups of people and situations that are somehow distant to designers.

This thesis focuses on a user group that has received limited attention in design, namely young children. Young children represent a group that can be perceived as difficult to reach for designers. This research has been carried out in order to develop knowledge around young children as product users in healthcare contexts. The thesis builds on the specific case of hospitalized young children who receive medical treatment for respiratory diseases.

This thesis is relevant for designers and stakeholders who are interested in children as product users in healthcare contexts. Above all, it is written for designers who take a human-centered position. It is necessary to specify that the term *designer* is understood here as a social construct. This also applies to all of the other groups that are referred to throughout the thesis. The designer, then, is understood to be a construct that represents a group of people who are knowledgeable in the discipline of design and

interested in theories, methods, and practices relevant to design processes. As such, the designer can be a practitioner, an academic, or both. The term human-centered designer is used to highlight the designer's specific interest in human-centered perspectives.

1.1 Focus of Thesis

Although human-centered design is interpreted and applied in various ways, a set of fundamental principles exists. These are defined in the International Organization for Standardization standard 9241-210 (ISO, 2010) as:

- The design is based upon an explicit understanding of users, tasks, and environments.
- Users are involved throughout design and development.
- The design is driven and refined by user-centered evaluation.
- The process is iterative.
- The design addresses the whole user experience.
- The design team includes multidisciplinary skills and perspectives.

Moreover, the human-centered design process that is guided by these principles includes the following activities (ISO, 2010):

- Understanding and specifying the context of use
- Specifying user requirements
- Producing design solutions
- Evaluating the design

The focus of this thesis is on young children as product users in healthcare contexts. A designer is faced with considerable challenges when trying to apply human-centered design principles related to this user group and context. Figure 1 shows the focus areas of the thesis and how they are combined. In the following, a number of relevant challenges for this thesis are highlighted.
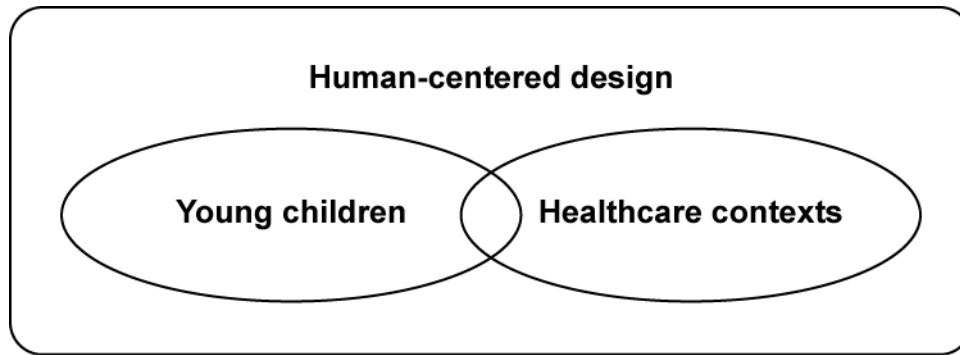
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Figure 1. Focus of thesis

At a fundamental level, the concept that children are a special group of product users can be related to the idea in social constructionism that "society is actively and creatively produced by human beings" (Scott & Marshall, 2009, p. 698). Existing discourses about children reflect how children are portrayed as a socially constructed group in time and place. The construction of children as a separate group is also politically underpinned in that they have their own set of rights. Studying children is not necessarily different from studying adults. However, the concept of the *child* is accompanied by a set of associated ideas, understandings, and images that require the designer's reflections.

While children have traditionally been overlooked as product users, they currently hold a powerful position as consumers. This is also reflected in the commonly accepted notion of involving children in the design process (Iversen & Brodersen, 2008; Nesset & Large, 2004). An increasing amount of research, especially in the field of information technology and the human-computer interaction (HCI) community, explores how methods can support design for and with children (see for example Druin, 2002; Garzotto, 2008; Kelly, Mazzone, Horton, & Read, 2006; Sluis-Thiescheffer, Bekker, Eggen, Vermeeren, & De Ridder, 2011). The discussion is thus not about *whether* children should be involved in the design process but rather about *how* to best involve them (Nesset & Large, 2004). Research in this area commonly builds on developmental psychology for developing methods. Some researchers criticize the adoption of theoretical and methodological perspectives portraying children as "cognitive incomplete" (Iversen & Brodersen, 2008). This point of departure does not seem to comply with a human-centered view wherein people are acknowledged as

competent human actors (Krippendorff, 2006). This discussion indicates that even if there is a desire to include children and to acknowledge their roles as active and competent actors, a consistent methodological approach is by no means established (Zaman, 2011).

This thesis seeks to contribute to common human-centered design principles by exploring how young children can be acknowledged as competent human actors. The focus is on young children between 1 and 3 years of age. Children in this age group have generally received limited attention as product users (Hengeveld, 2011; Yarosh, Radu, Hunter, & Rosenbaum, 2011; Zaman, 2011). With these young children, challenges related to applying human-centered design principles become amplified. The challenges are especially related to young children's extensive use of nonverbal communication.

This thesis thematizes the healthcare context as a specific setting in which young children use products. In the context of healthcare, designers have a special responsibility to ensure that products and services are well adapted to a wide variety of users, including patients and professionals. Medical products and services that fail to respond to the needs of users can at worst have disastrous consequences. The link between human-centered design and healthcare is growing stronger, with increasing attention to experience-based design in healthcare. A pleasurable user experience with medical equipment is for example considered to be a critical component in people's adherence to medical treatment (Gloyd, 2003). Moreover, patient experience design is pointed out as a new paradigm in the development of medical products and systems aimed at improving patient well-being and adherence (Mullaney, Petterson, Nyholm, & Stolterman, 2012; Turieo, 2012).

In the case of young children as users of medical products and services at the hospital, there are a number of considerations that call for human-centered designers' particular attention. Young children depend on assistance from caregivers such as parents and health personnel. In addition, children and caregivers enter medical treatment with different roles, goals, and responsibilities. A significant challenge, then, lies in acquiring understanding of experiences of both young children and their caregivers given their different positions. Moreover, gaining understanding of healthcare contexts can generally be difficult to achieve because users are typically in a

vulnerable situation. Specific challenges can appear when young children need to use medical products. For example, issues of children's acceptance, motivation, and understanding largely contribute to determine the outcome of medical treatment. Besides, the hospital context can limit the designer's opportunities to involve users as well as to evaluate design solutions.

This thesis will contribute to knowledge about how to go about applying human-centered design principles in the specific case of young children as users of medical products at the hospital. The research analyzes the specific case of young children with respiratory diseases using nebulizer devices at the hospital. The case serves as an example of young children as users of medical products. Nebulizers are used for treating respiratory diseases such as asthma and respiratory syncytial virus (RSV). The medication is administered in vaporized form. The child wears a face mask that covers the mouth and nose and inhales the medication passively. Infants and young children are particularly prone to respiratory tract infections, most often caused by RSV, because of their immature and inexperienced immune systems (Ruckwardt, Malloy, Morabito, & Graham, 2014). Respiratory infections lead to hospitalization of infants and young children worldwide; for example, in the United States more than 100,000 children are hospitalized for RSV infections each year (Krilov, 2011).

Hospitalized children with respiratory tract infections typically live in isolated rooms together with their parents during their stay. The isolation is necessary to avoid the spread of infection. These children are a group of patients who require close follow-up, as they often need nebulizer treatment every 2–4 hours. A single nebulizer treatment lasts between 5 and 10 minutes. Many children resist nebulizer treatment by crying, protesting, and fighting against it (Amirav & Newhouse, 2008). The reasons for resistance can be a combination of discomfort, fear, and lack of understanding of both the situation and the treatment. Poor cooperation between children and caregivers typically leads to power struggles, use of coercion, and reduced medical effect. Poor cooperation during medical treatment affects the healthcare experiences of both children and their caregivers. The results of the analyses may contribute to generate knowledge about the role that design can play in fostering cooperative interactions between children and their caregivers in healthcare contexts.

1.2 Goals and Research Questions

The overarching goal of the thesis is to support the human-centered designer who is concerned with young children in healthcare contexts and as users of medical products. Key principles of human-centered design are related to young children as the specific user group and healthcare as the specific context. Another goal is to stimulate debate and raise awareness about user groups that are commonly overlooked and perceived as difficult to reach. Such a debate is valid for the design community at large—that is, academics, educators, and practitioners—but also for stakeholders who work with these user groups. Based on these goals, the thesis asks the following three research questions:

1. How can the view of people as competent human actors be upheld when designers address young children?

2. How can theories and methods support designers to gain understanding about experiences of young hospitalized children and their caregivers?

3. How can design (as product) foster cooperative interactions between young children and their caregivers during medical treatment?

The first question has a broad scope, focusing on young children as the target group for design. This question relates to the human-centered design principle of gaining explicit understanding of users. Young children are perceived as a target group that can be difficult to reach. The human-centered designer is expected to benefit from theories that acknowledge young children as competent actors and methods that can be used to apply this view. The question is therefore considered to be relevant to design theory as well as design practice.

The second and third questions specifically address the intersection between healthcare as a domain for design and young children as a user group. The questions relate to the human-centered design principles about gaining explicit understanding of users and the context of use as well as user-centered evaluation. Given that caregivers accompany young children, particularly in a medical context, the notion of users here includes children, parents, and medical staff. Both questions address theoretical and practical challenges associated with design (as activity and product) concerning specific users in a specific context.

The research questions were explored by examining theories and concepts that were considered relevant to human-centered design, applying methods, and eventually constructing themes and design considerations. Fieldwork was carried out at the children's ward of a hospital, where the focus was on young children receiving medical treatment for respiratory diseases. The questions will be addressed in the single articles and the synopsis, and the main contributions are summarized in the conclusions.

1.3 Thesis Outline

The thesis consists of two parts. Following the current introduction, Part I: Synopsis includes the following chapters:

Chapter 2, Research Approach, gives an account of the project history as well as of collaborations central to the project. Further, the research approach is positioned, and methodological aspects are presented.

Chapter 3, Related Research, presents a historical perspective of human-centered design and discusses some key issues before relating these more specifically to concepts of children and healthcare design.

Chapter 4, Summary of Articles, provides an overview of purposes and contributions of the conducted studies.

Chapter 5, Conclusions, presents the contributions of the research with regard to the research questions. Moreover, it comprises reflections on strengths and limitations of the research as well as lessons learned. Finally, suggestions for further research are outlined.

Part II: Collection of Articles, includes the four articles on which the research is largely based.

2. Research Approach

2.1 History of the Project and Collaboration

This PhD project arose from my deep fascination and interest in young children. During my early design studies, I was intrigued by projects aimed at this particular user group. In these projects, the design process as I had known it got challenged, along with many of the ideas I had taken for granted. Some years later, when growing into my new role as a mother, my accepted ideas about children continuously called for reflection. I learned to know a whole new dimension of life, and with my background as a designer I was astonished to realize that the designed world took little account of the youngest among us. I started the PhD project with the desire to explore how designers could make products that were suited to meet young children's versatile methods of communication.

After some time, I got in touch with two academics (a pharmacist and an interaction designer) who shared interest in young children as a user group. With their experience from healthcare and hospital-related contexts, they saw a pressing need for design solutions that could contribute to support children as competent users of pharmaceuticals and medical devices. I was greatly drawn to the idea of continuing my research plans in the context of healthcare. Together with the Norwegian Asthma and Allergy Association and our respective institutions, we applied for funding to conduct a one-year pilot project in order to explore the case of young children receiving treatment for respiratory diseases. The BLOPP project (a Norwegian acronym for *Barns Legemiddelopplevelser*, translated as "children's pharmaceutical experiences") received funding from the Extrastiftelsen and was initiated in 2012.

The choice of focusing on young children's respiratory diseases was motivated by conversations with healthcare personnel who reported that nebulizer treatment was generally stressful and exhausting because many children resisted it. They greatly appreciated that research and design efforts were undertaken in order to contribute to improved healthcare experiences of children, parents, and healthcare staff alike.

My role in the BLOPP project group was as an independent project member. As I was already funded through my PhD project, the freedom to follow my own research

interests fully persisted. A number of studies were conducted for the BLOPP project. This thesis draws on empirical studies conducted at the hospital and a series of workshops. Moreover, I supervised a number of master students in industrial design. Although all of the student projects were valuable as drivers for reflection, one project was especially central to this thesis. Given my methodological choice, it was important to be personally and actively involved in the empirical studies underpinning the research. Beyond this, my collaboration with the BLOPP project group was of great importance and included countless discussions, design activities, presentations, meetings, different kinds of fieldwork, and paper authorship. In addition, the collaboration with the hospital staff and the participants was essential for realizing the research.

The following outline indicates my independent contributions to the included articles. Concerning Article I, I carried out the interviews and transcribed them. I led the continued research process, which included formulating research questions, analyzing data, and conducting major parts of the writing. Together with the coauthor, I established the theoretical background of the research. Moreover, the themes and the overall text were further refined in collaboration. Regarding Article II, I carried out the observations and created narratives. I led the continued research process and conducted major parts of the writing. Formulating questions, choosing theoretical concepts, refining themes, and revising the overall text were done in collaboration with the coauthors. Article III builds on a workshop that was conducted as a BLOPP team collaboration. I was responsible for facilitating the workshop. I was also responsible for leading the research process and conducted major parts of the writing. The affinity diagram technique was conducted as a BLOPP team collaboration. Collaboration with the coauthors consisted of data analysis, writing, and refining design considerations. Concerning Article IV, I carried out the fieldwork and was responsible for leading the research process. I transcribed data to textual accounts and conducted major parts of the writing. Collaboration with the coauthor consisted of choosing theoretical perspective, developing research questions, and conducting data analysis as well as writing.

2.2 Positioning Own Research Approach

In this section, the thesis is framed in terms of research approach. This includes an account of the chosen research paradigm as well as an outline of how design and design research are understood.

2.2.1 The interpretivist/constructivist paradigm. The boundaries between research paradigms are not fixed. When gradually moving deeper into the building blocks of different paradigms, one will find various overlapping streams of thoughts across them (Lincoln, Lynha, & Guba, 2011). However, at the most general level, the different paradigms can be distinguished in terms of their basic foundations concerning reality and knowledge. Four basic foundations of a research paradigm are *ontology* (the nature of reality), *epistemology* (what counts as knowledge), *axiology* (the role of values), and *methodology* (the process of research; Creswell, 2013; Lincoln et al., 2011).

At a basic level, the chosen research approach belongs to the interpretivist/constructivist[1] research paradigm. Here, the ontological assumption is that multiple realities exist (Lincoln et al., 2011). Moreover, reality is understood to be a social construct. Hence, reality is understood to be relative to constructions shaped by the individual as well as social groups. Guba (1990) provides the following account: "Realities exist in the form of multiple mental constructions, socially and experientially based, local and specific, dependent for their form and content on the persons who hold them" (p. 27). Constructions are not considered to be more or less "true," but rather more or less informed or sophisticated (Guba & Lincoln, 1994, p. 111). A contrasting worldview is found in the positivist paradigm, where the assumption is that there is a single truth that can be identified and measured (Lincoln et al., 2011).

Regarding the epistemological assumption, the interpretivist/constructivist paradigm holds that the foundation of knowledge is the constructed meanings of actors (Lincoln et al., 2011). Also, reality is taken to be coconstructed. This means that both

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[1] The constructivist paradigm includes several different positions (Young & Collin, 2004). Social constructivism and social constructionism are theories of knowledge within the constructivist paradigm. Whereas social constructionism primarily looks at development of phenomena relative to social context (often described as a sociological construct), social constructivism looks at an individual's meaning-making of knowledge relative to social context (often described as a psychological construct; Sirowy, 2010; Young & Collin, 2004).

the researcher and the researched are acknowledged as participants in constructing known realities. Hence, the researcher's individual experiences also contribute to shaping constructed realities (Creswell, 2013).

In terms of axiological assumptions, it is acknowledged that the researcher influences the research by virtue her or his own values. Therefore, rather than attempting to compensate for biases, the researcher seeks to openly include and discuss relevant values and how they relate to the process of interpretation (Creswell, 2013). As a researcher, I have tried to treat both participants and data with respect and sensitivity; as a designer, I have been concerned with the idea that products used in children's medical treatment should convey trust and care.

Finally, methodological assumptions from the interpretivist/constructivist paradigm reflect the preceding assumptions by taking an inductive approach. The researcher works in the field to study the topic within its context, and emerging field experiences, rather than predefined hypotheses, are the drivers of research questions (Creswell, 2013). The process of research is circular as opposed to linear (Creswell, 2013). The interpretivist/constructivist process is hermeneutic (interpretative) and dialectical, resolving disagreement through rational discussion (Lincoln et al., 2011). As such, methods serve to enable an adequate dialogue between the researcher and the researched, wherein meaningful reality is constructed. To this end, the interpretivist/constructivist typically uses qualitative methods in the natural world (Lincoln et al., 2011).

The basic foundations of the interpretative/constructivist paradigm resonate with the underlying principles of human-centered design. Like the interpretivist/constructivist researcher, who constructs findings based on interactions with the researched, the human-centered designer seeks to design on the basis of explicit understanding of users, tasks, and environments. Like the interpretivist/constructivist researcher engages in dialogue with the researched, the human-centered designer also involves users throughout the design process. Like the interpretivist/constructivist researcher uses a circular process, the human-centered designer uses an iterative process. Next, the term *design* is elucidated before the thesis is positioned as design research.

2.2.2 Research for human-centered design. There are countless definitions of design, strengthening the hypothesis that it is a social construct—that is, its meaning resides in people's interpretations and depends on the context in which it is used. Design is generally understood to be both a process (human activity involving the use of creativity, tools, and methods) and an outcome such as a product (Lawson, 2005). Most importantly, the processes and outcomes focus on people. According to Buchanan (2001a), "Design is the human power of conceiving, planning, and making products that serve human beings in the accomplishment of their individual and collective purposes" (p. 9).

Design is a family of several professional fields including fashion design, architecture, engineering design, interaction design, and product design or industrial design. Yet such distinction is often considered less interesting, given that design is inherently multifaceted and that disciplinary crossovers typically yield novel results (Lawson & Dorst, 2009). Some authors have claimed that design lacks a coherent subject matter compared to many other disciplines, such as physics or medicine (Buchanan, 1998; Swanson, 1994). Given that design is inherently multidisciplinary, it makes more sense to focus on the interventionist character of design, namely as a discipline that "seeks to bring about change by developing and staging artifacts and environments that alter how we perceive and act in these volatile conditions" (Dalsgaard, 2014, p. 148). To bring about changes and contribute to serve people's purposes, designers generally draw on knowledge from many different disciplines to fit the specific projects on which they are working.

As a process, design deals with "solving problems, creating something new, or transforming less desirable situations to preferred situations" (K. Friedman, 2003, p. 507). However, a necessary condition for "problem solving" is "problem setting" (Schön, 1983/2005). As such, the design process is seldom carried out linearly; rather, it can be understood as a hermeneutic practice wherein the designer moves between whole and parts to understand people's needs and how to respond to them through design (Hallnäs & Redström, 2006; Jahnke, 2012; Snodgrass & Coyne, 1992). The design process is a repetitive movement of thinking and doing (Dalsgaard, 2014). Steen (2011) understands this iterative process as a tension between a concern for *what is* and *what could be*. Regarding design as an outcome, technological developments during the last

decades have resulted in a shift from industrial products toward less tangible artifacts such as information, software, communication networks, and services (Krippendorff, 2004). However, the most important shift that this thesis attends to is the shift from technology-centered design toward human-centered design (Cross, 1981; Krippendorff, 2006).

The innovation and design company IDEO (2011) describes human-centered design as:

> A process and a set of techniques used to create new solutions for the world. Solutions include products, services, environments, organizations, and modes of interaction. The reason this process is called "human-centered" is because it starts with the people we are designing for. (p. 6)

Accordingly, the human-centered design process starts with an exploration of the people whom designers want to affect by seeking understanding of their needs, dreams, and behaviors (IDEO, 2011). As a consequence of the growing interest in human-centered design, design research has been moving progressively toward the front end of the design process (Sanders, 2005). This front end is often termed "fuzzy," referring to the ambiguous and chaotic phase wherein the designer does not yet know anything about the outcome or solution of the design process (Sanders & Stappers, 2008).

Design research has been described in various ways. From a conservative point of view, a certain conflict between design and research can be found in that design is oriented toward the future, while research deals with the past and the present (Fulton Suri, 2011). However, the boundary between design practice and design research is blurred. Design research is connected to practice and to a large degree motivated by its needs (Roth, 1999).

One commonly accepted principle of design research is the distinction regarding research *on* design, research *for* design, and research *through* design (Forlizzi, Stolterman, & Zimmerman, 2009; Frankel & Racine, 2010; Frayling, 1993; Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011). This thesis relates to both research *for* and *through* design in that it seeks to provide designers with theories and concepts that can benefit their practice and includes prototype exploration as a method of inquiry (Forlizzi et al., 2009; Stappers, 2007). It also relates to research *on* design, which deals

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with the construction of theory about the design process (Forlizzi et al., 2009), contributing to methodological reflections about coherency in the design process.

The most important positioning of the thesis is as *research for human-centered design*. Human-centered design is understood to be a range of approaches that share the aforementioned principles covered in the ISO standard. In addition, a specific view on people has guided my research. Following Krippendorff (2006), I understand a human-centered view to hold that people are creative, accommodating, context sensitive, resourceful, and possessors of multiple intelligences. Moreover, I relate this view to Buchanan's notion of human dignity:

> Human-centered design is fundamentally an affirmation of human dignity. It is an ongoing search for what can be done to support and strengthen the dignity of human beings as they act out their lives in varied social, economic, political, and cultural circumstances (Buchanan, 2001b, p. 37).

2.3 Methodology

This section first describes the theoretical background for the research. Following is a presentation of research methods, participants, and data. Here, I argue for the choice of methods and provide a reflection of my role as a researcher in the field. Finally, an overarching account of the approaches to data analysis is given.

2.3.1 Theoretical background. The theoretical background draws on a combination of different disciplines, most notably design, social science, pedagogy, and philosophy. In the following, the discipline strands and related concepts on which the research builds are elucidated.

Human-centered design is understood to have a *semantic* orientation (Krippendorff, 2006). Semantics is essentially the study of meaning and signs (Blackburn, 2008). For human-centered design, the concept of meaning is essential because "one always acts according to the meaning of whatever one faces" (Krippendorff, 2006, p. 58). This idea is also found in symbolic interactionism, where meaning is understood to be made through social interaction and interpretative processes (Blumer, 1986). Despite efforts and good intentions to make user-friendly and intuitive products, designers do not determine the way in which a person actually decides to use a product. Products are used in innumerous ways throughout their

lifetime depending on the meanings that people assign to them. From this viewpoint, a product can never be user-friendly and intuitive in itself—only people, through their ways of using it, can make a product a holder of such qualities. Krippendorff (2006) plays on the famous design principle "form follows function" and offers this version tailored to human-centered design: "Interfaces follow recognizable meanings" (p. 322).

Even if designers do not determine how people use products—and besides, they probably have little interest in such determination—products do essentially contribute to people's meanings and their lives. Therefore, it is essential for designers to seek to gain understanding of people and how they use products. Krippendorff (2006) takes the notion of design semantics to embrace both a designer's own understanding of an artifact and a designer's understanding of different users' understandings of that artifact. The design semantics of Krippendorff (2006) include four overlapping theories of how meaning can relate to artifacts, namely in tacit use, in language, in life cycle, and in ecology. In this thesis, the focus is on meaning related to products in use and in language.

Social semiotics is interested in the social dimensions of *meaning-making* (Hodge & Kress, 1988). A basic idea is that meaning-making takes place in and is influenced by social situations. Consequently, meaning cannot be understood as static and given but as something that occurs through dynamic and productive processes (Hodge & Kress, 1988). An important distinction to be made is between semiotics and social semiotics.[2] Semiotics is a vast field with divergent schools of thought (Chandler, 1994). Social semiotics developed from semiotics and took a new direction in emphasizing the role of human, social actors as producers of signs and meanings: "Traditional structural semiotics was primarily applied to textual analysis but it is misleading to identify contemporary semiotics with structuralism. The turn to social semiotics has been reflected in an increasing concern with the role of the reader" (Chandler, 1994, p. 175). In the words of van Leeuwen (2005): "in social semiotics the

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[2] Even though semantics represents one of the three branches constituting semiotics (Blackburn, 2008), Krippendorff (2006, p. 273) critically referred to semiotics as a discipline that excludes human agency and claimed that it is probably "the one discipline that is most frequently confused with what the semantic turn seeks to accomplish". This thesis – on the contrary, seeks to embrace and lift up the idea of human agency by using concepts from *social* semiotics.

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focus changed from the 'sign' to the way people use semiotic 'resources' both to produce communicative artefacts and events and to interpret them—which is also a form of semiotic production—in the context of specific social situations and practices" (p. xi). In this thesis, the social semiotics perspective has been used to study children and caregivers' meaning-making with an interactive healthcare game during medical treatment.

Meaning-making in semiotic terms is the fusion of form and meaning into signs and texts that represent and communicate ideas and understandings (Jewitt & Kress, 2008). In social semiotics, the term *text* is understood as communication (Kress, 2010). Text is thus understood in a broad sense. Rather than merely referring to a piece of verbal representation that is written down, social semiotics takes the concept of text to be a message that is communicated in and through itself. A related key concept for understanding texts and how people interact with them is *multimodality* (Kress, 2010). Multimodality refers to the wide collection of meaning-making or semiotic resources that people hold and employ, such as gesture, gaze, speech, posture, image, and writing (Jewitt, 2009; van Leeuwen, 2005). *Semiotic resources* are defined by van Leeuwen (2005) as:

> The actions and artefacts we use to communicate, whether they are produced physiologically—with our vocal apparatus; with the muscles we use to create facial expressions and gestures, etc.—or by means of technologies—with pen, ink and paper; with computer hardware and software; with fabrics, scissors and sewing machines, etc. (p. 3).

A semiotic resource can also be understood in terms of its potential for making meaning, its *semiotic potential* (van Leeuwen, 2005). In this thesis, the healthcare game is regarded as a multimodal text. Moreover, a multimodal analysis has been conducted for interpreting children and caregivers' use of semiotic resources when engaging with the game.

Halliday (2004), a key theorist in social semiotics, represents the child as a semiotic being—one who means. According to Halliday (2004):

> One only has to observe about the first half-hour of a newborn infant's life to recognize that here is a social creature, whose personality is formed out of the conjunction of material and semiotic modes of being. Like any other small

mammal, of course, the human child is bonded to its mother ***materially***, for

food, warmth and loving care; but beyond that, the human infant is also bonded

semiotically, from the start, through the exchange of attention. (p. 7)

As such, social semiotics and human-centered design have a common interest in

acknowledging people as multimodal meaning-makers. Moreover, especially in the case

of young children who primarily rely on nonverbal communication, social semiotics

concepts can contribute to increased sensitivity toward the idea of human agency.

Pedagogy places emphasis on the interactions between people and in the case of

children, it places emphasis on how children and adults interact with and influence each

other (van Manen, 1991). The concept of *pedagogical tact* is understood as a mindful

orientation that permits thoughtful human interaction, and it is often used to refer

specifically to adult–child relations (van Manen, 1991). The concept has primarily been

applied in educational research; however, in light of a human-centered design

perspective, it is considered relevant for studying interactions between children and

adults. In this thesis, pedagogical tact has been used to study caregiver–child

interactions in the context of medical treatment and further to understand how it can

relate to medical product design.

Phenomenological hermeneutics responds to the human-centered design

principle about seeking gained understanding of people and their experiences.

Phenomenological hermeneutics originates from the method that Heidegger presented in

his magnum opus *Being and Time* in 1927, building on the claim that human existence

is interpretative (Embree, 1997). This idea was among others adapted in *Truth and*

Method by Gadamer, whose intention was not to provide a "method of interpretation"

fitting into the scheme of modern human sciences, but rather a reflection on what

happens "over and above" our understanding (Gadamer, 1960/2004). Through

phenomenological hermeneutics the researcher aims to "disclose truths about the

essential meaning of being in the life world" (Lindseth & Norberg, 2004, p. 151). A key

method is to go beyond the data and look for hidden meaning rather than assuming that

data will "speak" for themselves (Maggs-Rapport, 2001). The iterative process in

human-centered design can essentially be understood as a hermeneutic practice wherein

the designer moves between whole and parts to understand people's needs and how to

respond to those through design (Hallnäs & Redström, 2006; Jahnke, 2012; Sengers &

Gaver, 2006; Snodgrass & Coyne, 1992). In this thesis, the *phenomenon of care* has been central to seeking to gain understanding about experiences related to the use of medical products.

Heidegger's philosophical project was essentially ontological, as it aimed at understanding the fundamental existential question: "What does it mean to be?" (Mackey, 2005, p. 181). Heidegger's concept of *being-in-the-world* (1996 [1953]) essentially denotes a social mode of being (as cited in Zigon, 2007) and concerns the ways people exist, act, and are involved in the world (van Manen, 1990, p. 175). According to Heidegger, human existence is being-in-the-world (Lindseth & Norberg, 2004). This world, also denoted the *lifeworld* in Husserl's work, is the world as it shows itself to our consciousness and is different from the objective, outer world (Lindseth & Norberg, 2004). Rather, being-in-the-world refers to being at home in *our* familiar world and can be understood as an at-homeness (Zigon, 2007). The concept represents Heidegger's notion that the object and the subject are inseparable (Mackey, 2005). As such, "being" and "world" are understood as united. Following these existential philosophical ideas, van Manen (1990) suggested four lifeworld existentials as guides for reflection in the research process. In this thesis, these lifeworld existentials have been used for the analysis of care.

2.3.2 Research methods, participants, and data. The research project is based on two periods of field study at the children's ward of a hospital in Norway, and qualitative methods have been used. Table 1 gives a general overview of the project, including the research methods used, participants, and data.

Table 1. General Overview of Project

Field study	Research methods, participants, and data	Aim	Related articles
Ia): January–March, 2012	• Participatory observation of nine children (aged 4–30 months) during single nebulizer treatment Data: Nine video recorded treatments and field notes	• Explore how children's nebulizer treatment is conducted and how the participants relate to each other	• Article II
	• Semi-structured interviews with nine parents and six nurses Data: 17 audio recorded interviews	• Gain understanding of how children's nebulizer treatment is experienced	• Article I
Ib): April 19th, 2012	• Workshop with five professionals with healthcare and pedagogy background, facilitated by five members from the BLOPP project Data: 175 written and drawn sticky notes and audio recorded discussions	• Get insight in experts' best practices with regard to medical treatment of young children	• Article III
II: October–December, 2013	• Participatory observation of three children (aged 13–23 months) using prototype during nebulizer treatment • Semi-structured interviews with three parents and six nurses Data: Six video recorded treatments and eight audio recorded interviews	• Explore how children and caregivers use an interactive healthcare game during nebulizer treatment and gain understanding of related experiences	• Article IV

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For both field study periods, I chose to combine the research methods of participatory observation and semi-structured interviews. Participatory observation allows a researcher to explore a situation in terms of what happens and how it happens. I wanted to participate in children's nebulizer treatments so that I could get a good impression of what the treatment entailed both in terms of medical procedures as well as the unfolding interactions between the children, the caregivers, and the connected products: how did the participants act and express themselves? Moreover, I wanted to gain an understanding of how children's nebulizer treatment was experienced: how did the participants feel about and give meaning to the situation? Therefore, I chose to conduct semi-structured interviews with parents and nurses subsequent to the observations. The interview guides for the parents and the nurses covered the same topics.

During the first field study, a workshop was conducted as well. Similar to a semi-structured interview, a workshop can also be regarded as a research method in that researchers meet participants with a professional intention to ask questions and probe their ideas, attitudes, and experiences about pre-defined themes (Gall, Gall, & Borg, 2003; Kvale & Brinkmann, 2009).

The project was approved by the Regional Committee for Medical and Health Research Ethics of Central Norway (REK) and by head physicians at the hospital. According to the guidelines of the (Norwegian) National Committee for Research Ethics in the Social Sciences and the Humanities (NESH) from 2006, research that includes children under the age of 15 usually requires parental consent. Parents received oral and written information about the research project and gave their consent before the observations were conducted. The participating nurses received the same information and gave their consent. The adult participants were informed about their right to withdraw from the study, the incorporated requirements for storing sensitive data, and how the findings were to be presented in the dissemination of the research.

My initial intention was to include the child patients as active participants in the research. The project application, which was approved by REK, included the use of a framework called the *mosaic approach*, which is a methodology for child-friendly research (Clark, 2005). The framework, which is especially developed for communication with young children (below the age of five), builds on a view that

acknowledges children as competent meaning-makers and explorers of their own environments, and it includes a set of methods that acknowledges children's communicative strengths: for example, use of visual techniques such as drawing, photo, and film that can give impulses to dialogues. It turned out, however, that conducting research in a hospital setting was different from what I had expected. There are three main reasons as to why the mosaic framework was not used in the research: first, because the process of recruiting patients as well as conducting observations and interviews was far more complicated than what I had expected; second, because the majority of children seemed too young; and third, because it did not seem appropriate given the children's health conditions. In the following section, I discuss these points.

Hospital treatment for young children's respiratory diseases that are caused by viruses is mostly seasonally dependent and occurs during the winter. As such, the opportunity to conduct fieldwork was limited to the winter. After the project had been approved by REK and the collaboration with staff at the children's ward had been established, the first field study period started in January 2012. The head nurse at the children's ward was, because of her professional knowledge, essentially responsible for the first round of selection among the patients. Every morning I called the head nurse to ask if there were any patients receiving nebulizer treatment. Some days there were no patients, and other days there were patients that could possibly be relevant. Before I could meet parents to inform them about the research, the head nurse needed to consider many things. For instance, it was important that the families were settled at the hospital, which meant that she waited one day before informing the parents about the study. In some cases, however, children were ready to leave the hospital after one day and were not recruited for participation. Often, the head nurse would call me back later in the day to let me know what the situation was. It was important that I was flexible and could show up at the hospital on short notice. When the head nurse considered participation appropriate, I could meet the parents and inform them about the research. The same approach was followed in the second field study.

When entering the isolated room in which the families live during their hospital stay, I was sometimes accompanied by a nurse. Other times, I went in alone or together with a member from the BLOPP project. I tried to be sensitive to the situation. I became more conscious of my role as a stranger when I put on the white coat and sterilized my

hands before knocking on the door. In some cases, the children were sleeping when I entered the room. When the children were awake I tried to make contact with them in a friendly manner and carefully considered how to explain the purpose of the research to avoid any terms that could somehow provoke anxiety. All of the parents that I was in contact with agreed to participate.

Once parents had agreed to participate, I waited until the nebulizer treatment would be administered. Sometimes, a child had just received treatment and the following treatment would take place some hours later depending on the medical prescriptions and whether the child was awake or not. While waiting, I usually stayed in the nurses' break room where I had the opportunity to talk with the nurses and other medical staff. These conversations contributed to my understanding of experiences related to children's nebulizer treatment. I also wrote field notes while waiting.

Before a nebulizer treatment was about to begin, the responsible nurse provided me with relevant information about how the treatment would be administered and how the patient had previously responded to the treatment. I informed the nurses about the research and shared my previous experience from participating as an observer. Moreover, I encouraged the nurses to behave like they normally would. During the second field study, which included a prototype of an interactive healthcare game, the nurses were provided with a demonstration and encouraged to briefly explore it before the treatment was initiated.

I entered the patient rooms together with the responsible nurse and tried to be sensitive to the atmosphere in the room and adjust to the situation by carefully choosing the position and time to commence filming to avoid any disruption. When children seemed to act reluctantly I attempted to remain in the background and when the participants seemed to seek contact I acknowledged their expressions and joined in when it seemed appropriate. During the first field study, I was in some cases accompanied by a member from the BLOPP project. We were careful to ask the participants as well as discuss between ourselves whether our presence caused additional distress.

During the second field study, there were two cases that raised ethical questions. During my second observation of a boy called Billy[3], I interrupted filming because he was strongly resisting the treatment. After a while, I chose to leave the room because it felt wrong for me to be there. The other case concerns a boy called Charlie. In this case, even though he was resisting the treatment, I did not regard the situation or my own presence as participatory observer as inappropriate. However, the two nurses responsible for his treatment told me afterward that they would like to delete the video recording for ethical reasons. They felt that it was very uncomfortable to be filmed while administering treatment to a child who resisted in this way. Therefore, we agreed to delete the video recording of Charlie's first treatment. Consequently, I proposed that instead of me participating in the following treatment, they could tell me about it and how they experienced using the prototype instead.

Observation as a research method proved vital as a means to gain understanding of how children's nebulizer treatment is conducted and how the participants interacted with each other and the connected products. Participant observation affected the observed treatment situations in various and unknown ways; it is difficult to know how the children experienced my participation in their treatment. From a hermeneutical perspective, I considered a personal presence both necessary and unproblematic for seeking understanding of the interactions taking place, as long as it felt ethically responsible. Apart from the two cases mentioned above, I did not regard my presence as problematic. Rather, most parents and nurses expressed their appreciation for the research and therefore wanted to participate.

During both field studies, semi-structured interviews with one of the parents and with the nurse who administered the medication were conducted after the observed treatment. This also implied that I was flexible and ready to start whenever the parents and nurses were available. The interviews were conducted when and where it best suited the participants. The parents were interviewed in the hospital room or in a quiet part of the corridor, whereas the nurses were interviewed in the break room or other rooms that were available.

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[3] All names of participants are pseudonyms.

It was rather straightforward to get started with the interviews because I was familiar with the participants from the process of recruiting and the observations. The participants were already aware of my intentions with the interviews, namely that I was interested in their experiences related to the treatment. However, I started the interviews by repeating the purpose so that the participants had a clear opportunity to ask me questions. In most cases, the participants were eager to tell me about how they felt. It was an advantage that I had observed a treatment beforehand because we could use it as common point of reference. Most interviews took place on the same day as the observations.

I had prepared for the interviews by making a guide with themes and questions. The first interview made me aware that some questions were unclear and I reformulated the guide accordingly a bit. After I had conducted a few interviews, I also got more confident in my role as researcher. By now, I knew the questions by heart, which affected the flow in the conversation, enabling the interviews to proceed smoother in a way. I used the questions as guides and followed up the participants' answers by asking new questions as well. I asked permission to use a sound recorder, and while some of the participants started off a bit reserved because the conversation was recorded, they seemed to quickly forget about it.

During the first interviews, I started out by making notes, but I quickly realized that this hindered me from conscious listening. I decided to put complete trust in the sound recorder and shift all of my attention to the person who was dedicated to share lived experiences with me—not only what they said, but also how they said it. This reflection is important because I realized that the participants had chosen to spend time and share personal stories with me. Both time and experiences are precious parts of someone's life, especially as a caregiver to a sick child in the hospital, and cannot be taken for granted by a researcher. Therefore, at the beginning of the interviews, I told the participants that I was grateful for their contributions and that the interviews were expected to take about 20–30 minutes. I also reminded them that they could always withdraw from the research and how they could contact me with questions. Throughout the interviews, I tried to make sure that I understood the participants' viewpoints by asking additional questions and sometimes repeating what they had told me to get confirmation.

Combining observations and interviews thus turned out to be both time consuming and intense. After a day at the hospital I was full of new impressions. I was also constantly thinking about how my interpretations of the different kinds of information related to design from a human-centered perspective. All of the child participants that were recruited, apart from one, were two years old or younger. Regarding my intentions to include the children as active participants, I had expected to recruit more children in the age range of 2–3 years. As I got started with the observations and interviews, I quickly realized that my idea of including children through using methods from the mosaic approach would not be feasible. Besides the fact that the children seemed too young, their health conditions also required a lot of sleep and rest. Therefore, use of the mosaic approach was regarded as a poor fit for the field studies at the hospital.

Regarding the workshop as research method, the BLOPP team planned and conducted it in collaboration. My role was to act as main facilitator, while the members of BLOPP facilitated on a group level. With their different kinds of expertise from the sectors of healthcare and pedagogy, the five participants enriched our understanding of important aspects of children's medical treatment. While this method was limited to a few hours, the value of gathering a group of practitioners to creatively brainstorm and discuss different viewpoints proved high. Because the participants did not know each other, we started the workshop with some informal exercises to "break the ice." We also showed some video clips from the observed nebulizer treatments. Next, the participants were divided into groups accompanied by BLOPP members and brainstormed around given topics. One challenge of facilitating the workshop was to keep it according to our planned schedule. It was, for example, difficult to interrupt interesting discussions, yet necessary in order to make sure that every topic was attended to by each group.

Table 1 shows how the articles relate to different parts of the field studies. A selection of participants and related data has been made for the purpose of each article and is accounted for there. In accordance with requirements from REK, sensitive data (video and sound recordings and related transcripts) have been stored securely, and all participants from field study I a) and II) have been assigned pseudonyms.

2.3.3 Data analysis. Table 1 includes an account of the data that resulted from the chosen research methods, namely video and audio recordings as well as a collection

of sticky notes. In line with the inductive approach, I did not work with fixed research questions during the field studies. Rather, I tried to keep an open mind and let experiences from the field, discussions with co-authors, as well as reviewed literature shape and reshape my research questions. As such, the analytic approach evolved in parallel with the emerging research questions.

A thorough description of data analysis is included in each article. Table 2 presents an overarching account of the used approaches for transforming and analyzing data.

Table 2. Overview of Data Analysis Approach

Article and aim	Selected data	Transformation of data	Concept/ Phenomenon	Data analysis approach
Article I: 1) Gain understanding of experiences 2) Consider relevance to human-centered design	17 audio recorded interviews from field study Ia)	Transcribing all interviews verbatim	Care	• Phenomenological hermeneutics • Lifeworld existentials
Article II: 1) Explore how tact relates to children's cooperation 2) Discuss the role of medical products in cooperation	Five video recordings from field study Ia)	1) Transcribing verbal and nonverbal utterances 2) Creating narratives	Pedagogical tact	• Hermeneutics
Article III: Provide a set of design considerations	175 sticky notes from field study Ib)	–	Best practices	• Affinity diagram • Iterative, interpretative process
Article IV: Explore how children and caregivers make meaning with an interactive healthcare game	Six video recordings from field study II	1) Transcribing all conversations verbatim 2) Transcribing selected events with emphasize on multiple modalities 3) Transcribing all interviews verbatim[4]	Meaning- making	• Multimodal analysis • Iterative, interpretative process

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[4] Analysis of the interviews is not included in the thesis (see chapter 5.4).

Data analysis has generally followed an interpretative, or hermeneutics, approach. Data from observations, interviews, and workshop were carefully documented and stored. As the project matured, the gained understanding included insights related to earlier parts of the field studies as well. Therefore, field notes, conversations, and impressions from the first encounter with the hospital and the staff have contributed to my reflections and interpretations. The hermeneutic circle, the reflective process of moving from preexisting interpretations toward new interpretations and connecting "parts" with the "whole," has been an important approach for analyzing data. In articles I and II, hermeneutics is used as a specific term, while in articles III and IV, the data analysis has been described as an iterative and interpretative process. Through asking questions of the data and as such entering a reflective dialogue with the text, the data analysis has resulted in themes and considerations that capture essential meanings of the data in light of the posed questions.

Throughout the data analysis and the overall research process, attention has been paid to considerations about trustworthiness and rigor. The criteria of *credibility*, *transferability*, and *dependability* relate to the establishment of trustworthiness in qualitative research (Guba & Lincoln, 1989). Credibility is established when there is a match between the constructed realities of the respondents or stakeholders and the constructed realities of the researcher. One way to enhance credibility is through presentation of faithful descriptions and interpretations (Koch, 2006). Transferability concerns the extent to which the findings of one study are available for comparison in other contexts and the extent to which an audience views the findings as meaningful and applicable (Koch, 2006). The issue of dependability refers to the ways in which the research process can be audited (Guba & Lincoln, 1989; Koch, 2006). Through presenting a clear account of the decision trail by explicitly discussing decisions regarding theoretical, methodological, and analytic choices, the researcher can establish auditability (Koch, 2006).

Further, the expressions of *balanced integration*, *openness*, *concreteness*, *resonance*, and *actualization* are central for establishing rigor in hermeneutic research (de Witt & Ploeg, 2006). Balanced integration relates to three considerations: 1) a clear presentation of the philosophy and how it fits the researcher as well as the topic, 2) an in-depth interconnection of the philosophical concepts with the research method and

findings, and 3) a balance between the voices of participants and the philosophical account. Openness deals with how the researcher orientates and attunes toward the phenomenon throughout the research process as well as how decisions are accounted for. While the first two expressions reflect the research process, the three remaining expressions reflect the research outcome. Concreteness deals with the presentation of study findings and how the reader can relate to these, and resonance refers to the reader's experience of reading the study findings. Finally, actualization focuses on the future and how the research can be understood to continue and contribute in unknown ways through readers' interpretations (de Witt & Ploeg, 2006).

A basic tenet of hermeneutic research is the interpretative, namely that a dialogue, colored by preconceptions, takes place between a researcher and a text (Koch, 2006). Even though the reader might not share the author's interpretation, given that the preconceptions of individuals are expected to be unique, the reader should be able to follow the author's process of interpretation (Koch, 2006). The thesis has attempted to meet the abovementioned criteria and expressions of trustworthiness and rigor through providing clear accounts of theoretical concepts, seeking methodological consistency, presenting faithful descriptions and interpretations, and giving explanations for decisions. Whether these accounts actually respond to trustworthiness and rigor is essentially a matter of the expectations and judgment of each reader.

To summarize, this chapter has outlined the history of the project and central research collaborations. The interpretative/constructivist research paradigm has been described in terms of basic foundations, and the thesis has been positioned as research for human-centered design. Moreover, the research methodology has been described by outlining the theoretical background and presenting research methods, participants, and data. Finally, considerations related to data analysis have been discussed.

3. Related Research

3.1 Human-Centered Design and Children

3.1.1 Historical perspective on human-centered design. Human-centered design represents an overall perspective wherein *people* are at the core. Designers relating to this perspective try to pay special attention and sensitivity toward people who are expected to use or otherwise have an interest in the designed products or services. Human-centered design is a perspective that is widely embraced by the contemporary design field. To better understand the history leading to this embracement, one needs to look at developments in a bigger societal picture, which is done in the following section.

The transition from industrial to postindustrial society is relevant for understanding how design has moved from a technology-centered to a human-centered orientation (Cross, 1981; Krippendorff, 2006). Krippendorff (2006, p. 14) provided a comprehensive account of shifts that have taken place in society at large, including categories such as dominant currencies, economics, hierarchical models, and conflicts of concern. While these all relate to the big picture, two categories are particularly useful for this discussion: *knowledge* and *ontological explanations*. Regarding knowledge or epistemology (what counts as knowledge), there has been a shift from knowledge models established on universal truths and objective methods toward increased concern about social constitutive processes and human agency. Regarding ontology (the nature of reality), explanations have shifted from being mechanical/causal toward greater appreciation for reality as a social construct, implied human ability to create, construct, and realize. In this context and in line with these shifts, as shown in Figure 2, the field of design has also moved attention toward the people who live in and use the designed landscape—products, buildings, artifacts, technologies, and services.
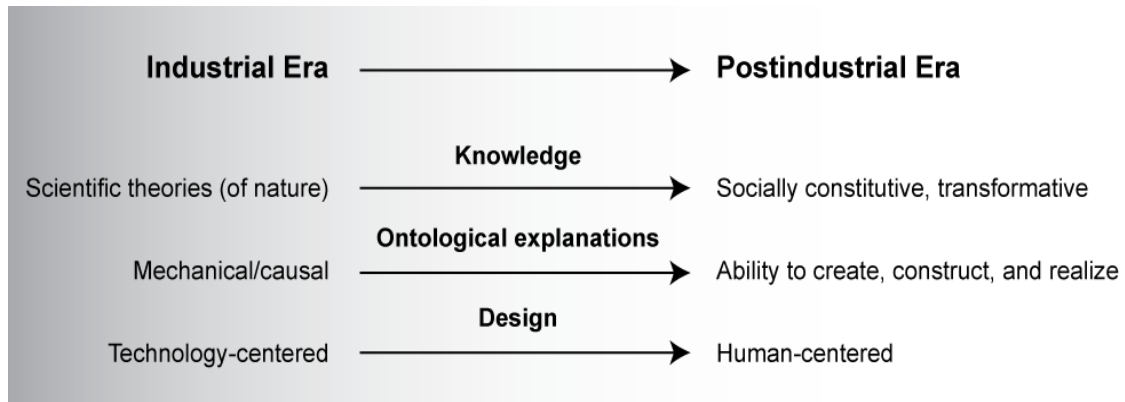
Figure 2. The shift toward human-centered design in societal context, adapted and modified from (Krippendorff, 2006, p. 14)

The transition from the industrial to the postindustrial era has been expected to result in a new paradigm for design (Cross, 1981; Krippendorff, 2006). However, according to Cross (1981), realization of the paradigm requires a reorientation of designers' values, beliefs, and attitudes and how these are manifested in the act and nature of design. This thesis is an attempt to contribute to develop approaches to support designers in their efforts to include people in and through their work.

3.1.2 Key issues in human-centered design. Human-centered design can be understood as an umbrella term for the range of approaches that reflect the attempts of designers and researchers to "cooperate with or learn from potential users of the products or services which they are developing" (Steen, 2011, p. 45). Steen (2011) identified six human-centered design approaches: participatory design, ethnography, the lead user approach, contextual design, co-design, and empathic design. Sanders and Stappers (2008) presented a similar overview in their model of the landscape of human-centered design. The human-centered approaches have different starting points and foci and also involve different methods and tools. According to Friess (2010, p. 42), the two common themes that connect human-centered design approaches are: 1) to conduct research with real people who are likely to use the product, and 2) to use that research to drive design solutions. As stated in the human-centered design standard ISO 9241-210, an explicit understanding of users, tasks, and environments forms the basis for design (International Organization for Standardization, 2010). The goal of human-centered design practitioners, then, is to develop products and services that meet the practices,

needs, and preferences of users (Steen, 2011). To this end, the human-centered designer seeks to understand how people act and experience certain situations and contexts.

Krippendorff (2007, p. 71) proposed five activities that define human-centered design: 1) designers invent or conceive *possible futures*; 2) designers are concerned with understanding *how desirable these futures are* to the people who might inhabit them. Accordingly, desirable futures reside in communication between designers and the people who will likely be using them; 3) designers *experiment with what is variable or could be changed*. These variables define a space of possible actions also called a *design space*; 4) designers *work out realistic paths*, meaning plans to move toward desirable futures, and 5) designers make *proposals* to those who could bring a design to fruition. These proposals must offer people possibilities to realize their desires and coordinate their actions toward something meaningful (Krippendorff, 2007). The content of these activities appears consistent with general design activity outlines. However, the wording of these formulations reflects a humble acknowledgement of human agency. Rather than portraying designers as "problem solvers," Krippendorff's account is sensitive to the role of designers as "proposal makers" and addressees as active agents: "those who could bring design to fruition." Buchanan (2001, p. 37) also reflected on human sensitivity:

> Human-centered design is fundamentally an affirmation of human dignity. It is an ongoing search for what can be done to support and strengthen the dignity of human beings as they act out their lives in varied social, economic, political, and cultural circumstances.

Adopting a human-centered design perspective requires recognition of people's agency, competence, and participation in the world. According to Krippendorff (2006, p. 40), a human-centered view holds that people are creative, accommodating, context sensitive, resourceful, and possessors of multiple intelligences, whereas machines are seen as unoriginal, rigid, and unimaginative. This is in stark contrast with the technology-centered view where machines are portrayed as precise, orderly, and logical as opposed to people, who are depicted as vague, disorganized, distractible, emotional, and illogical (Krippendorff, 2006). Even though these labels are pushed to extremes, they indicate that the attitude toward people has changed. A key concern of human-centered design is to adapt technology to people, asking how technology can support

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people rather than restrict them. Consequently, the design discipline has moved its focus from the notion of *designing of products* to the notion of *designing for a purpose* (Sanders & Stappers, 2008). If this purpose is experience, we can speak of experience design. Even if there exists no firm definitions for experience design, the following section will point at some main ideas.

Experience design can be understood as "the practice of designing products, services, events, and environments with a focus on the quality of the user experience and culturally relevant solutions, rather than a focus on increasing and improving functionality of the design" (Forlizzi, 2010, p. 60). Experience design aims at understanding how people interact with the designed environment and the related experiences. As such, the experience-centered designer is interested in people's lived experiences—their dreams, meaning-making processes, ambitions, fears, habits, memories, and relationships. Experience-based design thus goes beyond traditional usability aspects such as effectiveness and efficiency to emphasize subjective and social aspects in product interaction like emotions (e.g., Desmet & Hekkert, 2007; Desmet & Pohlmeyer, 2013; Hassenzahl, 2003; Hekkert, 2006; Jordan, 2000; Norman, 2007), aesthetics (e.g., Rozendaal & Schifferstein, 2010; Wright, Wallace, & McCarthy, 2008), values (e.g., B. Friedman & Kahn, 2002), and meaning- and sense-making (e.g., Battarbee & Koskinen, 2005; Wright, McCarthy, & Meekison, 2003).

In line with experience as general concern of human-centered design, this thesis places emphasis on experience. In design, experience is often referred to as *user experience* or *product experience*. According to Hassenzahl (2003), user experience includes "all aspects of interacting with a product" (p.11). Desmet and Hekkert (2007) shared an equally broad view by referring to product experience as "all possible affective experiences involved in human-product interaction" (p. 58). Even though various definitions of experience as applied in design appear to be similar, design researchers have addressed the issue of experience in various ways. The separate paths can be traced back to different schools of thought. This means that they do not share the same basic foundations about reality and knowledge (i.e., ontological and epistemological principles).

Considering how user experience is positioned in design, Battarbee and Koskinen (2005) described three distinct approaches to how the concept is applied and

interpreted: the measuring approach, the empathic approach, and the pragmatist approach. The measuring approach builds on the idea that experience is an emotional reaction. As such, designers can test and evaluate their prototypes by measuring people's emotional responses to them (Battarbee & Koskinen, 2005). Similarly, the empathic approach takes experience to be emotional in nature. The empathic approach, however, emphasizes the emotions of users as well as designers. Here, the focus is on design of products that can elicit experiences connected to people's needs, dreams, and motivations (Battarbee & Koskinen, 2005). The aim is to bring light to the designer's role and inspire empathic realizations for the users throughout the entire design process (Fulton Suri, 2003). Whereas the two aforementioned approaches view experience more or less through a psychological lens—seeking to identify components of experience and developing explanatory cognitive models (Battarbee & Koskinen, 2005; Wright et al., 2003)—the pragmatist approach takes a broader view by regarding experience as social, meaning-making processes (Battarbee & Koskinen, 2005; Blumer, 1986; Forlizzi & Battarbee, 2004; Krippendorff, 2006). Drawing on a pragmatist point of view, Battarbee and Koskinen (2005) used the term *co-experience* to highlight the social and contextual aspects of user experience: "people create, elaborate, and evaluate experiences together with other people, and products may be involved as the subjects, objects, or means of these interactions" (p. 15). Taking an empathic approach, however, does not necessarily rule out a pragmatic approach (Wright & McCarthy, 2008).

All of these approaches to user experience bring valuable input for the concerns of human-centered designers. Taken together, they can be useful throughout the entire design process, from the fuzzy front end to evaluation of prototypes and products that are already available on the market. However, a critical claim is that the concept of experience in design, also referred to as user experience or product experience, has not been well developed and therefore at risk to be fully realized in studies dealing with people and technology (Wright et al., 2003). Several authors claim that incoherence in human-centered design rests on uncritical adaptation of methods of contradicting research paradigms or worldviews (Dourish, 2006; Gaver, Boucher, Pennington, & Walker, 2004; Hussain, 2011; J.-J. Lee, 2012). Conducting research to understand people is a complex endeavor. Friess (2010) claimed, for example, that practitioners engaged in human-centered design tend to rely solely on quantifiable and easily

relatable user data to support design decisions. In a way this contradicts fundamental claims of human-centered design such as acknowledging people's competence and participation. If a "positivist" method and the designer's ambitions and knowledge do not match, a methodological gap appears (J.-J. Lee, 2012).

This thesis takes an interpretivist/constructivist approach to human-centered design. Regarding experience, the idea here is to embrace it as a complex and multi-faceted construct rather than to steer away from it. Moreover, the concept of meaning is understood as closely connected to experience:

> What an experience means to a person, defined in terms of intentions and consequences. Meaning is always triadic, involving interactions among a person, an object, and action taken toward the object. Meaning is interactional, interpretative, open-ended, often ambiguous, inconclusive, and conflictual. (Denzin, 2001, p. 160)

Similarly, the three basic premises of symbolic interactionism, as accounted for by Blumer (1986), are relevant for how people's meaning-making is understood. First, humans act toward things based on the meanings that these things have for them. In this context, the term *thing* is used to denote everything that exists in people's lifeworlds, such as physical objects, other humans, activities, values, and situations. Second, the meaning of things has its source in human interaction. This second premise represents a major line of difference compared to other dominant views that take the source of meaning to either be inherent in the thing or an expression of psychological elements. Third, people use and revise meanings in a process of interpretation. In line with these premises, meaning is understood to be a defining concern in experience and human-centered design.

Meanings, according to Krippendorff (2006), "do not merely occupy the central focus of human-centered design, they offer designers a new kind of 'becausality,' which is captured by the simple insight that *One always acts according to the meaning of whatever one faces"* (p. 58). Meanings are dynamic in the sense that they emerge, are maintained, and embedded in conversational and cultural contexts (Krippendorff, 1995). The meanings that people attach to specific products are also dynamic and will depend on personal, social, and cultural aspects. Furthermore, meanings are constructed through cognitive processes. Through interpretation, memory, and associations, we can, for

instance, recognize product characteristics and assess a product's significance (Desmet & Hekkert, 2007). From a human-centered perspective, designers are encouraged to take into account that the existence of products depends on being meaningful to the network of stakeholders (Krippendorff, 2006).

      3.1.3 Socially constructed views on children. This thesis seeks to contribute to the human-centered design principle about gained understanding of users by exploring how young children can be acknowledged as competent human actors. This section discusses the background for this aim by taking a closer look at what socially constructed views on children entail.

      Taking an interpretivist/constructivist approach implies that views on children and childhood are regarded as social constructions. This means acknowledging that there are countless different images of children and childhood, both in place and time. Moreover, different images of children and childhood are outcomes of different worldviews (Stainton-Rogers, 2003). Parallel to the societal shifts, in which design has moved from technology-centered toward human-centered, there exists a similar shift in sociology. Whereas previous sociological work portrayed children as pre-adult becomings, the emerging paradigm called *the new social studies of childhood* investigates children as social actors, that is, as beings in their own right (Halloway & Valentine, 2000; James, Jenks, & Prout, 1998) The emerging paradigm came forward as a critical reaction to the dominant use of positivistic frameworks in sociology and developmental psychology (James et al., 1998). What does it mean, then, to claim that children and childhood are social constructions? According to James et al. (1998, p. 27): "To describe childhood, or indeed any phenomenon, as socially constructed is to suspend a belief in or a willing reception of its taken-for-granted-meanings." Hence, the premise to acknowledge the concept of child as a social construction lies in consenting that "the child" is not a natural or universal category.

      Conventional images of children and childhood within Western constructions draw upon central ideas in British and French philosophy from the seventeenth and eighteenth century (Montgomery, 2003). Montgomery focuses on the philosophical basis for three discourses about childhood: the *Puritan discourse,* the *Romantic discourse* and the *Tabula rasa discourse* in which the images of children respectively are portrayed as "wicked and sinful," "innocent and wholesome," and "blank and

neutral." While the Romantic discourse, greatly influenced by the work of the French philosopher Rousseau, associates childhood with happy times of playfulness and naturalness wherein children are allowed to enjoy the moments before having to deal with adulthood's responsibilities and difficulties, the Puritan discourse is concerned with educating children to fit into society in order to control their lack of morality. The discourses resemble each other, however, by assuming that children have *innate* qualities of good or evil. The term Tabula rasa, as used in the philosophy of Locke, rejects the notions of innate qualities and rather constructs children as blank slates that are products of their environments (Montgomery, 2003).

According to James et al. (1998), these discourses, or pre-sociological set of models, do not take concepts of social structure into consideration. Nevertheless, their importance in contemporary times is recognized: "they are models which continue to inform everyday actions and practices alongside more sophisticated theorizing about childhood" (James et al., 1998, p. 21). Children have been and are constructed as different from adults for different reasons. One important reason that children are constructed as different from adults is related to their occupations of less powerful positions (Ribbens, 2003). This point of view is in line with the concept of social structure as referred to by James et al. (1998).

Looking at dominant Western constructions of children and childhood from the last century, childhood has been defined in opposition to adulthood by typically distinguishing adult "human beings" and child "human becomings" (N. Lee, 2001). According to Lee (2001), children were seen as weak and vulnerable because they were treated as investments that might be damaged. The dominant Fordist characteristics of Western businesses in the 1970s, such as stability, reliability, mass production, and hierarchical organization, was a "total way of life" and therefore indispensable in relation to the way adulthood has been constructed in Western discourses about childhood. By understanding adulthood as a stable and fixed period in terms of work and marriage, childhood came to represent the opposite: a time of instability and incompleteness (N. Lee, 2001). Consequently, images of children as dependent, passive, changeable, incomplete, and lacking self-control were taken for granted. According to Jenks (2005, p. 8), all "growth" metaphors that are used in discussions about children are indeed characterised by notions of a journey: what is yet to be, where childhood is

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understood as "becoming," tabula rasa, laying the foundations, growing up, preparation, inadequacy, inexperience, and immaturity.

A core idea in the new social studies of childhood, also labeled "childhood studies," is that children can be seen as independent *social actors* (James & James, 2009). This entails the acknowledgement of children's *agency*—their capacities to make choices about their actions and to express their own ideas (James & James, 2009). Focusing on children's agency enables exploration of how children's interactions with others "makes a difference – to a relationship or to a decision, to the workings of a set of social assumptions or constraints" (Mayall, 2002, p. 21, cited in James & James, 2009, p. 9). Hence, children's *competence* as social actors is fundamental to the emerging paradigm.

It is important to emphasize that the emerging paradigm does not deny that there are differences between children and adults in terms of biological and social characteristics. Compared to adults, children tend to be less well-developed regarding physical (e.g., in height and weight), mental (e.g., in intellectual abilities, cognitive skills, and ability to understand and reason), and psychological and social aspects (e.g., emotional maturity, social skills, and articulation) (James & James, 2009). These developmental criteria, essentially connected to age, are, however, seen as problematic and delimiting in that they lack precision. The argument of the emerging paradigm is thus that that age and developmental criteria need to be supplemented by acknowledging the importance of social and cultural contexts and practices (James & James, 2009).

3.1.4 Human-centered views on children in terms of competence. This section provides an account of the term *competence* as accounted for in the new social studies of childhood and presents an outline of how this concept is expressed in or relates to research dealing with design related to children as users of products.

Competence can be defined as: "The ability, capacity or qualification to perform a task, fulfil a function or to meet the requirements of a role to an acceptable standard" (James & James, 2009, p. 34). James and James (2009) drew attention to the basic meaning of this definition, namely that competence is understood in a performative sense referring to the ability to "do" something, rather than emphasizing the quality of such performance. This is an important point because competence is frequently

connected to chronological age: "This is as a result of the paradigm of children's development offered by developmental psychology, implicit in which an emphasis on children's relative *in*competence, immaturity and dependency" (James & James, p. 34). Moreover, James and James (2009) emphasized that competence, as a concept, is culturally relative and covers a wide range of attributes such as physical, cognitive, emotional, social, and moral capacities.

Along with this view, that children are social actors with agency and that they are competent in being and expressing themselves, emerged the need for developing new or adapted research approaches and methods corresponding to these constructions. Viewing children as social actors has comprehensive implications for research. Whereas the past tendency was to research *on* or *about* children, researchers gradually move toward doing research *with* children. Researchers within this paradigm thus have to reflect upon how to put these recognitions into practice when studying children and childhood and what it means to carry out research with children.

Assuming that these notions make up the framework for the researcher, conducting research today is perhaps more challenging than it used to be. An implication of viewing young children as competent communicators is that researchers and practitioners need to readdress their relationship with young children and accordingly their roles (Clark, 2005). A special challenge with child research is that all adults have once lived in childhood and therefore may believe that they have greater knowledge about children's culture than they actually do. Fine and Sandstrom (1988) argued that there is a tendency to assume that children's culture is very much similar to adult culture and as such children are often understood from an adult-centric perspective. Consequently, children's ways of acting might be interpreted through old or mistaken frames of reference. The questions that children are asked, for instance, often presuppose an adult theory of childhood.

Use of participatory methods with children has also gained popularity in design, and the discussions are centered on *how* rather than *whether* children can participate in the design process (Druin, 2002; Iversen & Brodersen, 2008; Nesset & Large, 2004). Most of this research is related to the human-computer interaction community. Druin (2002) identified four roles that children can play in design of new technologies: the child as 1) *User*; 2) *Tester*; 3) *Informant*; and 4) *Design partner*. Her well-known model

is shaped as a set of four water ripples, where the first inner ripple represents the role as a user and the fourth outer ripple represents the role as design partner, and it reflects how children's roles have changed during the last two to three decades. When children hold the roles of users, the purpose of the research is to evaluate existing technology. Theories for education and research methods are used to understand the impact that technology has on the user, such as development of skills. The role as tester refers to research involving prototypes of emerging technologies, which implies that children's experiences are considered valuable for improving products. As informants, children can participate in various stages of the design process, from offering ideas in the fuzzy front end toward testing prototypes in the later development stages. Finally, as design partners, children are considered as equal stakeholders in the design process. The significant idea here, from a human-design perspective, is the emphasis on children's impact on design of technologies and the design process.

Another relevant model is the Ladder of Participation, which Hart (1992) developed as a beginning typology for reflecting on children's participation in projects. The model distinguishes between non-participation and several degrees of participation. Inspired by the models of both Hart (1992) and Druin (2002), Hussain (2010) developed the Design Participation Ladder. The model describes three levels of participation: 1) *Included*; 2) *Consulted*; and 3) *Empowered*. As included, children's participation takes place when researchers observe them during use of products, prototypes, or services. Here, children are not given many opportunities to share their experiences and opinions directly; rather, the researcher relies on consultation with adults. As consulted, children are asked about their experiences but are not directly included in the design process. Designers seek to use methods that are adapted to children's ways of expressions in line with cultural and developmental aspects. Finally, as empowered, children learn design skills and take an active part in the design process. Designers put great effort into gaining an understanding of children's experiences and their contributions are considered to be important for design outcomes. Even though the model of Hussain (2010) is adapted to design projects addressing underprivileged children in developing countries, it is also relevant for other design projects related to children.

Even if there is a desire amongst designers to include children and to acknowledge their roles as active and competent actors, a consistent methodological

approach is by no means established (Iversen & Brodersen, 2008; Zaman, 2011). The theoretical assumptions in design are often limited to a developmental psychology perspective. Moreover, little is known about the young children's roles as competent actors and their opportunities to influence and participate in design (Hengeveld, 2011; Yarosh et al., 2011; Zaman, 2011). Hence, additional perspectives are considered necessary in order to explore the core ideas behind human-centered design and how they relate to young children.

3.2 Healthcare and Medical Product Design

Health can be understood as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1948). This holistic understanding of health as an interrelated state embracing social, emotional, and physical components represents a shift from mainstream medical practice, focusing on physical symptoms and complaints toward a patient-centered care that values the relation between the person and the caregivers (Mullaney et al., 2012; Szczepanska, 2011). Whereas design has traditionally not been associated with medicine, the emergence of notions such as healthcare design, medical design, and patient-experience design shows that this is no longer the case (Bate & Robert, 2007; Holzer & Holzer, 2007; Turieo, 2012).

There exist different definitions of medical products and medical design. A medical device can be understood as "an object, tool, or piece of equipment that clinicians or patients use to accomplish medical diagnostic or therapeutic tasks or activities" (Wiklund & Wilcox, 2005, p. xxii), and with a special emphasis on the patients, medical design can be understood as "introducing design into medicine and utilizing the advantages of good design to please patients" (Holzer & Holzer, 2007, p. 3).

Comprehensive definitions of medical devices are proposed by the European Medical Device Directive 93/42/EEC (European Commission, 1993), the World Health Organization (World Health Organization, 2003) and the U.S. Food and Drug Administration (FDA) (U.S. Food and Drug Administration, 2013). According to European classifications, a nebulizer is defined as a "drug-delivery product regulated as a medical device" whereas a nebulizer that is precharged with a specific medicinal

product is defined as a "drug-delivery product regulated as a medicinal product" (European Commission, 2010). The nebulizers that are used at the hospital belong to the former definition. The FDA regulates medical devices according to a three-level classification system based on the required level of control for assuring safety and effectiveness as well as the degree of associated risk to the patient and/or user (U.S. Food and Drug Administration, 2014a). Nebulizers with direct patient interface belong to device class II, which means that both general and special controls are required for approval (U.S. Food and Drug Administration, 2014b). For the purpose of this thesis, however, the definition of medical device as presented above is considered sufficient, and even though many standards distinguish between the terms medical device and medical product, the terms have here been used interchangeably.

A pleasurable experience with medical equipment is considered to be a critical component in users' adherence to medical treatment (Gloyd, 2003). According to Holzer and Holzer (2007), "There seems to be no field in which design would be more required or helpful than in medicine. Instead of sterile ambiences or cold technological devices, design may help reduce fears and increase acceptance" (p. 3). This is also the point of Turieo (2012) who claims that medical device manufacturers need to focus on reducing the existing gap between medical products and consumer products to improve patient adherence: "medical products generally look serious and functional, while consumer products are meant to evoke a delightful feeling from users" (p. 26).

Applying a human-centered design approach to healthcare contexts is important for at least two reasons. First, medical products and services that fail to respond to the needs of the users can at worst have disastrous consequences. As such, the healthcare context imposes designers with a special responsibility to ensure that products and services are well adapted to a wide variety of users, such as patients and healthcare personnel. Second, medical products are typically used and purchased because people need them rather than have a special desire to use them. Because users do not have a choice, it is crucial that designers are sensitive toward the users and the context through seeking gained understanding. According to Mullaney et al. (2012) human-centered design thinking is "ideal for finding new ways to generate the frame-shift required to think beyond the 'cure' to person-centered care and wellbeing" (p. 37).

Even though genuine application of design practice and design research in the domain of healthcare is still largely unexplored (Bate & Robert, 2007), an increasing amount of projects confirm that design efforts are being made in the healthcare domain. The company Philips Design has during the last two decades developed a people-focused innovation approach to healthcare and one of their projects called Ambient Experience focuses on design of the environment around the medical equipment and machines in order to improve experiences of patients, caregivers, and medical staff during treatment (Philips Design, 2010). Addressing the particular experience related to pediatric computerized tomography scanning (CT scan), research with pediatric specialists has led to the insights that narratives engage children and parents and when children gain understanding of what the treatment involves, they are more likely to cooperate. As such, the healthcare designers developed a toy CT scanner called the Kitten scanner that displays an informative animated story when children place a toy inside it (Philips Design, 2010). Moreover, the innovation and design company IDEO has dedicated teams of designers working on medical products and health and wellness to "humanize health care" and "help people lead healthy and happy lives through design" (IDEO, 2014). Also, the HCI community and several design conferences devote increasing attention toward healthcare.

User participation and cooperation is essential in human-centered design. Benefits of involving people in the development of medical device technologies include knowledge about user perspectives, generation of ideas, and improvement in design of devices and interfaces with regard to functionality, usability, and quality (Shah & Robinson, 2007). Even though these benefits are rather general in that they apply just as much to the development of any kind of product, the value of involving users in the specific domain of medical products is particularly vital for the success of a device (Shah, Robinson, & Alshawi, 2009). However, the practice of involving users in medical product design has been limited. Related key barriers include resources (e.g., time, money, and labor), user characteristics (e.g., availability and disability), manufacturers' attitudes (e.g., regarded unnecessary), and regulatory controls (e.g., ethical approvals) (Shah & Robinson, 2007). End users such as patients, people with disabilities or special needs, and lay carers are less likely to be included in the design

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process compared to healthcare professionals such as clinicians and nurses (Shah et al., 2009).

Even though children are also potential end users of medical devices, very little research has focused on their role in related design processes (Allsop, 2010; Allsop & Holt, 2013). As such, Allsop (2010) proposes that designers in healthcare technology direct attention to methods used in the domain of child-computer interaction (a sub-domain of HCI) as well as healthcare research involving children's participation.

The majority of existing research from the interaction design and children community deals with children between the ages of six to twelve years, and design frameworks or guidelines addressing younger children are scarce (Hengeveld, 2011; Yarosh et al., 2011). However, Hengeveld (2011) provides important contributions regarding this gap in focusing on design aimed at stimulating language development of non- or hardly speaking children aged between one and four years who have cognitive and/or motor limitations. Through a cyclical research-through-design approach, he developed and refined a prototype of a play-and-learn system called LinguaBytes. Drawing on phenomenology and ecological psychology, Hengeveld (2011) argues that the concept of meaning and understanding how objects can facilitate sharing of meaning between children and caregivers is essential for designers. Regarding methods for evaluating how young children and caregivers use prototypes, participatory observational studies combined with interviews and questionnaires with caregivers are considered useful (Hengeveld, 2011; Hengeveld et al., 2009).

Concerning use of participatory methods with children in hospital settings, Robertson and Balaam (2013) call attention to a number of ethical and practical challenges that can be considered relevant regardless of age. A key challenge is related to working with a group that is transient, which means that it is difficult to plan sessions appropriately as well as to build empathic relations. Moreover, the question of whether it is appropriate to ask children who are feeling ill, tired, worried, or sad to spend time on a project that might not seem relevant to them is raised. Also, constraints related to health and infection control can limit use and particularly participants' shared use of ordinary design materials such as Lego bricks, play dough, or technology (Robertson & Balaam, 2013). Therefore, participatory observations and listening to experiences of stakeholders without being intrusive as well as working with child representatives (e.g.,

previous patients or siblings) are considered beneficial methods for designers (Robertson & Balaam, 2013).

In healthcare research, young children are increasingly involved as participants. One important argument for encouraging and supporting the involvement of children in healthcare research is that it eventually can benefit many children (Alderson, 2007). This must be seen in connection to ethical aspects, which are often highly complex, and involves how researchers and caregivers view children. According to Alderson (2007), the status of children as competent decision makers is gradually gaining respect in healthcare and research, and, "Criteria for competence have moved from age toward individual children's experience and understanding" (p. 2272). Harder, Christensson, and Söderbäck (2009), studied three-year-old children's expressions during regular health visits at primary child health care centers. Based on overt video observations, their theoretical approach was to understand children as actors who express their subjective perspectives through the body (gestures, facial expressions, movements) and voice (talking and sounds) (Harder, Christensson, & Söderbäck, 2009). It is important to realize that when adult researchers seek gained understanding of these expressions, it is *their* interpretations of a child's perspective being presented (Sommer, Samuelsson, & Hundeide, 2010; Söderbäck, Coyne, & Harder, 2011). According to Söderbäck, Coyne, and Harder (2011), a child-centered approach in health care settings, wherein children are acknowledged and respected as competent actors, includes both the adult's child perspective (regarding the child's best interest related to care) as well as the child's perspective (regarding her or his preferences). This is also relevant from a human-centered design perspective and calls for designers' reflections about child perspectives and how to interpret children's expressions accordingly.

To summarize, this chapter has provided a historical perspective on human-centered design. Moreover, key issues of human-centered design have been presented and related to the interpretative/constructivist approach of the thesis. Further, socially constructed views on children have been discussed and related to the concept of competence. Finally, the topic of healthcare and medical product design has been introduced and related to research about human-centered design and children's participation in design processes.

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4. Summary of Articles

This chapter provides a summary of the four articles that are presented in the second part of the thesis. The articles are not presented in the chronological order in which they were written and completed but present a coherent story for the reader.

Article I: Høiseth, M. & Keitsch, M. M. Human-centered design: Using phenomenological hermeneutics to gain understanding of users in healthcare contexts. Submitted to peer-reviewed journal.

In this article, an understanding of users and use context in the case of children's nebulizer treatment is attempted through a phenomenological hermeneutics approach inspired by views of Heidegger, Gadamer, and van Manen. This approach is chosen because it encourages gained understanding of care as a phenomenon through an interpretative dialogue. Care is a central aspect of human interaction during medical treatment. Even though phenomenological hermeneutics is at its core an acknowledgement of the human-centered view based on lived experience, this approach has received limited attention in design literature. The purpose of the study was to gain understanding of how caregivers experience children's nebulizer treatment in terms of care and to provide an appraisal of phenomenological hermeneutics as a human-centered design approach. The article draws on interviews conducted with nurses and parents who have experienced nebulizer treatment of young children. Five themes that capture the phenomenon of care are then presented. Rather than appearing as obvious pointers to design solutions, these themes are considered useful as results in themselves to elucidate the care phenomenon for the design community and serve as inspiration. Regarding the methodology, phenomenological hermeneutics is coherent with a human-centered view, which rests on acknowledging human agency, competence, and participation. Conclusively, the phenomenological hermeneutics perspective is seen as a necessary supplement in human-centered design, where aspects connected to users' experiences are too often measured and averaged.

Article II: Høiseth, M., Keitsch, M. M. & Hopperstad, M. H. (In press). Interactions between caregivers and young children: Exploring pedagogical tact in nebulizer treatment. Accepted for publication in *Qualitative Health Research*.

This article explores interactions between parents, nurses, and young children during nebulizer treatment in terms of tact as a pedagogical concept. The purpose of the study was twofold: first, to explore how manifestations of pedagogical tact during caregiver-child interaction might relate to the children's cooperation in treatment that involves a medical product, and second, to discuss the role that medical products can play in this cooperation. Tact denotes a special form of human interaction as a mindful mode of knowing and being in social encounters and in this article, it specifically refers to relations between adults and children, serving as an expression of the responsibility that adults bear concerning children's protection and well-being. The analysis followed a hermeneutic approach and included narrative accounts based on video observations of five hospitalized children aged between 15 and 30 months. Four themes to discuss how caregivers' pedagogical tact might influence children's willingness to cooperate during nebulizer treatment are presented. These themes are understood as potential domains for positive interactions between the caregivers and the children, rather than fixed categories by which to describe the children's behaviors during medical treatment with respiratory products. In light of the themes, designers are encouraged to give a higher priority to aspects beyond technical improvements and to be attentive toward the role that medical products can play in supporting cooperation based on tact in pediatric contexts.

Article III: Høiseth, M., Giannakos, M. N., Alsos, O. A., Asheim, J., & Jaccheri, L. (2013). Designing healthcare games and applications for toddlers. In *Proceedings of the 12th International Conference on Interaction Design and Children* (137–146). New York: ACM Press.

This article draws upon a workshop that was conducted with experts from pediatric healthcare and pedagogy to gain understanding about their best practices with regard to medical treatment of young children (toddlers). The purpose of the study was to provide a set of design considerations for healthcare games and applications for toddlers. The motivation for this is that while healthcare games are becoming increasingly popular because of their potential to improve patients' well-being before, during, and after medical treatment and even though toddlers make up a growing group of gamers, there is a lack of research focusing on healthcare games for this group. The collection of best practices from the workshop was categorized by a focus group

through the use of an affinity diagram technique. The affinity diagram was used for establishing a connection with game components and finally for constructing design considerations. A healthcare game prototype called BLAPP is presented to serve as an illustrating example. BLAPP was developed to improve toddlers' experiences with nebulizer treatment in a hospital setting. Whereas the affinity diagram can serve as inspiration for opening up areas wherein designers can contribute to support desired relations between children and healthcare professionals, the final result of this work is presented as seven design considerations that can serve as useful guidance in the design process of healthcare games and applications for toddlers.

Article IV: Høiseth, M. & Hopperstad, M. H. "Now we are going on a journey": Meaning-making with a healthcare game during toddlers' medical treatment. Submitted to peer-reviewed journal.

This article explores how toddlers and caregivers use the interactive healthcare game BLAPP on a tablet during nebulizer treatment at the hospital. The study followed a social semiotics perspective and included multimodal analysis based on video recordings of six nebulizer treatments of two children aged 21 and 23 months. The approach was to define the game as a multimodal text and its use during treatment as text events. The purpose of the study was to explore the text events that occur as children and caregivers use the game and more specifically to explore their meaning-making orientations through which text events develop. This article builds on findings from article II by aiming to illustrate the potential that a healthcare game might hold for constituting a shared focus. While there is widespread support that distraction, such as games, can help children cope with medical treatment there is a lack of qualitative research exploring *how* children and caregivers initiate and engage in such activities. Social semiotics offers a framework for studying the use of BLAPP in terms of multimodality, which refers to the wide variety of meaning-making resources that people hold. Recognizing children's perspectives and agency as meaning-makers was attempted by studying how they, together with their caregivers, used the healthcare game as a medium for meaning-making. The findings show that the participants' meaning-making appears to have a narrative and an analytical orientation. When children and caregivers share their meaning-making orientations in the text events, the

medical treatment can be brought into the background. Conclusively, it is suggested that the potential of healthcare games lies in the creation of text events.

5. Conclusions

This chapter presents the contributions of the research by elucidating how the three research questions have been answered. Next, reflections of strengths and limitations as well as lessons learned are presented, and finally suggestions for future research are given.

5.1 Contributions of the Thesis

1. How can the view of people as competent human actors be upheld when designers address young children?

The study presented in **article IV** illustrates how a social semiotics approach including the key concepts of meaning-making and multimodality can be used to acknowledge people—young children as well as adults—as competent human actors. From a social semiotics perspective, people are, regardless of age, understood as holders of a wide range of meaning-making resources that they use with an intention to convey meaning. Moreover, meaning-making is understood as a process that is socially situated. By observing how young children express themselves through multiple modalities such as speech and sound, gestures, and gazing and further interpreting this in light of the concept of meaning-making, designers may gain understanding of young children as competent human beings, which in turn can contribute to enhancing their status as product users and as members of the designed environment. Gaining recognition and understanding about the many languages, that is, the multimodalities that people hold and use to communicate meaning, beyond the verbal is thus considered to be essential for human-centered designers who specifically address young children (as well as people of all ages).

The study presented in **article II** is an attempt to recognize children's perspectives and agency as patients. The concept of pedagogical tact is a relevant way of framing and understanding interactions between adults and children. This concept is also useful for understanding the role of the designer. Focusing on children as the primary user group for a product, particularly in healthcare contexts, also implies considering related caregivers as a user group. The research shows how the concept of pedagogical tact can serve as an analytical tool for interpreting interaction between

caregivers and children. Through observing, narrating, and interpreting caregiver-child interactions in light of pedagogical tact, designers are prompted to reflect upon existing and desired views of young children and also how the designed world plays a role in manifesting human-centered views.

To summarize, adopting a conscious human-centered view regardless of people's ages or social status can be seen as an exercise in ethics as well as creativity. It is important that a designer's human-centered view is manifested through methodological consistency. In the case of understanding young children as product users, designers need to reflect upon how methods and analytical concepts acknowledge their competence.

2. How can theories and methods support designers to gain understanding about experiences of young hospitalized children and their caregivers?

Article I shows how a phenomenological hermeneutics approach can be used to gain deeper insights into the lived experiences of users. Through conducting interviews and interpreting care as a phenomenon within an interpretative dialogue, one can become more responsive to users' lifeworlds when it comes to developing products and services aimed at supporting more humanizing healthcare practices.

Article II shows how participatory observation in a naturalistic clinical context fosters valuable insights for a designer to approach and better understand experiences of children and their caregivers. Moreover, following a hermeneutic approach for analysis, the designer is supported to enter a reflective dialogue with the observed situation including the users, tasks, and environments for new interpretations about needs, values, and solutions.

Article III discusses how working with domain experts can inform and inspire designers to formulate practical design considerations based on best practice experiences.

Article IV shows how prototypes (here in the form of a healthcare game) can be introduced to a naturalistic clinical context to gain understanding about how design (as product) might fit the needs of young hospitalized children and their caregivers. Participatory observation and interpretation based on multimodal analysis appears to be a useful approach for deeper understanding about how young children use products in terms of related meaning-making processes in social contexts.

3. How can design (as product) foster cooperative interactions between young children and their caregivers during medical treatment?

Article II presents four themes that appear as potential domains for positive caregiver-child interactions during medical treatment:

- Shared focus
- Social rituals
- Interaction with comforting objects
- Bodily closeness

The two first themes stand out as the most relevant features of caregiver-child interactions concerning children's cooperation. Based on these, designers are encouraged to be attentive toward the role that medical products as well as other related products can play in supporting cooperative interactions. Product properties that support pedagogical tact can be of great importance for enhancing children's cooperation during medical treatment and for achieving a successful treatment in general. It is suggested that products or actions can become meaningful to young patients in treatment when they are able to experience or enjoy it together with their caregivers through shared focus and social rituals.

The study presented in **article IV** explores how a shared focus may be realized through meaning-making with a healthcare game. The study identifies how children and caregivers make meaning with the game, regarded as a multimodal text, through creating text events. It is suggested that the potential of healthcare games lies in the creation of text events where the game constitutes a shared focus. When children and caregivers share their meaning-making orientations, the medical treatment appears to be a less relevant aspect of the context and can be brought into the background. This represents a good example to meet the question above.

In summary, the four domains for positive caregiver-child interactions together with the concept of meaning-making through creation of text events are considered to be relevant starting points for improving and evaluating existing medical products and non-pharmacological products used as interventions. Moreover, they are useful as inspiration for opening up new design spaces aimed at promoting cooperative caregiver-child interactions during medical treatment and in other healthcare contexts.

These contributions are expected to be valuable for designers involved in practice as well as research addressing young user groups, healthcare contexts, and medical product design. Additionally, the thesis is relevant for pediatric health personnel and people involved in purchasing products for hospitals and other healthcare clinics.

5.2 Reflections on Strengths and Limitations of the Research

The overarching goal of the thesis has been to support the human-centered designer who is concerned with young children in healthcare contexts and as users of medical products. Another goal was to stimulate debate and raise awareness about user groups that are commonly overlooked and perceived as difficult to reach. In order to address these goals, the thesis has examined questions that relate to human-centered design principles about gaining understanding of users and the context of use as well as user-centered evaluation. In the following, a reflection on the strengths and limitations of the research is given.

An important strength of this thesis lies in its contribution to design literature regarding an alternative view toward children as a user group. While young children represent a user group that has largely been overlooked in design literature, older children get increasingly more attention as users of products and as participants in design processes. A tendency is, however, that the ways in which children are portrayed in design, that is, the adopted view on children, does not seem to match a human-centered design perspective. Design is an interdisciplinary field and hence draws on literature from various domains. Design research involving children, however, tends to rely mostly on concepts from psychology. The thesis contributes to design literature by uniting the human-centered design paradigm with corresponding paradigms or views from other fields, notably contemporary childhood studies and pedagogics. The research explores how recognition of people's agency, competence, and participation in the world applies to young children as well as adults. The concepts of pedagogical tact, meaning-making, and multimodality are considered suitable for emphasizing children's competence as social actors, who through their ways of acting and expressing themselves influence and shape relationships with others. As such, the thesis contributes to raising awareness about how human-centered design can relate to young users.

The selected literature can be regarded a limitation as it is a small part of all the literature that is available. The choice of literature reflects the exploratory process in which the research as well as my own role as researcher has been shaped. For example, some of the literature that I found useful early on in the process did not seem valuable some months later, and texts that initially seemed of no use proved to be highly relevant some years later. Throughout the process, my interpretation of central concepts has also changed and contributed to interest in new literature. Essentially, the choice of literature has been motivated by my evolving interpretation of the human-centered perspective wherein concepts such as experience, human interaction, and meaning-making are central. As such, several issues such as production, marketing, and economy have been outside the scope of the research.

Another strength of the thesis lies in the methodological contribution to research in human-centered design. Through combining theories, methods, and approaches from the interpretivist/constructivist paradigm (e.g., phenomenological hermeneutics, hermeneutics, social semiotics, multimodal analysis, and affinity diagram) the research illustrates how methodological coherency can be strengthened.

The research in this thesis builds on fieldwork that has several limitations. A considerable limitation is that the children occupied a less powerful position as participants in the research. Acknowledging children as competent actors—competent to make choices about their actions, expressions, and meaning-making processes and holders of their own experiences—did not necessarily make me capable of understanding their experiences. Conducting research with young children comes with extra challenges because adult researchers usually depend on verbal language in communication with participants. When this opportunity is lacking, the researcher faces significant challenges. Rather than discussing interpretations directly with the young child participants, the dialogues with caregivers and co-researchers contributed to shaping my interpretations. In addition to entering a dialogue with stakeholders, a reflective dialogue with the situation or data was established. An advantage of following a hermeneutic approach is that it stimulated reflections about my view on children and how to interpret children's expressions accordingly.

Further, the fieldwork has limitations in terms of location, time, as well as number of participants. Moreover, one prototype was explored during the second field

study. Once the fieldwork was initiated after agreements with the hospital staff, an inductive approach was followed. The number of observed treatments and conducted interviews did not govern decisions about when to end the fieldwork. Rather, the fieldwork lasted until data allowed for a detailed and in-depth exploration.

The research has also been limited to one kind of medical device, namely the nebulizer devise used in nebulizer treatment. One advantage of such narrow focus is the capacity for deep exploration, scrutinizing how participants use the same device in various ways and realizing that the device is actually not the same but rather that its character depends on how participants interact with it and assign meanings to it. A nebulizer device is not necessarily the same product for a toddler, a parent, or a nurse. The thesis contributes with knowledge about how children's acceptance toward a medical product is related to social interaction with caregivers.

The thesis also provides contributions for practice. Firstly, it provides valuable insights from working with pediatric and pedagogic specialists as well as a set of design considerations for healthcare games. Secondly, it presents a set of themes that can serve as inspiration for design of products that relate to young children's medical treatment. Thirdly, it shows how prototypes can be an approach for including young children in the design process. A designer may indeed face great challenges if attempting to conduct activities such as brainstorming, co-design sessions, and interviews with a group of one-year-old children in a traditional way. However, the ways in which young children use prototypes can be valuable for informing designers. According to frameworks about children's roles in design, Druin (2002) distinguished between the child as user, tester, informant, and design partner and Hussain (2010) distinguished between participatory roles as included, consulted, and empowered. The roles that young children can have depend also on researchers' view on children and *how* children's use of prototypes is interpreted. One reason as to why young children can appear hard to reach and relate to can be designers' habitual way of working. For example, ideas are often communicated verbally or visually. Prototypes represent a medium through which young children can express and demonstrate different ideas and opinions. As such, prototypes can be considered a medium that can bring young children and designers closer to each other. Developing and exploring prototypes at an

early stage of the design process instead of a later stage can be a way to encourage children's participation beyond a role as users, that is, as competent social actors.

To summarize, the thesis supports the human-centered designer in different ways. In terms of literature, it provides a new view of existing theories that position children as competent actors. Related to methodology, the research combines theories and uses methods from the interpretivist/constructivist paradigm that is coherent with a human-centered design perspective. Finally, with respect to practice, the research can inspire designers to establish a conscious human-centered view regarding people of all ages on which design (process and product) can be based. Moreover, the research is interdisciplinary and is expected to be relevant for researchers and practitioners within healthcare and pedagogy as well. As such, it should contribute to raise awareness about young children as users of medical products and stimulate debate in several communities.

5.3 Lessons Learned

Conducting research with hospitalized children is challenging for different reasons. One reason is that research in healthcare contexts falls under a comprehensive set of ethical guidelines. A detailed research protocol had to be prepared for evaluation by REK and by head physicians at the hospital. During this process, my collaboration with the BLOPP team was very valuable and enabled me to establish initial contact with the head nurse at the children's ward. Preparing the research protocol was useful for sorting out different ideas and sketching out a selection of methods. The project was approved by REK and the hospital. An important lesson learned is that the process of preparing research for ethical approval (proposing a research plan, evaluating the application, modifying the plan based on received comments or additional information, and submitting an application for a new evaluation) can be a time-consuming process. It is important to take this into account when planning a project. At the same time, the ethical guidelines have been very useful for reflecting about a number of issues that can occur. The guidelines are intended to protect potential research participants as well as the researcher and should be taken seriously.

Furthermore, the process of gaining access to research participants is challenging in that the researcher needs to be very flexible. For initiating contact with

caregivers and children, the collaboration with the hospital staff has been crucial. The hospital staff has to be included in planning of the fieldwork and they define the terms for a scheme that corresponds to their ways of working. In order to achieve their engagement, the researcher should ask about their views and how they think that the research can influence them and the patients in both in a short-term as well as a long-term perspective. This research was essentially grounded in the everyday caring practices of the nurses at the children's ward. The nurses encouraged the initiation of the BLOPP project and were very appreciative toward the research. At the same time, they made it clear that the patients and their families were always their main concern. The agreement was made that I could call to the head nurse every morning and that she would follow up by assessing whether patients and parents could be contacted. This way of establishing contact with potential participants for the research meant that I had to be ready to show up at the hospital immediately, be on hold, or wait until the next day. This requirement for flexibility was essential. In addition, nebulizer treatment is mostly administered in the winter season, which put further restrictions on the fieldwork. Even though the process of gaining access was not as straightforward as in many other cases, the most important concern was to make sure that our approach was proper.

Being a participant observer during medical treatment of young children can also be challenging. While I observed several treatments that proceeded without noticeable power struggles, there were also several treatments wherein children and caregivers clearly were not cooperating and in some cases children protested intensely. As an observer, I tried to consider consciously whether my presence was acceptable or not. The situations were more private than what I had expected, and even though the caregivers had consented to my presence, it was more difficult to interpret how the children thought about being observed and filmed. In the moment, I had to rely on my own judgments. After the observations and during the interviews, it was helpful to discuss such issues with the participating nurses and parents. In the few cases wherein observation/video recording was considered inappropriate, I experienced it as both relieving and frustrating—relieving because it was a moral action to stop observing and delete the material and frustrating because the observation had been considered intruding, which also meant that the material could not be used.

Finally, prototyping for exploration in naturalistic clinical contexts is not straightforward. A lot of precautions have to be made. A requirement that was defined in the research protocol for REK was that prototypes intended for exploration would not directly influence the medical function of the nebulizer device. Prototyping of medical products would require a whole different application and approach. There are, for example, strict requirements that materials need to withstand certain ranges of temperatures. The intention of this project was rather to gain understanding of the diversity in design space, which was not necessarily restricted to the medical device as such. The tablet for the healthcare game was put inside a protective case that could easily be disinfected. The case was disinfected after each observed treatment. In between treatments, it was important to remember to charge the tablet so that it was ready for the next treatment. Bringing a prototype into the medical treatment also meant that caregivers were given an additional thing to think about. When researchers bring prototypes into a situation like this, it is important to state clearly that participants are in full charge as to how they use it and if the prototype interferes with their intentions, they can stop using it.

One of my main motivations for pursuing a PhD project was that I believed it could make me a better designer. Throughout the project, I have become more attentive toward the important roles that questions have. I have learned a lot from the process of constructing questions, finding ways to answer questions, and connecting questions to theory, entering a dialogue between "parts" and the "whole" on different levels. Such a hermeneutic approach is valuable for practitioners and researchers, whether one's field of interest is design or a different domain. Human-centered design is about people and how the environment suits their lifeworlds. Many aspects are beyond designers' work. However, through this project I have learned that human-centered design is just as much about asking the right questions as it is about proposing solutions. Human-centered design perspectives and principles do not exist as static definitions; rather, people continuously interpret and fill such notions with meaning in social and dynamic processes. The thesis is as such regarded as a small piece in a big picture, which hopefully can inspire to further movement of human-centered design in desirable directions.

5.4 Further Research

Regarding my personal continuation of the research, the data from the field studies still offer opportunities for further research. The in-depth exploration of selected data implied that the interviews from the second field study were not applicable for the current study. This is, however, interesting material, which would be valuable to elaborate for further development of knowledge. Moreover, interpreting data in light of other theoretical perspectives, for example, regarding play would be interesting and is expected to yield new valuable findings. These opportunities for further research with existing data are related to the richness of data that is often realized through qualitative methods.

Children's experience with medical treatment and products is an important topic that deserves increased research consideration. The following suggestions for further research should be relevant for researchers, practitioners, and educators in the design community.

The thesis has contributed to research concerning human-centered design and has investigated the specific case of hospitalized young children who receive nebulizer treatment for respiratory diseases. However, more research is needed to understand how design can benefit patients and caregivers with regard to nebulizer treatment. Future research in this area should include long-term studies in naturalistic clinical contexts with exploration of different experience prototypes (of both the medical device as well as other kinds of products such as healthcare games). Long-term studies would be beneficial because they allow for assessment over time, include more participants, and give opportunity for several design iterations. For example, healthcare personnel can assess prototypes according to their daily activities and a larger group of patients and parents can participate.

Nebulizer treatment is merely one of many treatments that call for designers' attention. Research focusing on human-centered design related to other medical treatments and products is also necessary. To broaden knowledge and gain understanding about young children in healthcare contexts and as users of medical products, future research about how design relates to time consuming, painful, or scary hospital treatments as well as treatment for chronic diseases, general medicine use, and

hygiene routines is encouraged. Research that addresses use of human-centered design in the medical device industry is also needed.

The focus on young children as a patient group challenges researchers' interpretations of their lived experiences. This research has attempted to meet these challenges by interpreting the verbal and nonverbal expressions of the children similarly to those of the caregivers through the use of narrative accounts and multimodal analysis. Further development of these approaches is necessary to acknowledge children as competent actors. Moreover, studies that explore how children and caregivers can participate as co-designers within healthcare contexts would be valuable.

In general, more studies that take a human-centered design perspective to healthcare contexts are needed to build a stronger bridge between design practitioners, healthcare practitioners, and patients. When more field studies, workshops, and design activities are introduced to healthcare, healthcare practitioners and patients can hopefully gradually influence the designed surroundings and products, and underlying choices to participate in research and design processes might be more motivated by a growing certainty that their lived experiences and opinions matter to designers.

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Part II: Collection of Articles

Article I

Human-Centered Design:

Using Phenomenological Hermeneutics to Gain Understanding of Users in Healthcare Contexts

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Human-Centered Design:

Using Phenomenological Hermeneutics to Gain Understanding of Users in Healthcare Contexts

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The use of medical products differs from so-called everyday products in that people need them, rather than have a special desire to use them, and also because the use contexts often relate to care. For human-centered designers, it is essential to understand users as well as use contexts, and more research is needed about how products and services can facilitate improved healthcare experiences. In this article, an understanding of users and use context in the case of children's medical treatment is attempted through a phenomenological hermeneutics approach inspired by the views of Heidegger, Gadamer, and van Manen. We chose this approach because it encourages gaining an understanding of care as a phenomenon through an interpretative dialogue. Based on an analysis of interviews conducted with nurses and parents who have experienced medical treatment of young children, we present five themes capturing the perspectives of the phenomenon of care in the case of children's medical treatment. Another outcome of this analysis is an appraisal of phenomenological hermeneutics as a human-centered design approach and its utilization for the design of medical products. We argue that its strength lies in the dedication toward lived experience, responding to a human-centered view that acknowledges human agency, competence, and participation.

Keywords – Healthcare, Human-Centered Design, Phenomenological Hermeneutics, Phenomenon of Care.

Relevance to Design Practice – This article explores how phenomenological hermeneutics fits within human-centered design and suggests that it is valuable for informing and inspiring designers addressing lived experiences of users in healthcare contexts.

Introduction

Human-centered design represents an overall perspective wherein human needs and concerns are the foremost drivers for the development of technologies. As such, human-centered design research deals with people who use or who are potential users of products and services, and it aims to provide frameworks that can contribute to more successful solutions (Roth, 1999). Human-centered design applied to healthcare contexts is important for at least two reasons. First, medical products and services that fail to respond to the needs of the users can, at worst, have disastrous

consequences. As such, the healthcare context imposes designers with a special responsibility to ensure that products and services are well adapted to a wide variety of users, such as patients and healthcare personnel. Second, medical products are typically used and purchased because people need them, rather than because they have a special desire to use them. Because users do not have a choice in using these products, it is crucial that designers are sensitive toward the users and the use context through seeking gained understanding.

There is a need for more knowledge on how designers can gain an understanding of people's experiences with products that they are compelled to use for medical reasons. Despite the desire to pay special attention to people, the application of human-centered design principles in healthcare contexts can be challenging for a number of reasons. Health-related issues are often vulnerable. For this reason, it can be difficult not only to actually come in contact with people and involve them in studies but also to relate to people's experiences, which can be demanding. As such, healthcare contexts often challenge designers because people and their situations can appear hard to reach and relate to.

This article is an attempt to understand how human-centered designers can benefit from taking a phenomenological hermeneutics perspective for meeting users in healthcare contexts. We are not drawing an explicit distinction between the notions of hermeneutic phenomenology and phenomenological hermeneutics. As Paul Ricoeur (1975, p. 93) emphasized in "Phenomenology and Hermeneutics", "The question is no longer to define hermeneutics as an inquiry into psychological intentions which are hidden in the text, but as the explication of the being-in-the-world shown by the text."

An analytic distinction can be made in that phenomenological hermeneutics is sometimes used to describe a method aiming at a certain phenomenon (Lindseth & Norberg, 2004), while a characteristic of hermeneutic phenomenology is to present a rich and deep account of the phenomenon by simultaneously acknowledging one's own implicit assumptions about it as well as one's attempt to make them explicit (Cohen & Daniels, 2001). One reason to choose phenomenological hermeneutics for this article is that to be hermeneutic means to be aware of one's own perceptions and experiences in a subjective, cultural, and historical context (this is referred to as the lifeworld) and include them in the interpretation process. Thus, in the ductus of phenomenological hermeneutics, the main question of this article is not "How should we analyze care?" Rather, it is one of the following: How do the stakeholders experience care in the hospital situation? What is the core of their experience? What can I, as a designer, learn from them, and how? The results of such a research is then to elucidate what a particular caring experience means for parents and nurses in order to learn more about how to design sensible products for children's medical treatment.

In this article, care related to the medical treatment of young children is explored. More specifically, we examine the phenomenon of care related to caregivers' (parents' and nurses') experiences in the case of young children's nebulizer treatment. Nebulizer treatment is used for

treating respiratory diseases. In design research, the interest toward young children as a user group has been limited. One reason can be that young children are perceived as a hard-to-reach group. The design of medical products for young children is even less discussed. The purpose of this article is two-fold: 1) to gain an understanding of how caregivers experience children's nebulizer treatment in terms of care and 2) to provide an appraisal of phenomenological hermeneutics as a human-centered design approach.

The article is structured as follows. First, we present key principles of human-centered design and phenomenological hermeneutics. We argue that exploring the phenomenon of care is crucial for understanding the context in which medical products are being used. Next, we discuss a case dealing with nebulizer treatment of hospitalized children with respiratory diseases. Phenomenological hermeneutics is introduced for interpreting interviews conducted with parents and nurses in terms of care, and five themes that capture the notion of care are presented. Conclusively, we reflect on phenomenological hermeneutics as a human-centered design approach, and we also examine its utilization for the design of medical products and services.

Human-Centered Design and Phenomenological Hermeneutics

Key Issues in Human-Centered Design

Before turning to human-centered design, some aspects of the term "design" are briefly outlined. At the bottom line, design is seen as both a process (human activity involving the use of creativity, tools, and methods) and an outcome (e.g., products), as is commonly agreed upon (Lawson, 2005). Moreover, design is about "solving problems, creating something new, or transforming less desirable situations to preferred situations" (Friedman, 2003, p. 507). Design is a family of several professional fields, including fashion design, interaction design, architecture, engineering design, and product design. Yet such a distinction is often considered less interesting, given that design is inherently multifaceted and that disciplinary crossovers typically yield novel results (Lawson & Dorst, 2009). As such, it makes more sense to focus on the interventionist character of design, namely as a discipline that "seeks to bring about change by developing and staging artifacts and environments that alter how we perceive and act in these volatile conditions" (Dalsgaard, 2014, p. 148).

Regarding design as a process, we follow the notion that design is essentially a hermeneutic practice wherein the designer moves between the whole and the parts to understand people's needs and how to respond to those through design (Hallnäs & Redström, 2006; Jahnke, 2012; Snodgrass & Coyne, 1992). The designer, thus, works in an iterative process, which Steen (2011) understood as a tension between a concern for *what is* and *what could be*. Regarding design as an outcome, technological developments during the last decades have resulted in a shift from industrial products toward less tangible artifacts, such as information, software, communication networks, and services (Krippendorff, 2004).

Design is ultimately about *people* whom designers seek to address through their work. Human-centered design represents an overall design perspective wherein the desire to *understand* people is at the core. According to Krippendorff (2006, p. 40), a human-centered view holds that people are creative, accommodating, context sensitive, resourceful, and possessors of multiple intelligences. An instant reaction may be that this is rather obvious. However, the shift from a technology-centered view toward a human-centered view did not come about randomly. On closer inspection, there exist several examples of how products have been designed with lacking consideration for people's interactions and experiences. Consequently, human-centered design can be understood as a shift in focus from the notion of *designing of products* to the notion of *designing for a purpose* (Sanders & Stappers, 2008).

According to Buchanan (2001, p. 37), "Human-centered design is fundamentally an affirmation of human dignity. It is an ongoing search for what can be done to support and strengthen the dignity of human beings as they act out their lives in varied social, economic, political, and cultural circumstances." As such, adopting a human-centered design perspective entails recognition of people's agency, competence, and participation in the world. This view on people resonates with the basic foundations of the interpretivist/constructivist research paradigm. This paradigm assumes that reality is a social construct. Multiple realities exist, and they are co-constructed in processes that are both individual and collective (Lincoln, Lynha, & Guba, 2011). On a methodological level, then, the principles on which human-centered design rests can be understood as fundamentally different from a positivistic worldview where the assumption is that a single truth exists, which can be identified and measured (Lincoln et al., 2011).

The goal of human-centered design practitioners is to develop products and services that meet the practices, needs, and preferences of users (Steen, 2011). As stated in the human-centered design standard ISO 9241-210, an explicit understanding of users, tasks, and environments forms the basis for design (International Organization for Standardization, 2010). According to Friess (2010, p. 42), two common themes in distinctive definitions of human-centered design are as follows: 1) to conduct research with real people who are likely to use the product and 2) to use that research to drive design solutions.

There are many ways that designers can go about to gain an understanding of users, tasks, and environments. Rather than a specific method, human-centered design can be seen as an umbrella concept for a range of approaches that researchers and designers can use to "cooperate with or learn from potential users of the products or services which they are developing" (Steen, 2011, p. 45). Steen (2011) identified six human-centered design approaches: participatory design, ethnography, the lead user approach, contextual design, co-design, and empathic design. With their different starting points and foci, these approaches also involve different methods and tools.

Several authors claimed that incoherence in human-centered design rests on uncritical adaptation of methods of contradicting research paradigms or worldviews (Dourish, 2006; Gaver, Boucher, Pennington, & Walker, 2004). Conducting research to understand people is a complex

endeavor. Friess (2010) claimed, for example, that practitioners engaged in human-centered design tend to rely solely on quantifiable and easily relatable user data to support design decisions. In a way, this contradicts fundamental claims of human-centered design, such as acknowledging people's competence and participation. If, then, a "positivist" method and the designer's ambitions and knowledge do not match, a methodological gap appears (Lee, 2012). From our point of view, phenomenological hermeneutics responds to claims in human-centered design in a systematic way. At the same time, phenomenological hermeneutics sensitizes the designer not just to work with data or abstract information but also to acknowledge real people in their lifeworld, which is a key principle in human-centered design. In this way, phenomenological hermeneutics informs and inspires human-centered design in different phases of research and practice.

Even though phenomenological hermeneutics is at its core an acknowledgement of a human-centered view based on lived experience, this approach has received limited attention in design literature. In the next section, we discuss some key aspects of phenomenological hermeneutics as a methodological supplement in human-centered design.

Key Issues in Phenomenological Hermeneutics

Our motivation for exploring how phenomenological hermeneutics fits under the human-centered design umbrella resides, among others, in the notion by Donald Schön that "problem setting" is a necessary condition for "problem solving" (Schön, 1983/2005, p. 40). Design thinkers follow Schön's argument when, for example, emphasizing that methods and tools should support designers to be "prepared-for-action" rather than "guided-in-action" (Stolterman, 2008, p.61). Phenomenological hermeneutics can be a useful approach, for example, by supporting designers in their early navigations. Exploration of a phenomenon through an interpretative dialogue can further inspire to acknowledge complexity, rather than hastily steering away from it. Thereby, designers can attend a rich solution space, reflecting openly about multiple realities.

Phenomenological hermeneutics stems from the method that Heidegger presented in *Being and Time* in 1927, as he stated that human existence is interpretative (Embree, 1997). This idea was, among others, adapted by Gadamer in *Truth and Method*, whose intention was not to provide a "method of interpretation" fitting into the scheme of modern human sciences, but rather a reflection on what happens "over and above" our understanding (Gadamer 1960/2004, p. xxvi). According to Gadamer, the Enlightenment's ideal of overcoming all prejudices by rationality proved itself to be a prejudice. He developed a method—"the hermeneutic circle" (Gadamer, 2004)—in which the meaning of any text (e.g., product, artifact) relates to the historical situations of both the author and the artifact. The hermeneutic circle refers methodologically to the idea that a person's understanding of a text or an artifact as a whole is established by referring to their [own] history and cultural background. The person and the text are referring to each other in a way that cannot be excluded from the other. The interpretation of an artifact has to be explored within its cultural, historical, and in situ context, as well. Through phenomenological hermeneutics, the researcher aims to "disclose truths about the essential meaning of being in the life world" (Lindseth & Norberg,

2004, p. 151). A key method is to go beyond the data and look for hidden meaning, rather than assuming that data will "speak" for themselves (Maggs-Rapport, 2001).

Phenomenological hermeneutics attempts to grasp lived experience in a comprehensive way. In this perspective, the main challenge for design is to find a balance between the sphere of technology and the sphere of non-instrumental human needs, i.e., between levels of reality that can be directly manipulated and those that resist such manipulation. Doing research from a phenomenological perspective is about questioning the way we experience the world and desiring to know the world wherein we live as human beings (van Manen, 1990). A central argument in phenomenology, referred to as the principle of intentionality, is that knowing the world is inseparable from being in the world. From this point of view, research can be understood as a caring act, as van Manen points out: "We can only understand something or someone for whom we care" (1990, p. 6). A generalizable ideal of natural science research is that actions should be repeatable and subjects replaceable. In opposition to that, phenomenology draws attention to the unique and irreplaceable (van Manen, 1990): "In phenomenological research the emphasis is always on the meaning of lived experience. The point of phenomenological research is to 'borrow' other people's experiences and their reflections on their experiences in order to better be able to come to an understanding of the deeper meaning or significance of an aspect of human experience, in the context of the whole human experience" (van Manen, 1990, p. 62).

Heidegger's philosophical project was essentially ontological, as it aimed at understanding the fundamental existential question: "What does it mean to be?" (Mackey, 2005, p. 181). Heidegger's concept of *being-in-the-world* (1996 [1953]) essentially denotes a social mode of being (as cited in Zigon, 2007) and concerns the ways people exist, act, and are involved in the world (van Manen, 1990, p. 175). According to Heidegger, human existence is being-in-the-world (Lindseth & Norberg, 2004). This world, also denoted the *lifeworld* in Husserl's work, is the world as it shows itself to our consciousness and is different from the objective, outer world (Lindseth & Norberg, 2004). Rather, being-in-the-world refers to being at home in *our* familiar world and can be understood as an at-homeness (Zigon, 2007). The concept represents Heidegger's notion that the object and the subject are inseparable (Mackey, 2005). As such, "being" and "world" are understood as united.

Following these existential philosophical ideas, van Manen (1990) suggested four lifeworld existentials as guides for reflection in the research process. In this article, we use these lifeworld existentials for the analysis of care. They are the lived body (corporeality), lived human relation (relationality), lived space (spatiality), and lived time (temporality): "They all form an intricate unity which we call the lifeworld – our lived world. But in a research study we can temporarily study the existentials in their differentiated aspects, while realizing that one existential always calls forth the other aspects" (van Manen, 1990, p. 105).

The existential of lived body relates to the phenomenological consideration about how "we are always bodily in the world" (van Manen, 1990, p. 103). The existential of lived human relation refers to the relations that we maintain with others – how human beings are social beings making

meaning through sharing experiences (van Manen, 1990). The existential of lived space can be understood as "the world or landscape in which human beings move and find themselves at home" (van Manen, 1990, p. 102). Furthermore, van Manen (1990) understood lived space as felt space. The existential of lived time refers to subjective time, rather than clock time – for example, how we feel that time appears to pass quickly when we are having a good time (van Manen, 1990).

In this article, we understand lived space to include the physical environment and the things/objects that surround us. The hospital environment with all of its medical products, such as the nebulizer device, is of particular interest in this article. We draw on the semantic argument in design that people do not see and act on the physical qualities of products but rather on what they mean to them (Krippendorff, 2006). From this perspective, thus, the idea of lived space as felt space is relevant. Objects and products contribute to meaning-making in people's daily lifeworlds (Battarbee, 2004; Fredriksen, 2011; Krippendorff, 2004).

Regarding people's experiences with products, then, Heidegger's concept of *breakdown* is relevant for our study. A breakdown occurs when something shifts from being ready-to-hand to becoming present-to-hand (Zigon, 2007). Heidegger's classical example is the hammer. In a ready-to-hand experience, the carpenter uses a hammer without reflecting about the hammer in terms of what it is, how to use it, or what it means to be using it; rather, the hammer is simply a means to insert nails, and it does not evoke a subject/object distinction (Zigon, 2007). When the hammerhead loosens or the carpenter hits his own hand, a present-to-hand experience occurs as the situation suddenly changes. The breakdown forces the carpenter into a stepping-away mode of being-in-the-world and entails reflection on being as subject and object, presence and consciousness (Zigon, 2007). The concept of breakdown is, however, not only useful for considering lived experience with products; it is just as relevant for all other aspects within the lifeworld because it motivates humans to act – instrumentally, aesthetically, epistemologically, and morally.

The Phenomenon of Care and Healthcare Design

Care is a central aspect of human interaction during medical treatment. As such, the phenomenon of care should be of particular interest for human-centered designers working within healthcare. Recently, there is an increased focus on *experience-based design* in healthcare. A pleasurable experience with medical equipment is considered to be a critical component in users' adherence to medical treatment (Gloyd, 2003). Moreover, *patient-experience design* has been pointed out as a new paradigm for the development of medical products and systems aimed at improving patient adherence (Turieo, 2012). Mullaney et al. (2012, p. 37) used "quick" ethnographic methods to explore patient experience within cancer treatment and concluded that human-centered design thinking is "ideal for finding new ways to generate the frame-shift required to think beyond the 'cure' to person-centered care and wellbeing." However, genuine application of design practice and design research in the domain of healthcare is still largely unexplored (Bate & Robert, 2007).

We argue that care is one key phenomenon for design practitioners and researchers to attend to

when seeking to understand and influence people's healthcare experiences. The term "care" has a twofold meaning, referring to love and attentiveness as well as concern and grief (van Manen, 1990). Care can further be considered a human life fundament because people have a general desire to be cared for (Noddings, 2002). Care is also a relational phenomenon. Noddings (2013) understood a caring relation to consist of one who cares (the "one-caring") and the one who is cared for (the "cared-for"). The one-caring engages in caring by sharing a feeling, a notion that Noddings (2013) referred to as engrossment. Rather than acting in a rule-bound manner, the one-caring acts out of desire for promoting the wellbeing of the cared-for. The one-caring and the cared-for are both active and contributing participants in their caring relation, and in this way, they depend on each other for establishing a caring encounter.

The Phenomenon of Care in the Case of Children's Nebulizer Treatment

The Case of Children's Nebulizer Treatment

Respiratory infections lead to frequent hospitalization of infants and young children worldwide. Respiratory syncytial virus (RSV) commonly causes respiratory infections, and in the United States, for example, more than 100,000 children with RSV are hospitalized each year (Krilov, 2011). Nebulizers are used for treating respiratory diseases. Figure 1 gives an impression of how nebulizer treatment is administered. To receive the medication, the child wears a face mask covering the mouth and nose and inhales the medication through passive breathing for between 5 and 10 minutes. The treatment is typically repeated every 2–4 hours, often over several days.

Figure 1. Nebulizer treatment

The motivation for addressing the case of children's nebulizer treatment is that the treatment itself comes with a lot of challenges. The overarching challenge is that many children resist nebulizer treatment, and it is suggested that approximately 30% of young children are distressed during the treatment (Esposito-Festen et al., 2006). Distress expressed through struggling, crying, screaming, and turning away from the mask reduces the amount of medication reaching the lungs (Amirav, Balanov, Gorenberg, Groshar, & Luder, 2003; Iqbal, Ritson, Prince, Denyer, & Everard, 2004). Different forms of distress and lack of cooperation lead to tense interactions between children and their caregivers. It is not unusual for physical coercion to occur, and sometimes, nurses

decide to terminate the treatment. Healthcare experiences that are perceived as scary, painful, or uncomfortable deserve designers' full attention.

Background of the Research

The research is connected to a one-year pilot project called BLOPP (a Norwegian acronym for "Barns Legemiddelopplevelser," translated as "Children's pharmaceutical experiences") conducted in 2012. The aim of the BLOPP project was to explore how design and technology can motivate children with respiratory diseases to take prescribed medication and promote positive interactions between children and caregivers, thereby increasing adherence to medical treatment. The project group was multidisciplinary and consisted of people with backgrounds from industrial design, pharmacy, and human-computer interaction.

Between January and March 2012, members of the BLOPP team conducted participatory observations of hospitalized children who received nebulizer treatment and carried out semi-structured interviews with their parents and the health personnel who administered the medication. The purpose was to gain a better understanding of how children, nurses, and parents experience nebulizer treatment. The fieldwork was approved by The Regional Committee for Medical and Health Research Ethics of Central Norway and head physicians at the children's ward.

Research Process

Our research process aimed at gaining an understanding of care as a *phenomenon* through an *interpretative* dialogue—that is, a phenomenological hermeneutics approach. Analyzing the phenomenon of care, we specifically draw on interviews conducted with nurses and parents who have experienced nebulizer treatment of young children.

Following a participatory observation of the nebulizer treatment of nine children between the ages of 4 months and 2.5 years, the first author interviewed nine parents and six nurses. One nurse was interviewed three times, and one nurse participated in two treatments but was only interviewed once. In total, this resulted in 17 interviews. The interviews took place in the hospital rooms, in a quiet part of the corridor, or in the nurses' break room. The interviews were audio-recorded and later transcribed verbatim. All participants were informed about the purpose of the research and gave written consent.

The purpose of a semi-structured interview is to obtain people's descriptions of their lifeworlds and to interpret the meaning of the described phenomena (Kvale & Brinkmann, 2009). Such interviews come close to an everyday conversation, but they differ because the researcher has a professional intention and asks an open question about predefined themes (Kvale & Brinkmann, 2009). The role of the researcher is to ask a series of structured open questions and to probe more deeply into respondents' beliefs, attitudes, and inner experiences by following up their answers (Gall, Gall, & Borg, 2003).

The parents were interviewed to gain an understanding of how they experienced different

aspects related to their hospitalized children's nebulizer treatment. The interviews with the nurses were conducted to construct knowledge about how they experienced administering nebulizer treatment to young children by asking questions about the specific event that had been observed as well as general events. The interview guides for the parents and the nurses covered the same following topics: their own experiences of participating in pediatric nebulizer treatment, their perception of the children's experiences related to the treatment, their understanding of the social interactions that take place during treatment, and suggestions for improved treatment. The interviews lasted between 20 and 40 minutes.

Our approach for interpreting the interview texts—that is, the verbatim transcripts of 17 interviews—was to move between the following three steps: *naïve reading*, *thematic structural analysis*, and *comprehensive understanding*. These steps form the phenomenological hermeneutics approach of Lindseth and Norberg (2004).

First, the first author read the interview texts several times. The purpose of this step—that is, naïve reading—was to grasp the meaning of each single text as a whole (Lindseth & Norberg, 2004). While transcribing and afterward reading each interview, the first author's feelings from the interview setting were recreated. She recalled the atmosphere during each interview and could, as such, revive how the interaction with the other person unfolded—how experiences were conveyed and shared through words, moments of silence, gazes, gestures, and sounds. Through a reflective dialogue with the text, the first author got an impression of what caring "is about" in the specific case (Storli, Lindseth, & Asplund, 2008). When the authors discussed together, another reflective dialogue was initiated, which gradually led to an integrated impression.

There are different ways to conduct a thematic structural analysis. At a general level, we have followed the idea that creating a thematic understanding in human science research should be seen as a free act of "seeing" and interpreting meaning, as opposed to a clear-cut and mechanical application of counting acts or terms as they appear in, for example, a transcript (van Manen, 1990). Our approach was to construct themes by dividing the texts into meaning units (Lindseth & Norberg, 2004). For each single interview text, we identified and clustered meaning units. A meaning unit is part of a text, ranging from just a few words to several paragraphs, which conveys one essential meaning that is relevant for illuminating the phenomenon (Lindseth & Norberg, 2004). Next, we combined the interview texts into two groups—the parents and the nurses. The reason for separating the parents and the nurses was that they have different roles in the medical treatment. Then, all of the meaning units within each of the two groups were further clustered. Based on the total collection of the clustered meaning units, the first author suggested a preliminary set of themes to represent the clusters.

A comprehensive understanding was gained by, as it were, focusing again on care as an overarching phenomenon. Through discussions, the two authors collectively refined the themes further and used the lifeworld existentials as reflection guides. We reflected on how the themes conveyed different, albeit connected, meanings of care. The themes were considered in relation to

our impressions of each single interview text as well as relevant literature and theoretical perspectives (Lindseth & Norberg, 2004). Moreover, we reflected on own pre-understanding and how the themes broadened our awareness in terms of challenging our first notions of "the problem." This also included a discussion of how designers could make use of the themes to increase understanding of users and use context.

Our interpretative process, consisting of the three described steps, reflects a circular movement between the "whole" (care as a phenomenon) and the "parts" (perspectives on care as a phenomenon). Such movement between the "whole" and the "parts" proceeded in a more fluent manner, rather than as strictly organized shifts. The authors entered the hermeneutical circle with their own pre-understandings. Even though prior understanding is difficult to account for, as it is embedded in one's life, we can reflect on our motivations for conducting this study – that is, our professional pre-understanding. With a background in industrial design, the first author arrived with the view that designers have a special responsibility when it comes to adapting products that take part in medical treatment and healthcare context to the users. The second author has a background in philosophy, and her research revolves around welfare and design. Our intentions, assumptions, experiences, and backgrounds have contributed to the interpretative process.

Findings: Five Themes Capturing the Phenomenon of Care

Based on the interviews, we constructed five themes that capture perspectives of the phenomenon of care in the case of children's nebulizer treatment. We understand a theme to be a means to get at the notion by giving it shape and content while acknowledging it as a reduction that cannot completely unlock the deep meaning (van Manen, 1990). Each theme can be understood to represent a sub-phenomenon of care. Taken together, they give shape to the phenomenon of care in the case of children's nebulizer treatment (van Manen, 1990). While the two first themes reflect the meaning of care as experienced by parents, the other three themes regard parents as well as nurses.

Theme 1 – Feeling Helpless

The parents in this study frequently referred to feeling helpless. The kind of helplessness that parents experience before attending the hospital can be severe:

> "When we were at home and he was at his worst I felt pretty small and terrified actually… because I didn't know what to do. … When feeling he almost doesn't breathe in the evenings … it becomes a bit like … almost a bit like hysteria. … You get stressed throughout." (Diane, mother)

Other parents experienced helplessness at the hospital in realizing that there is little or "nothing you can do":

> "You are helpless and powerless. …Quite simply … there is nothing you can do for your child. … This actually concerns the airways … your child has problems breathing … and you can't do anything … just be present. … It is kind of a sore feeling." (Hannah, mother)

"Yes, it is difficult because you know there is nothing you can do … besides comforting and being there." (Andrew, father)

"Helpless … is what I am. … I can only stand there and watch." (Christina, mother)

Some parents expressed a kind of helplessness related to being confined to an isolated space:

"We are at an isolate here, too. … You are supposed to be in the room and as little as possible out in the corridors and stuff." (Kate, mother)

"You get lots of emotions. … You can get upset and everything, but I think it is very smart and easier to wait until you get out of this tiny little room." (Hannah, mother)

Experiencing helplessness relates to the meaning of care as a bodily phenomenon. Taking part in a caring relationship by feeling helpless is experienced as "nasty," "sore," "feeling small," "terrified," and "stressed throughout." As such, helplessness is manifested as bodily experiences. Parents, too, *feel* their children's diseases through bodily expressions. "Feeling small" also relates to care as a spatial phenomenon—the felt space. Moreover, the hospital room, which is a physical isolate in attempts to hinder the spread of infection, contributes to the feeling of helplessness. The physical isolation can be understood to reinforce the limits one has as a caregiver.

Further, experiencing helplessness relates to the meaning of care as a relational phenomenon. Here, parents' helplessness refers to an inability to directly influence the child's wellbeing through their own actions. As such, helplessness appears to challenge the role of the parents: "you know there is nothing you can do." Whereas the role as one-caring in everyday life can imply both the ability and the responsibility to repair and sort out, caring for a child who is unexpectedly seriously ill can mean a readjustment of one's perceived role in the caring relationship. Helplessness, then, reflects a tension in a parental desire to provide care, resulting in a medically healthy child and the realizations of one's own limitations.

Theme 2 – Feeling Cared-For

Several parents were explicit about that they, too, felt cared for:

"I feel that we are incredibly well cared for so that I can relax, and it is very clear that the ones treating her know what they are doing." (Kate, mother)

"Here at the hospital, all is fine so then I think it is very … very like … then I am calm… because you know you've got help." (Diane, mother)

"It is absolutely great actually to be here. … It is very good help. … They are like little angels—the ones working here—and they are busy arranging for the ones who are here right and … [I] think they are really good in trying to facilitate in the best possible ways for the children and for us and … it is a bit hotel-like, despite the fact that you are in an isolate" (Hannah, mother)

These parents experienced holding a two-fold role in being the one-caring and at the same time

being the cared-for. Feeling cared for relates to the meaning of care as a relational phenomenon. Feeling cared for means to be able to "relax," be "calm," be "taken seriously," get "help," and be "met in a good way instead of feeling that one is a burden." It feels good to be cared for, and it stimulates the parents to care for the child in the ways that they prefer. As a cared-for parent, you can focus on being "just a parent," instead of being "a mom, a nurse, and a cleaner all at once." The nurses are described as "little angels" making the hospital stay "a bit hotel-like". For Kate, the collaborative aspect of the caring relation is important: "You know that they are here and like … I am the one who takes care of her and changes her nappies and those kinds of things … while they come in and do their things. … I can ask for help at any time."

Theme 3 – Being in an Ambivalent Struggle

The majority of both parents and nurses who have administered medical treatment to children who resist experience caregiving as an ambivalent struggle:

> "[I experience] some mixed emotions because … it was bad enough that he was hospitalized but then on top of that [I] ... have to force him to take medication." (Mia, mother)

> "I have to in a way… assist in that she gets the medical help that she needs … but [laughs] at the same time I feel a bit rotten … when I have to hold her tight while she is hollering and screaming and saying no." (Beth, mother)

> "I don't think it is okay to hold him in a vise like that [laughs] … but it is nevertheless maybe a little necessary, I think." (Diane, mother)

Experiencing ambivalent struggle relates to the meaning of care as an intertwined bodily and relational phenomenon. The struggle is unwanted and elicits strong emotions, such as "bleeding mommy's heart" and a sense of guilt. Taking on a struggle with one's own child feels "nasty" and "sad," yet it is necessary: "you know you have to struggle" and "sometimes I have to hold her." Considering the caring relation between a parent and a child, ambivalent struggles can also raise issues of trust. Beth confirms this: "I am frightened that she will lose confidence in me."

Nurses on their side are also strongly affected by struggles:

> "It feels like a sharp pain inside of you. … Sometimes, it feels like it borders ... [on] abuse, even though the indications are not the same, but they cry and think it is terrible … and we have to do our utmost to make it as comfortable as possible …and sometimes you can become frustrated and think that you don't want to this again and stuff like that … and then you have to look at the whole picture … and often one has to [do] things one doesn't like to make it become better again." (Eric, nurse)

> "With her [Karen] I didn't feel like the big bad wolf as I sometimes do when they really resist." (Karla, nurse)

> "When he [Harry] was protesting at his worst then I [felt] like a very evil person [laughs]. … I mean … he gets so angry, and it is like, 'Why are you doing that?'" (Cornelia, nurse)

Nurses treat many children every day. When children strongly resist, it can create a strong impression that is bodily experienced: "like a sharp pain inside." The metaphors of "the big bad

wolf" and an "evil person" also denote a clear ambivalence in care as a relational phenomenon – representing a contrast in how the nurse wants to appear as opposed to how the nurse perceives his or her own appearance. The reason for compromising the desired appearance is that the end justifies the means. One looks at the treatment in a more holistic perspective and is certain that treatment is necessary for the children to get better again:

> "When I see how much better they get from one inhalation then … I think that the struggle is fair enough." (Cornelia, nurse)

> "Adults have to be in charge and it is in a way … we have to help them… and it doesn't always feel okay, it really doesn't, but … yeah… I don't find it difficult." (Anna, nurse)

> "And they [children with croup] are [experiencing] really narrow [airways], they are like, 'Ejjh' … they are unable to get air down. … It is obvious, of course, that you just throw yourself over this patient." (Anna, nurse)

Ambivalence emerges also in cases when nurses start to question whether the treatment is beneficial and necessary. One is cautious on behalf of the child's wellbeing and, for that reason, continuously assessing procedures:

> "And then I send a thought back to the physician again … is it really necessary to have it [the procedure] every two hours? You become a kind of lawyer for the child, but at the same time, it is about me, too … because it is like a struggle ... every two hours. … Must we have that struggle every two hours? Okay, if we must. But if it is not necessary then I suggest we think it through." (Anna, nurse)

> "If they [the children] rage, then it is almost pointless because then they don't get any effect of the treatment either. … So then it is almost like you just turn it off." (Laura, nurse)

On a relational level, caring means to see oneself as a "child's lawyer" who seeks to act in the best interests of the child and, therefore, questions the benefit of the procedures when children resist heavily. Struggles are also experienced as a bodily and temporal phenomenon:

> "You get worn out when you have to give many inhalations to one who protests for each and every … but we manage." (Cornelia, nurse)

> "When they cry a lot and resist then it seems like it takes forever." (Karla, nurse)

Struggles are experienced as "exhausting" in a physical sense, but the experience of lived time is also affected: "it takes forever." Regarding lived space and relation, the difference between caring in theory and practice is also important:

> "It is very easy for a physician who is not actually standing in this situation to sit in theory and write it down." (Anna, nurse)

Theme 4 – Finding Ways to Establish an Authentic Caring Relation with the Child

In all interviews, finding ways to establish an authentic caring relation with the child dominates. During treatment, establishing an authentic caring relation with the child is related to children's acceptance toward the treatment. Caregivers try to contribute to gained acceptance and trust through

keeping calm, using conscious body language and physical contact, and shifting the focus toward something else besides the treatment.

"I believe that if the person who is holding her is calm and it is calm around her, then she will experience it calmly and become more secure … but I do not know if this is true; it is just the way I experience it … that if I and we are calm and do not stress, then she will also not experience stress and stuff like that." (Leonora, mother)

"I think it is really important that mom and dad keep calm." (Hannah, mother)

What is emphasized here is the importance of a calm bodily presence for establishing a caring relation with the child. Calmness can be attained in different ways:

"I sing … and then I hold them and I sit there and sing … so that they become a bit interested in that … to make them relax. … They often relax with songs." (Anna, nurse)

"A simple language and distractions through questions and taking a playful approach … getting down on the same eye level … not seem[ing] big and scary because it can seem quite threatening when someone is standing and talking down to you." (Eric, nurse)

Considering the *relational* level, parents and nurses try to make the treatment seem "less frightening" and "dramatic" through "making the best of it" and "doing what you can":

"He is a bit more vulnerable and needs extra much comfort and cuddles and things like that. ... He needs much more attention than he usually needs." (Mia, mother)

"We do our best to distract so it won't be such a dramatic experience for the children and the parents." (Bridget, nurse)

"We talk to them … try to use a calm voice, and we joke a bit and show them things that they like and that they can do." (Cornelia, nurse)

"We use other means, too. … We use dolls and parents … as means… like mommy tries the mask, and I try it, and dad tries it … and then you [the child] can try it a bit." (Eric, nurse)

"To be close and hold a hand and … breastfeed afterwards." (Diane, mother)

Through distraction, such as talking, singing, playing with toys, blowing soap bubbles, or watching a film, one can contribute with play and enjoyment. Through space as well as movement, caregivers can come closer to children during treatment and thereby also enhance children's acceptance toward the treatment. Regarding acceptance, the aspect of time is relevant. Time influences the experience of treatment:

"The first time she got it, she really protested … but now she is calm." (Christina, mother)

"For me, everything is really okay because she doesn't make a fuss about it … so it would have been worse if she would constantly cry and I would have to hold her [in a firm grip] like I had to the first time. … That was really not okay at all." (Edward, father)

"I think she actually understands that these inhalations are doing her good … that she feels her breath is getting better, and you can kind of tell by the way she acts, like she is saying, 'Ohh … this is really good!'" (Kate, mother)

Time—and lived time—can be a way to acceptance and, thus, also a contributor to establishing an authentic caring relation with the child during treatment and hospitalization. Over time, some children seem to get used to the treatment, and some children seem to feel an immediate relieving effect of the treatment. Becoming familiar with the treatment influences children's attitudes.

Theme 5 – Understanding the Nebulizer as a Care Object

The nebulizer device affects the interaction between the children and their caregivers during the medical treatment. The device is the means for delivering the medication to the children and can, as such, be understood as an object with a caring intent. Yet the nebulizer device is often regarded as an unfriendly object, which children frequently resist and turn away from:

"I don't think he saw it as a buddy. … I don't think that the shape gave him any interest for either holding it or looking at it." (Andrew, father)

"There is no interaction going on … It is more like pushing it away [laughs] … getting rid of it." (Beth, mother)

Some children find the nebulizer an interesting object, which must contain a different reason for not being able to use it as intended:

"She tries to grab it … look at it and eat it." (Christina, mother)

In other cases, the nebulizer seems to be accepted as a caring object:

"She just lies there and welcomes it." (Kate, mother)

The relation between the child and the nebulizer device can change in the course of a single treatment or after a few treatments:

"Usually it is okay in the beginning but then it lasts up to five minutes … and maybe even longer … and then they get impatient. … They do." (Eric, nurse)

"She doesn't care that much anymore … so I think she's alright with it" (Edward, father)

Several parents and nurses have concrete ideas about how the nebulizer can be improved to better fulfill its role as a caring object. The importance of reducing sound and time is essential. At the hospital, there are two different kinds of nebulizer devices available. The difference is essentially related to how the medication is vaporized—that is, either by compressed air or via ultrasound. The compressed-air nebulizers are noisy, while the ultrasonic nebulizers are almost soundless. At this hospital, the compressed-air nebulizers are commonly used. However, there are a few ultrasonic nebulizers available at another ward, and these can be borrowed, if necessary.

"I like it [the ultrasonic] better because it doesn't make sound, and I have used it on a child who really resisted, and when I gave her inhalation while she was sleeping and she didn't wake up, it was really worth it." (Karla, nurse)

"We have borrowed it a few times, and I have a very positive experience with it [the ultrasonic]. … It doesn't have that sound. … It is less scary." (Anna, nurse)

"I wish it didn't take so long." (Bridget, nurse)

"Maybe … if it would have been possible to make the treatment shorter … because now it feels very long." (Laura, nurse)

The concerns about reducing sound, noise, and (lived) time can be understood as proposals to make the nebulizer a milder object – envisioning it as an object that neither scares children nor requires their endurance. Besides these concerns, some also imagine that the nebulizer could be a more fun object – a medical product that can afford play and pleasure:

"I think the shape in terms of color and music … all such kinds of little details could have been more fun." (Andrew, father)

"If it is decorated or it blinks or it has disco lights [laughs] … then it kind of becomes more like a toy than a medical instrument … which really can contribute to make it less scary … quite simply." (Eric, nurse)

Understanding the nebulizer as a care object relates much to care as a bodily and relational phenomenon. Whereas the concern to reduce elements that can clearly evoke fear has to do with the lived body, the concern to add elements that contribute to play and joy has to do with the lived relation.

Discussion

The aim of this article was to understand how human-centered designers could benefit from taking a phenomenological hermeneutics perspective for meeting users in healthcare contexts. Our entrance to better understanding the approach was to explore the phenomenon of care in the case of children's nebulizer treatment. In the following, we reflect on the care themes and on phenomenological hermeneutics as a human-centered design approach.

The Phenomenon of Care in Children's Nebulizer Treatment

Based on interviews with parents and nurses, we constructed five themes that capture the phenomenon of care. The theme of *feeling helpless* refers to parents' vulnerability as caregivers in the situation. Experiencing helplessness especially relates to the meaning of care as both a bodily and relational phenomenon. A commonly expressed frustration was limited opportunity to directly influence the wellbeing of their child. The theme of *feeling cared-for* reveals how parents have a need for as well as experience care in the situation. Feeling cared for relates greatly to the meaning of care as a relational phenomenon. Parents experience that being cared for enables them to be better caregivers to their children.

The theme of *being in an ambivalent struggle* deals with experiences of administering treatment to children who resist. Both parents and nurses are strongly affected by struggles that can relate to the meaning of care as a bodily, relational, temporal, and spatial phenomenon. The theme

of *finding ways to establish an authentic caring relation with the child* is concerned with how parents and nurses try to contribute to children's acceptance of the treatment. This theme has been connected to the meaning of care as a bodily, relational, temporal, and spatial phenomenon. The theme of *understanding the nebulizer as a care object* refers to parents' and nurses' experiences of using the nebulizer device and their ideas of how the device could improve as a caring object. This theme relates especially to the meaning of care as a bodily and relational phenomenon.

We suggest that the themes above can serve as inspiration. Rather than appearing as obvious pointers to design solutions, they are considered useful as results in themselves to elucidate the care phenomenon for the design community. They broaden our understanding of care as a complex and conflicting phenomenon. Also, not every aspect of care is "solvable" through design. However, designers can, for instance, benefit from "borrowing" the feeling of helplessness to better understand a parent's relation to a child with a critical disease and how this relates to the use of a medical product, such as the nebulizer device.

Focusing on the phenomenon of care is valuable in that it opens up for interpreting how and what role a medical product plays in a caring relation. Especially when young children are expected to use a medical product, it is essential for designers to reflect on its potential as a caring object in addition to its medical purpose. In reformulating our question from the introduction, a designer with a phenomenological hermeneutics perspective will, instead of asking how medical products or services can be improved, rather ask the following question: How can we—that is, the other persons involved and I—contribute to establish caring relations?

The nebulizer device is a central product in our case. This product, which is supposed to contribute to children's bodily wellbeing, frequently contributes to bodily and relational distress. We can reflect on Heidegger's notion of breakdown in relation to the themes. First, children's disease represents a breakdown of their lived body. This breakdown is also bodily experienced by the parents, as incorporated in the theme of *feeling helpless*. When children resist the nebulizer, this object also represents a breakdown – as equipment that is no longer "ready to hand" (Blattner 2006; Zigon, 2007). Rather, the nebulizer device is part of a treatment that both parents and nurses can experience as *being in an ambivalent struggle* – that is, a relational breakdown. People tend to enter into a creative dialogue when things do not function as intended (Koskinen & Battarbee, 2003). This is also reflected by the two themes of *finding ways to establish an authentic caring relation with the child* and *understanding the nebulizer as a care object.*

One example of the latter is elucidated in the BLOPP project. The idea of the concept was to include the child and caregiver in the treatment through facilitating play, thus taking the meaning of care as a relational phenomenon as a starting point. Figure 2a shows the prototype, which is attached onto the tube of the nebulizer device, consisting of two handles and a flexible wire with a table tennis ball. When the mask is pushed toward the face, a switch inside the handle triggers a LED inside the ball to light up (Figure 2b-c). The ball also has a little bell inside. Some children have explored the prototype during nebulizer treatment at the hospital (Figure 2d-e). Preliminary

analysis indicates that the prototype mediated meaning-making through shared exploration, play, and communication between children and caregivers.

Figure 2. Prototype: (a) attached to nebulizer (b-c) designer demonstrates and (d-e) children's exploration.

Beyond this example, we suggest that there are many ways in which design can contribute to meet the challenges that are reflected in the themes. However, our intention is not to outline a range of different solutions in a recipe style. Rather, we acknowledge readers' own interpretations of the themes, and we hope that the resulting dialogue will contribute to enhance awareness toward healthcare experiences as an important purpose for design.

Phenomenological Hermeneutics as Human-Centered Design Approach

This study challenged the authors' pre-understandings, such as that designers have a special responsibility when it comes to adapting products that take part in medical treatment to the users. Our first notion of "the problem" in children's nebulizer treatment was limited to children's resistance toward the nebulizer device and wearing the mask. Through exploring the phenomenon of care, we have become more aware that there are, in fact, many aspects within the case that call for designers' attention. A typical designer impulse would be to immediately raise the following question: How can we meet these problems through design? We suggest that phenomenological themes are useful for dwelling on the complexity of people's lifeworlds and, in our case, the complexity surrounding care in young children's medical treatment. The result of such a research is, then, to elucidate what a particular caring experience means for parents and nurses in order to learn more about how to design sensible products for children's medical treatment.

A practical research problem with phenomenological hermeneutics is that it is time consuming as a method compared to, e.g., document and literature analyses and some types of data collections. The time-consuming aspect can make phenomenological hermeneutics less feasible for design practice. We suggest that phenomenological hermeneutic studies also can be valuable as secondary source. Phenomenological hermeneutics is widely used in nursing research and can serve as an alternative entrance into the hermeneutic circle.

An epistemological challenge is that phenomenological hermeneutics encumbers the identification of general characteristics of products and services and that the phenomenological hermeneutics analysis (e.g., the themes in this article) can be called subjectivist and finally that results do not conglomerate individual and shared impressions of phenomena. This would make information imprecise and not easily communicated or put on trial. The challenge for phenomenological hermeneutics is to realize that even the most individual experience may, under

certain circumstances, give access to phenomena of a truly shared character, such as emotional involvement in dealing with objects and phenomena (such as care) which are, although in several senses not at all new, certainly now growing in importance and quantity.

Conclusively, the phenomenological hermeneutics perspective is seen as a necessary supplement in human-centered design, where aspects connected to users' experiences are too often measured and averaged. The relation to the users and study participants is frequently one of detachment, and the focus on precise measurements may take over in favor of the concern for understanding what different measurements stand for. Assuming interpretation of products based on their highly individual experience means more or less abandoning the idea of patterns, implying a methodology where the focus is on engagement with users and their experiences, interpreting and developing an idea about what is important but not generalizing any findings.

Conclusions

How, then, does phenomenological hermeneutics fit under the human-centered design umbrella? Regarding the methodology, phenomenological hermeneutics is coherent with a human-centered view, which rests on acknowledging human agency, competence, and participation. Phenomenological hermeneutics takes people's lived experiences as starting points for one's own reflection. Rather than delimiting people's opportunity to express and share their experiences, which is typically the case when using a survey or conducting a controlled experiment, phenomenological hermeneutics encourages the researcher to listen and learn.

The acknowledgment that multiple realities exist and that they are co-constructed mutually in processes that are individual as well as collective is valid for both human-centered design and phenomenological hermeneutics. On a methodological level, then, the principles on which human-centered design rests can be understood as fundamentally different from a positivistic worldview where the assumption is that a single truth exists, which can be identified and measured (Lincoln et al., 2011). Moreover, the relation between the researcher and the researched is not insignificant but quite the opposite – people do not simply share lived experiences because someone claims to be a researcher; rather, sharing parts of one's lifeworld is a matter of trust.

Further, phenomenological hermeneutics enables the spreading of people's voices and experiences to a larger community. This relates to the human-centered idea that people have a right to take part in shaping their environments. Moreover, an experience is not simply an experience – instead, there is always an interpretation going on. Hence, experiences are co-constructed. Involving people in learning from their lived experiences benefits designers through own awareness that they are partners in the hermeneutic circle, too. Better appreciation for lived experiences can influence design decisions of an existing product or trigger exploration of new solution spaces.

Phenomenological hermeneutics can be understood as a supplement to existing approaches within human-centered design. It offers a thorough exploration as "parts" and "whole" movement of people's lived experience and a designer's own understanding. Even if phenomenological

hermeneutics overlaps with many of the human-centered approaches, such as participatory design and ethnography, we argue that its strength lies in the dedication toward lived experience as well as its methodological coherence with human-centered design principles.

Acknowledgments

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Article II

Interactions Between Caregivers and Young Children:

Exploring Pedagogical Tact in Nebulizer Treatment

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Qualitative Health Research

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What is This?

Interactions Between Caregivers and Young Children: Exploring Pedagogical Tact in Nebulizer Treatment

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Abstract
Although research in health care suggests that one of the most important factors for efficient medical delivery is the child's willingness to cooperate, little is known about how caregivers facilitate cooperation with young children during medical treatment. In this article, we explore interactions between parents, nurses, and young children during pediatric nebulizer treatment in terms of tact as a pedagogical concept. Based on our analysis, which followed a hermeneutic approach and included video observations of five hospitalized children aged between 15 and 30 months, we present four themes related to pedagogical tact of caregivers and children's willingness to cooperate, and discuss the role that medical products can play in this cooperation. The results benefit pediatric health personnel, as well as product designers.

Keywords
children; group interaction; health care; hermeneutics; observation; pediatrics; respiratory disorders; technology

Obtaining children's willingness to cooperate during medical treatment is of interest for the child patients and their parents, as well as for medical staff and medical product designers. From a broader social and ethical perspective, it is also of interest that children's medical treatments are cooperative, effective, and efficient. When the medical treatment in question is relatively lengthy or frequent, the need for cooperation becomes especially evident.

A challenge connected to infants and toddlers as a specific patient group is for the adults to explain, and the children to understand, why the medical treatment is necessary. To support increased medical adherence and improved health care experiences, there is a need for research to deepen an understanding of how to better influence and facilitate young children's willingness to cooperate during medical treatment. For human-centered product designers, it is core to understand the users and the use context when trying to influence a desired experience through products. Focusing on children as the primary user group for a product, particularly when the product has a medical function, also implies considering related caregivers as a user group.

Guided by a hermeneutic approach and applying van Manen's (1991) concept of pedagogical tact, we analyze five video observations documenting nebulizer treatment of five hospitalized children. Nebulizer treatment is commonly used in hospitals to treat young children with serious respiratory infections. It is suitable because no special breathing techniques are required. During treatment, the patient receives medication in the form of a mist through a mask that covers the mouth and nose. We present four themes to discuss how caregivers' pedagogical tact might influence children's willingness to cooperate during medical treatment with the nebulizer mask. The term "caregiver" refers to parents, nurses, or other central adults who interact with, and hold a responsibility for, children during medical treatment. Cooperation is understood as expressions and actions that indicate children's willingness or acceptance of working together with present caregivers to conduct the treatment.

The research is connected to a 1-year pilot project called BLOPP (a Norwegian acronym for "Barns Legemiddelopplevelser," translated as "Children's pharmaceutical experiences") conducted in 2012. The aim of the BLOPP project was to explore how design and technology can motivate children with respiratory diseases to

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take prescribed medication and promote positive interactions between children and caregivers, thereby increasing adherence to medical treatment.

According to previous research, one of the most important factors for efficient medical delivery, with specific reference to the treatment of respiratory diseases, is the child's willingness to cooperate (Janssens et al., 2000; Janssens & Tiddens, 2006). However, the majority of the research that has been conducted in the area of children's respiratory diseases consists of quantitative studies which lack analysis of attitudes, behaviors, experiences, and in-depth opinions of central stakeholders (Grover, Armour, Van Asperen, Moles, & Saini, 2011). Our study is an attempt to recognize children's perspectives and agency as patients.

The purpose of the study is twofold. First, we aim to develop knowledge around the social context surrounding children's nebulizer treatment. More specifically, we explore how manifestations of pedagogical tact during caregiver–child interaction might relate to the children's cooperation in treatment that involves a medical product. Second, our purpose is to discuss the role that medical products can play in this cooperation. Medical products are seen here as objects that can contribute to improve interactions between caregivers and children.

Background for the Study

Medical treatment of young children with respiratory diseases is associated with many challenges. About 30% of young children are distressed during inhalation therapy (Esposito-Festen et al., 2006). Distress causes poor delivery of medication for two reasons: First, failure to achieve a good seal between the mask and the face results in a significant reduction of delivered medication (Amirav, Balanov, Gorenberg, Groshar, & Luder, 2003; Everard, Clark, & Milner, 1992); second, distress by itself, as expressed through struggling, crying, or screaming, strongly reduces the amount of medication reaching the lungs (Iles, Lister, & Edmunds, 1999; Iqbal, Ritson, Prince, Denyer, & Everard, 2004).

Some researchers have suggested administering medication during sleep as an option to treat uncooperative children; others have claimed this strategy to be ineffective because many children tend to wake up during the treatment (Esposito-Festen et al., 2006). There is strong agreement that young children's cooperation and acceptance largely determines the outcome of inhaled drug treatment (Janssens et al., 2000). Everard (2000) asserted that pharmaceutical companies and nebulizer manufacturers have failed to develop devices that are intrinsically acceptable for young children and suggested delivery systems incorporating factors that will positively encourage children's cooperation. Consequently, understanding

the special needs and characteristics of infants and toddlers is vital to improving patient-friendly approaches as well as devices (Amirav & Newhouse, 2008; Esposito-Festen, Ates, van Vliet, Hop, & Tiddens, 2005; Everard, 2003).

According to a substantial amount of research, young children need nonpharmacological interventions to decrease stress and pain during medical procedures (McCarthy & Kleiber, 2006). Various approaches have been found to be useful for motivating and distracting child patients and reducing stress and fear in hospital settings—for instance, play, humor, and laughter (Dowling, 2002; Jun-Tai, 2008).

Some researchers have focused on the interaction between parents and children during medical treatment. Blount, Devine, Cheng, Simons, and Hayutin (2008) used observational scales to examine the relationships among adult and infant behaviors during immunizations to identify behaviors associated with infant distress. The researchers documented that behaviors associated with low levels of infant crying included sucking on a pacifier, playing with an object, maintaining close body contact and physical comfort, and using nonprocedural language. Adult verbal expression of reassurance, empathy, and apology showed no indication of being helpful (Blount et al., 2008). Conversely, researchers who investigated how infants responded to parents using distraction with toys, supportive care, or typical care during immunization found that the use of distraction had a minimal effect on infants' distress and proposed that reminding parents to use their normal comforting behaviors might be more effective than instructing them in a specific distraction technique (Cramer-Berness & Friedman, 2005).

Theoretical Framework

Originally connected to music, tact is used to denote a special form of human interaction (van Manen, 1995). The term refers to a special mode of knowing and being in dialogical encounters (Gadamer, 1989; Juuso & Laine, 2006) that also is suited to study interactions between adults and children (van Manen, 1991). The Latin words "tactus" and "tangere" mean touch, the sense of touch, and effect (Heyd, 1995; van Manen, 1991). To be tactful means to be "in touch with" and implies the potential to create an effect (van Manen, 1991). People experience and use tact in their own, unique ways. In general, a tactful person respects the dignity and subjectivity of other people and tries to be sensitive to their intellectual and emotional lives (van Manen, 1991). According to Gadamer (1989), tact can be understood as "a special sensitivity and sensitiveness to situations and how to behave in them, for which knowledge from general principles does not suffice. Hence an essential part of tact is that it is

tacit and unformulable" (p. 16). For van Manen (1991), tact differs from tactic because it essentially cannot be planned.

In his book *Pedagogical Tact* from 1962, Jacob Muth discussed the work of the German philosopher Herbart, who coined the notion of pedagogical tact almost 200 years earlier (van Manen, 1995). Muth developed the concept systematically and explored how tact manifested itself in education (Juuso & Laine, 2006). In his book *The Tact of Teaching*, van Manen interpreted the themes of Muth from a phenomenological viewpoint through practical examples from education (Juuso & Laine, 2006).

In accord with van Manen (1991), we understand pedagogical tact as a mindful orientation that permits us to act thoughtfully with children. Although the concept of pedagogical tact has been primarily applied to the particular context of education, the fundamental ideas of the concept can be considered equally relevant for studying interactions between children and adults in the context of medical treatment. Pedagogy places emphasis on the interactions between people, and in the case of children, it places emphasis on how children and adults interact with, and influence, each other (van Manen, 1991). Qualities that are essential to good pedagogy are also vital in pediatric care, such as a sense of vocation, love of and caring, a deep sense of responsibility, moral intuitiveness, tactful sensitivity toward the child's subjectivity, and a sense of humor (van Manen, 1991). Even if tact does not primarily manifest itself through observable behaviors, it is possible to describe, and reflect on, how tact reveals itself (van Manen, 1991).

Manifestations and mediations of pedagogical tact, as accounted for by van Manen (1991), are briefly outlined in the following. Pedagogical tact can manifest itself by holding back. Various forms of holding back, such as patience or withdrawal, contribute to enable children to grow or learn something. Pedagogical tact also implies showing openness to the child's experience. Moving beyond conventional perspectives of children's experiences implies that adults ask themselves the following question: What does this experience mean to the child? Pedagogical tact can show itself as attuned to subjectivity. We also speak of tact as a subtle influence. Situational confidence is another manifestation of pedagogical tact. Finally, tact can reveal itself as improvisational gift. Tact can be mediated through speech, silence, the eyes, gesture, through atmosphere, and through example. People are highly sensitive to all of these mediations in which experiences are shared.

Pedagogical tact in this article specifically refers to relations between adults and children, serving as an expression of the responsibility that adults bear concerning children's protection, education, and growth (van Manen, 1991). We use the description of its manifestations to illustrate caregiver–child interactions in medical treatment and how these interactions might influence children's willingness to cooperate during medical treatment with the nebulizer mask.

Pedagogical tact does not depend on physical objects. However, "human beings act toward things on the basis of the meanings that the things have for them" (Blumer, 1986, p. 2). Meaning is made through social interaction and interpretative processes. Meaning also evolves through continuous negotiation within a lifeworld that consists of social relations, ideals, situations, institutions, as well as physical objects. This is in line with symbolic interactionism (Blumer, 1986). Relating symbolic interactionism to design semantics, Krippendorff (2006) argued that artifacts must also be regarded as language in interaction. Objects and products contribute to meaning-making in people's daily lifeworlds (Battarbee, 2004; Fredriksen, 2011; Krippendorff, 2004).

From a designer's perspective, symbolic interactions imply that the meaning of a product resides in how its use is understood; that is, "symbolic interactions are interpretations of a product's meaning and of the meaning of the experiences it provides" (Battarbee, 2004, p. 83). In addition, when the term *hermeneutics* is used in design, it often refers to interpretations of products through an iterative examination of their specific details along with their context (Krippendorff, 2006). This assertion is also valid for our study. The interpretation of hermeneutics is highly related to the designer's own knowledge. According to Schön (1995), reflective, hermeneutic practice in design contributes to new ways of thinking. The practitioner establishes a dialogue with the situation and the stakeholders, which allows her or him to interpret needs, values, and solutions differently. Cultivating the designer's own knowledge as a reflective practitioner, pedagogical tact is an attitude that emphasizes emancipatory relationships between actors.

Research Process

The article is based on the analysis of five video observations documenting nebulizer treatment of five hospitalized children. The observations were conducted from January to March 2012. By observing and interpreting how children direct attention toward various phenomena in their surroundings, the researchers had the opportunity to gain an understanding of, and participate in, children's worlds (Samuelsson & Lindahl, 2002). Video recording expands these opportunities and is therefore commonly used in research that includes young children (Harder, Christensson, & Söderbäck, 2009; Samuelsson & Lindahl, 2002).

The observed treatment entailed video recording a single nebulizer treatment of each participating patient. A

single nebulizer treatment typically lasts for 5 to 10 minutes. The total duration depends on the amount of medication as well as the degree to which the child cooperates during treatment. The nebulizer treatment of hospitalized children can be administered as often as every other hour. The observed patients and their parents all resided in isolated rooms at the hospital. When viruses cause respiratory diseases, treatment takes place in isolation to reduce the spread of infections. The observed children were treated for serious respiratory infections caused by respiratory syncytial virus or related viruses.

The head nurse at the pediatric ward of the hospital was, because of her professional knowledge, essentially responsible for the first round of selection among the patients. When the head nurse considered participation appropriate, she informed the first author who in turn contacted the families after the child had been hospitalized for at least 1 day. If the parents were interested in the research, the first author gave them information about the purpose of the project and what a potential participation would imply. These conversations usually took place in the isolated rooms wherein the families lived during the hospital stay. In some cases, when children were awake, the first author had the opportunity to make contact with them before participating as observer in their treatment. The first author also informed the nurses about the study and told them that she was interested in observing treatments as they would normally take place. Because the nurses were encouraged to behave as they normally would, the observed treatments included unique approaches and different means of distractions such as films and play.

The selection criteria for the purpose of this article were that the children should be older than 12 months, awake during parts of the treatment, and that the first author should be personally involved in the observation. This led to the selection of five cases. The participants were children, parents, and nurses. The children were two girls and three boys: Adrian (18 months), Brittany (19 months), Evelyn (24 months), Harry (15 months), and Max (30 months). Their experiences with the nebulizer treatment ranged from minimal to a daily basis. The observations took place on their second, third, or fourth day of hospital treatment. The parents were four mothers and three fathers. Two children had both parents present during the observation. The nurses included four women and one man, with professional experience ranging from 2 to 32 years. In two of the treatments, the first author was assisted by a student from the BLOPP project.

In addition to the use of observation, semistructured interviews with one of the parents and with the nurse who administered the medication were conducted. Even if the interviews contributed to the researchers' changes in perspectives, we focus here on the observational part of the study.

The first author entered the patient rooms together with the responsible nurse. When stepping into the private lives of these families, she tried to be sensitive to the atmosphere in the room and adjust to the situation by carefully choosing the position and time to commence filming to avoid any disruption. She attempted to remain in the background when children seemed to act reluctantly and acknowledged the participants' expressions if they sought contact, such as applauding if the participants were celebrating the completion of the treatment. Participant observation affected the observed treatment situations in various and unknown ways; however, from a hermeneutical perspective, the first author considered such a personal presence both necessary and unproblematic for seeking understanding of the interactions taking place—as long as it felt ethically responsible.

For the analysis, we followed a hermeneutic approach. Hermeneutics refers to the theory and practice of interpretation (van Manen, 1990) and can be explained as an approach to the analysis of texts that emphasize how prior understandings and preconceptions shape the interpretive process (Denzin & Lincoln, 2005). According to the philosophy of Gadamer (1989), interpretation is an aspect of all forms of human understanding. Therefore, hermeneutics occurs no matter which aspects of our cultural and social worlds we seek to understand: "be it the meaning of life or the more mundane interpretation of everyday objects, ideas, and situations" (Lawn, 2006, p. 9). A pillar in hermeneutics is the hermeneutic circle (Prasad, 2002), which is comprised of connecting "parts" with the "whole." This is a process in constant movement and according to Lawn (2006), an actual clue in this process is that preexisting interpretations are necessary to make new interpretations possible.

In design, hermeneutics requires a thorough consideration and acknowledgment of the social, cultural, and historical context of designed artifacts, and the users' lives serve as the guideline for the design processes (Krippendorff, 2006). The goal is to learn from the informants. In this article, the hermeneutic approach lies in the appreciation of the observer's involvement in the observed context. Through this approach, we seek to gain understanding of the users' needs within their own contexts.

To capture a first understanding of the data material, the video recordings were watched several times in their entirety. The length of the video recordings ranged from 6 to 11 minutes. The analysis consisted of trying to understand certain fragments and how these fragments relate to the authors' understanding of the entire observed treatment. In this process, the goal was to focus on examples that reveal good practice. This choice was motivated by

ethical reasons and based on the view that good practice is important knowledge in itself.

In the analytical process, we followed the idea that creating a thematic understanding in human science research should be seen as a free act of "seeing" meaning as opposed to the unambiguous and mechanical application of counting acts or terms as they appear in, for example, a video recording or a transcript (van Manen, 1990). Our analysis led to the identification of four central themes connected with caregivers' tactfulness and children's willingness to cooperate with the treatment. The themes were captured as a result of a cyclic, analytical process, which was guided by three hermeneutic episodes.

The first episode was individually experienced when the first author was present as participant observer during the treatments. Successively, the importance of documenting the observations through video recordings became clearer as the author's individual understanding of the experienced situation changed when the material was explored by watching the sequences several times. Through repeated viewings, her understanding of the complexity of human relations increased.

Second, when the first author changed between methods—exploring the video material, transcribing the verbal and nonverbal utterances into text, and developing the narratives—her awareness of the rich nuances that characterized the caregiver–child interactions improved. The first author transcribed the conversations that took place during the treatment into text. Next, she created narratives describing the caregiver–child interactions with a high level of detail and contextual accounts (Fredriksen, 2011; Spalding & Phillips, 2007). These narratives represent the first author's interpretations of the interactions. The concept of pedagogical tact served as an analytical tool for interpreting the caregiver–child interactions as described in the narratives. Fragments wherein children seemed to cooperate with the treatment were selected and analyzed in terms of caregivers' pedagogical tactfulness. As a result of this second episode, the first author identified a number of themes that seemed to describe the content of the notion (van Manen, 1990).

Third, common observations of the videos and discussions between the three authors again transformed interpretations of the interactions between the children and the caregivers. Such collaborative analyses or hermeneutic conversations enable deeper insights and understandings by taking one researcher's descriptions as a starting point for sharing views and entering a process in which "themes are examined, articulated, re-interpreted, omitted, added, or reformulated." (van Manen, 1990, p. 100). The first author informed the two co-authors of her earlier interpretations by using the method of phenomenological reduction (see Groenewald, 2004; Sadala & Adorno,

2002). She described her understanding of the study, not only in terms of the external situation and the activities of the participants, but also through reflections on her experiences, such as changes in the rhythms of her own recognitions and emotions.

Eventually, the early research plan to examine and categorize the children's cooperation had to give way to a less rigid scheme, as a child can shift between what we have interpreted as cooperative expressions to strong resistance against treatment within a single minute of a medical treatment. During this collaborative process, the themes that were proposed by the first author were modified and narrowed. As a result of the third episode, the following four central themes were captured: shared focus, social rituals, interaction with comforting objects, and bodily closeness. We understand these themes as potential domains for positive interactions between the caregivers and the children rather than as fixed categories by which to describe the children's behaviors during medical treatment with respiratory products.

The Regional Committee for Medical and Health Research Ethics of Central Norway, in addition to head physicians at the hospital, approved the study. In Norway, according to the guidelines of the (Norwegian) National Committee for Research Ethics in the Social Sciences and the Humanities (NESH) from 2006, research that includes children under the age of 15 usually requires parental consent. Parents received oral and written information about the research project and gave their consent before the observations were conducted. The participating nurses received the same information and gave their consent. The adult participants were informed about their right to withdraw from the study, the incorporated requirements for storing sensitive data, and how the findings were to be presented in the dissemination of the research. All the participants have been assigned pseudonyms.

According to Norwegian guidelines for research ethics in the social sciences, law, and the humanities, "children's own consent is required from the time they are old enough to express an opinion" (NESH, 2006, p. 17). In a pediatric context, informed consent can be explained as "approval of the legal representative of the child or of the competent child for medical interventions following appropriate information" (Levy, Larcher, & Kurz, 2003, p. 629). A child's full right to give his or her own autonomous consent depends on national legal regulations (Levy et al., 2003).

Many ethical guidelines call attention to the issue of the child's assent (Caldwell, Murphy, Butow, & Craig, 2004), which is explained as "a child's agreement for medical procedures in circumstances where he or she is not legally authorized or has insufficient understanding to be competent to give full consent" (Levy et al., 2003, p. 629). It is also "defined as 'positive agreement,' of

children who are capable of providing it" (Wendler, 2006, p. 229). According to Leikin (1993), the fundamental purposes of assent include providing information to the child, offering shared decision making with parents, and honoring dissent. Because of the children's young ages, as well as the particular circumstances, the first author did not consider it feasible to get their active agreement based on challenges in providing information or facilitating shared decision making. Rather, the practice of honoring dissent was considered highly applicable and was attempted by the first author through acting sensitive toward the children's expressions.

The in-depth study of a small set of video observations might usually be considered a limitation. In the present study, however, the set is regarded as an advantage rather than as a restraining condition because the main criterion for its selection was not to represent a typical example, but to maximize what can be learned. According to Morse (1995), a crucial principle for understanding the process of saturation is that the "richness of data is derived from detailed description, not the number of times something is stated" (p. 148). In line with the description of saturated data as "rich, full, and complete" (Morse, 1995, p. 149), the authors concluded that the five cases were suitable for full and extensive description that in turn allowed us to capture themes that made sense.

Hermeneutics puts emphasis on shared understanding, and rigor as a criterion for research yields a different connotation than in the natural sciences. Although Davies and Dodd (2002) proposed that the conception of rigor is inherent to a quantitative bias encompassing criteria such as "detachment, objectivity, replication, reliability, validity, exactitude, measurability, containment, standardization, and rule" (p. 280), Guba and Lincoln (1989) introduced the criteria of credibility, transferability, and dependability to establish trustworthiness in qualitative research. Koch (2006) interpreted these criteria in ways that are relevant for this study, which is further discussed in the section "Methodological Issues."

Findings

In the following, we present the four themes that appear as potential domains for positive interactions between the caregivers and the children. We use vignettes from the first author's narratives to illustrate each theme.

Shared Focus

A shared focus can be understood as a mode wherein children and adults direct their attention toward the same situation. In the treatments of Harry and Brittany, a shared focus was established through the means of film. In Harry's treatment, the adults' tactfulness mainly

manifested itself as holding back. Harry was completely calm and quiet during the treatment. So were Nurse Cornelia and the parents. Harry's interest in the film, as well as the adults' awareness and respect toward his interest, enabled a shared focus. While Harry watched various short film clips that displayed him engaged in joyful action, such as jumping on the bed, the adults were quiet and nearly unmoving:

> "Look what Daddy has," says Cornelia and places the mask above Harry's mouth and nose. "What does daddy have on his phone?" Cornelia continues with a calm voice. Harry has his full attention on the film. He sits in an upright position. He is calm. He concentrates on what is happening on the screen and pays no attention to the mask as Cornelia places it back onto his face after she has made some adjustments. There is complete silence. They all sit calmly. Harry watches the film closely. (Vignette [V] 1)

Brittany watched an animated cartoon on a tablet while Nurse Bridget held the mask onto her face and her mother held her daughter in a firm grip. Brittany cried, roared, and made several attempts to get loose from her mother during the first minutes of the treatment. After a brief interruption of the treatment, caused by the device accidently being dropped onto the floor, the mother tactfully attuned to Brittany's expression of resistance by releasing her grip. Brittany made no signs of physical resistance once she was able to sit freely; on the contrary, she leaned toward the mask. Throughout the remainder of the treatment, Brittany was sitting on her mother's lap without being held, while concentrating on her film. Bridget and the mother collectively showed tact by holding back.

> Then Bridget and the mother become quiet. They observe Brittany while she sits quietly watching her film. No one makes a sound. (V2)

The adults' pedagogical tact in recognizing and respecting the children's interest in the films by gently holding back through silence and facilitating a calm atmosphere was important for enabling a shared focus. Brittany's willingness to cooperate clearly increased when she was able to sit freely. Harry, who initially avoided Cornelia's attempts to relate to him before the actual treatment started, remained cooperative through the whole treatment.

Social Rituals

Social rituals mean here a set of actions that appear to bring humor and enjoyment into the treatment. Two kinds of rituals have been observed, namely play and celebration. Smiles and laughter in the caregiver–child interactions have been related to moments of lightheartedness.

In Evelyn's case, humor and enjoyment were expressed through play. Before the actual treatment started, Nurse Eric showed improvisational tact by using the mask, which was shaped as a duck, as a reference. This duck shaped mask was the only sample present at the ward. Together, nurse and child engaged in transforming the mask into a duck:

> Eric holds up the mask that is shaped as a duck and asks: "Shall we say hello to the duck?" Evelyn looks at the duck. "What does the duck say?" Eric asks. Evelyn smiles without saying anything. "Quack, quack, quack, quack," says Eric. "Does it say that? Wonder if it says that?" he continues to ask. "Quack," says Evelyn and smiles to Eric. "Yes," says Eric. Evelyn points to the duck. "Yes, does it say quack, quack, quack?" he asks. "Yes," Evelyn replies. "Maybe you want to hold it yourself?" Eric asks. "Quack, quack," says Evelyn, while she watches Eric, who prepares the medication. (V3)

In this way, the duck became a "participant" in Evelyn's treatment. It was the duck that made the noisy sound and it was the duck that came close to her nose, not the device or the mask:

> "Let us see. It says 'Psjjt,'" Eric says before he connects the device to the oxygen. Evelyn looks at Eric and the device. Eric calmly bends down to Evelyn's eye level and asks, "Shall we say hello to the duck?" "Quack," Evelyn replies. She looks at Eric and the device while smiling. "Quack, quack, quack. Then comes the duck. Over the nose. Yes. Like that," Eric says while he places the mask onto her face. "Quack," Evelyn says when the mask is put on. (V4)

During the treatment, Nurse Eric encouraged Evelyn to participate in tapping the device. To prevent condensation, nurses need to gently tap onto the nebulizer cup occasionally. The following fragment is an example of how the ritual of tapping the duck brought humor and enjoyment to the situation:

> "Are we going to tap a little?" Eric asks and demonstrates a tapping movement in the air. The father taps onto the device and says: "Evelyn can also tap." Evelyn taps the device. When she stops, Eric claps and says, "Very good." She looks at Eric and smiles. "Very good," he says again. Evelyn says, "*Euhh*," and fumbles a bit with the handle. Eric says, "You are really good. Do you want to tap some more?" She moves her hand to the top of the device. "Do you want to tap more onto it?" Eric asks. The father taps a bit on the device. Evelyn also taps on the device together with Eric. Evelyn continues to tap on her own. She smiles and looks at Eric. "Yes, like that. You really knew how to do that," says Eric. (V5)

In the case of Harry, the importance of social rituals was emphasized when he himself took the initiative to celebrate. Nurse Cornelia used certain expressions such as "Hurrah for Harry" and "How big is Harry today?" when she sought contact with Harry before the actual treatment was initiated. At the time, Harry did not directly respond to this. However, halfway through the treatment Harry wanted to celebrate his efforts:

> After a while Harry turns his head and lifts his arms. He starts to clap and looks at Cornelia. "Yes," Cornelia says with a loud, singing voice while she removes the mask from his face and claps along. Cornelia and the parents cheer and laugh; so do I [observer]. "Hurrah for Harry," says Cornelia. Harry turns to the film again. "Yes, we need a hurrah for Harry," says Cornelia while she puts the mask back onto Harry's face. Harry does not pay any attention to the mask; he is focusing on the film. (V6)

Adults' sensitivity toward children's experiences and ability to improvise can help to establish caregiver–child interactions that are characterized by humor and enjoyment. Harry reminds us that the sharing of meaningful rituals depends on time and place. Evelyn seemed to enjoy taking an active role in her own treatment. Through play, she was able to control much of the situation and interact with her caregivers in a positive way. By involving the device as part of their play, Eric and the father tactfully influenced Evelyn's willingness to cooperate during treatment as they interacted in moments marked by enjoyment.

Interaction With Comforting Objects

Comforting objects can be understood as objects that are familiar and meaningful parts of children's everyday lives, such as pacifiers, comfort blankets, and teddies. For Adrian, the pacifier provided comfort. In addition to having a pacifier in his mouth, he was holding a pacifier in each hand during the whole treatment. Although it is recommended that children do not use pacifiers during nebulizer treatment, Nurse Anna supported Adrian's use of pacifiers:

> "I am thinking that it is better to give [medication] without the pacifier," Anna says. "Mm," the father replies. "But the very best is of course that he is calm," she continues. (V7)

Anna's way of reasoning about the pacifier is an example of how she showed situational confidence. Anna's choice to bypass the procedural recommendations for optimal administration deals with moral intuition and her reflection suggests that she was sensitive toward Adrian's experience. She considered the pacifier important for Adrian's well-being. Adrian's mother also acknowledged the importance of the pacifier as Adrian's comforting object:

Adrian is coughing. He loses his pacifier and wakes up. Adrian turns away. He looks upset and pushes the mask away while he makes some small noises. He takes a pacifier into his mouth and closes his eyes. The mother places the mask onto his face. Adrian pushes the mask away. "Adrian, stop," the mother says in a low voice. She grabs a pacifier, places it in his hand and says: "Here. Here. You can hold this in your hand." He opens his eyes and closes them again. (V8)

Max woke up about half a minute into the treatment and stayed awake for the remainder of the treatment. Nurse Laura turned off the nebulizer immediately when Max woke up. She tried to make eye contact with Max and provided him with his teddy Koko and his pacifier. Max was coughing a lot and seemed frustrated. Throughout most of the treatment, Max cried and turned away from the nebulizer. The following fragment illustrates how Koko functioned as a comforter:

The mother manages to hold the mask onto his face for a little while. She is holding his arm in a fixed position. Max coughs. He lies calmly, leaning backwards in his mother's arms with the pacifier in his mouth and Koko on his lap. Then he starts to cry and kick with his leg. "Koko," says Max. "Koko is here," says the mother. "Here he is. Here he is," says Laura and shows Koko to Max. Max becomes quiet. He coughs, but lies calmly. (V9)

Brittany used a pacifier at the very beginning of the treatment, but after a little while Nurse Bridget removed it. As soon as the treatment was finished, Brittany sought comfort in the pacifier and her comfort blanket that were provided by the mother in an almost automatic way:

"All done," says Bridget and the mother repeats, "Oh, all done," while she leans close to Brittany. Brittany whines. "Hurrah," says Bridget while she claps. The mother puts the pacifier into Brittany's mouth. Brittany stretches her arm toward her comfort blanket. The mother has already grasped it and gives it to her. Brittany takes the blanket to her face while she sucks on her pacifier. (V10)

Rather than suggesting that there is a direct cause between comforting objects and cooperation, our analysis indicates that certain objects that are deeply meaningful in children's lives are also of great significance during medical treatment. Parents and children bring comforting objects to the hospital because they are important. Caregivers' tactfulness in recognizing the meaning of such objects can contribute to children's calmness and influence their willingness to cooperate during treatment.

Bodily Closeness

Bodily closeness enables parents and nurses to mediate tact through their whole way of being: through speech, through silence, through the eyes, through gestures,

through atmosphere, and through example (van Manen, 1991). All of the observed children received treatment while sitting on the lap of one of their parents. Adrian's mother praised, stroked, and sang to him:

The mother says: "You are doing so well. Really well." Adrian turns his head away and starts to cough. She strokes his head. He whimpers and closes his eyes. The mother sings gently. (V11)

In the case of Max, both his mother and Nurse Laura were concerned with obtaining his approval before initiating the treatment. They asked Max several times whether he wanted to sit with his mother. Finally, the mother decided to lift Max from his bed:

"Do you want to sit in mom's lap?" Laura asks twice and bends down to Max. Max looks straight ahead and coughs. The mother strokes his head. The mother leans close to him and asks: "Do you want to sit in my lap?" Max starts to cry and puts his face on the duvet. The mother asks: "Huh? Do you want to? Come and sit here," she says while standing up and lifting Max from the bed. She chats a bit and gives Max his teddy while hugging him before they sit down. Laura starts the device for the third time. (V12)

Bodily contact enables children and parents to share their experiences, whether characterized by frustration, fear, and resistance, or rather the feeling of mastery and success. Understanding the issue of bodily closeness regarding children's cooperation is complex. Nevertheless, our observations reveal the highly social dimension of children's nebulizer treatments. Bodily contact between a child and a trusted caregiver can be considered a necessary foundation for establishing any kind of cooperation during medical treatment. Through bodily closeness, a tactful caregiver can provide comfort and thereby influence a child's willingness to cooperate.

Discussion

Nurses and parents can, through manifestations and mediations of pedagogical tact, facilitate shared focus, social rituals, interaction with comforting objects, and bodily closeness, thereby contributing to children's cooperation during medical treatment. In the following sections we discuss the findings in light of previous research, provide some reflections on the role that medical products can play, and review the methodological issues of this article.

The Findings

The two themes of shared focus and social rituals stand out as the most relevant features of caregiver–child interactions concerning children's cooperation. In addition, there is a strong link between the two themes. The children who

cooperated over longer time frames were interacting with their caregivers in contexts of shared focus or social ritual. In these cases, the nebulizer treatment seemed to become invisible to the children.

The establishment of a shared focus that is meaningful to the children can influence their willingness to cooperate with medical treatment. In the explored cases, the shared focus was watching films. It is difficult to assess how the specific content of the different films might have influenced the treatments of Brittany and Harry (Vignettes 1 and 2). An essential point for reflection is the importance of the meaning that children already assign to particular films prior to the treatment. Both Brittany and Harry were, according to their parents, watching their favorite films. This might have contributed to experiencing the situation as meaningful for both the children and the parents. Adults' pedagogical tact of holding back is especially important for enabling the participants to collectively focus their attention on the film.

Social rituals can influence children's willingness to cooperate, as demonstrated in the exploration of Vignettes 4 to 6. For social rituals to develop, caregivers need to be attentive and attuned to the child's experience. The pedagogical tact of improvisation is of particular importance for the social ritual of play, as demonstrated in Vignette 3.

Comforting objects such as pacifiers, blankets, and teddies played a role in most of the observed treatments. The pedagogical tact related to the objects involved acknowledging the meaning that the child assigned to them. In the explored cases (Vignettes 7–10), comforting objects did not lend themselves to shared use such as play. They can be interpreted as a security for the child during the nebulizer treatment. Comforting objects can play an important role in terms of supporting children during the whole hospital stay, as well as during specific medical treatment.

Similarly, bodily closeness to a trusted caregiver is interpreted as more of a general and calming support (Vignettes 11 and 12). All of the children were bodily close to one or both parents during the nebulizer treatment. Although it is difficult to evaluate how they influence children's willingness to cooperate, we can assume that—combined with pedagogical tact—the physical presence of comforting objects and bodily closeness contributes to an improved experience of the medical treatment and hospitalization.

The significance of shared focus and social rituals is supported by previous research. Besides technical medical care, the presence of parents and skilled nursing care, as well as the provision of play, are considered top priorities for a sick child's recovery and well-being (Sylva, 1993). Mason, Johnson, and Woolley (1999) demonstrated that simple interventions that keep parent and child collectively engaged in an activity have the potential to reduce distress of young children during medical procedures. Humor and play can reduce anxiety and hence stimulate willingness to cooperate. According to van Manen (1991), humor is valuable for opening "new possibilities where things otherwise get edgy, messy, stuffy, stodgy, dreary, or stuck" (p. 201). Mireault et al. (2012) have also shown that children as young as 3 months engage in social play.

Research concerning the effects of films as passive distraction in medical treatment is conflicting. Although some researchers found that films can contribute to a decrease in a child's perceived pain and distress during different kinds of procedures (Low & Pittaway, 2008; MacLaren & Cohen, 2005; Mifflin, Hackmann, & Chorney, 2012), others concluded that television and movies are insufficient for reducing pain and distress (Koller & Goldman, 2012). For instance, the use of short stories and interactive toys was found to be more effective than watching cartoons during painful procedures of 2- to 5-year-old children (Mason et al., 1999).

Our findings about bodily closeness and comforting objects can be related to the research of Pinto and Barbosa (2007) who argued that a mother's presence during pediatric treatment is essential because they can give meaning to their child's lived experiences. Similarly, LeRoy et al. (2003) emphasized the importance of parents' presence and transitional objects for the youngest child patients and Blount et al. (2008) showed that sucking on a pacifier or bottle, along with close body contact, is associated with reduced child distress during medical treatment. The term "transitional object" refers to something that becomes important to the infant and somehow serves as a protector against anxiety, such as a doll, a corner of a blanket, or a tune (Winnicott, 1971).

In the case of somewhat older children, Salmela, Salanterä, and Aronen (2010) explored how 4- to 6-year-old children deal with their hospital-related fears and identified security as a main cluster of strategies. The experience of security includes the presence of parents, the child's personal toys, and experiences of proximity and tenderness. The children described their need to remain near their parents and how their toys or other personal objects gave them a feeling of security. They also reported that tenderness and intimacy from health personnel were important (Salmela et al., 2010).

Based on our study, we suggest that within the moments when children and caregivers share their focus—whether it is toward a film or in social activities that include elements of humor, enjoyment, and play—the medical treatment fades to the background. The ways in which caregivers are able to follow or enhance a child's interest is essential. Comforting objects are most reserved for children's own use. Bodily closeness primarily takes place between children and their parents. Moreover,

when caregivers, both parents and health personnel, direct their attention more toward initiating shared focus and social rituals, the experience of meaningfulness during medical treatment might intensify by making it more enjoyable, less frightening, and possibly fun. Pedagogic tactfulness, such as holding back or improvising, can increase and strengthen a child's willingness to cooperate. Success in establishing an authentic relation depends on the readiness of both adult and child; however, caregivers have a stronger role to play when it comes to initiating and facilitating such relations.

Pedagogical Tact and Medical Product Design

When children are seriously ill and hospitalized, the first and foremost concern is to ensure that they receive the medical treatment that is necessary. If receiving medical treatment depends to a high degree on a child's willingness to cooperate, the caregiver's pedagogical tactfulness is crucial in terms of influencing preferred experiences. The hermeneutic approach of interpreting interactions among children and caregivers can provide product designers with important insights. It also fosters empathic realizations and inspiration in the process of creating improved products and environments (Fulton Suri, 2003) that are intended to influence desirable experiences for children and their caregivers in hospital settings.

Products or actions can become meaningful to young patients in treatment when they are able to experience or enjoy it together with their caregivers through shared focus and social rituals. This aligns with the semantic argument in design that people do not see and act on the physical qualities of products but rather on what they mean to them (Krippendorff, 2006). The core product in our study is the nebulizer device and related mask. Nebulizer facemasks for young children have typically just been small versions of the masks used for adults (Everard, 2003). In recent years, more attention has been given to technical aspects of mask design such as improved seal, anatomical contours, and increased flexibility (Amirav & Newhouse, 2008).

We suggest that designers should give a higher priority to aspects beyond technical improvements. This thought is supported by the claim that medical technologies cannot be perceived as neutral (Mol, 2008). Medical products for young children should be designed to contribute to pleasurable and playful caregiver–child interactions. The medical product will then serve as a tool for caregivers to facilitate shared focus and social rituals. For that reason, integrating familiar elements from a child's world such as recognizable shapes, colors, sounds, smells, materials, and other expressive elements should be considered important in the design of medical products.

Although medical products are used in clinical contexts, it is not necessarily an advantage that they appear cold and antiseptic. Product properties that support pedagogical tact can be of great importance for enhancing children's cooperation during medical treatment and for achieving a successful treatment in general. When children are compelled to use medical products, it is highly important that the "product language" relates to children's ways of meaning-making (Bruner, 1990; Fredriksen, 2011). Moreover, it is equally important that these aspects are strongly considered when hospitals purchase medical products. Ultimately, thinking about and designing medical products for children means taking children seriously as users of products and as equal members of society.

Methodological Issues

According to Guba and Lincoln (1989), credibility is established when there is a match between the constructed realities of the respondents or stakeholders and the constructed realities of the researcher. Researchers can enhance credibility by presenting faithful descriptions and interpretations (Koch, 2006). A basic tenet of philosophical hermeneutics is the interpretative, namely that a dialogue, colored by preconceptions, takes place between a researcher and a text (Koch, 2006). Although the reader might not share the author's interpretation, given that the preconceptions of individuals are expected to be unique, the reader should be able to follow the author's process of interpretation (Koch, 2006). The themes presented in this study were constructed by a process wherein the authors moved between observing the video material and reflective interpretations and discussions, both individually and collectively. Our interpretations of pedagogical tact and cooperation guided these discussions. Through our discussions, our interpretations were also gradually shaped by each other's preconceptions.

Participant validation is also a way to establish credibility; however, Koch and Harrington (1998) call attention to ethical and practical challenges in relation to sharing data and outcomes with study participants, and question its benefit. As with their studies of older patients, our study with young children challenges the conventional criteria of participant validation. The transcribed conversations were mainly led by adults and could have been returned for verification and feedback. Our alternative to data return was to follow up each observed treatment by conducting semistructured interviews with both the nurse and one of the parents, during which the first author always asked questions about how the treatment was experienced from their respective viewpoints.

To gain an understanding of the caregiver–child interactions, the first author developed narratives to account

for both verbal and nonverbal expressions, as well as contextual aspects. Rather than a mirror of reality, the narrative can be understood as a poetic and expressive form that reflects the experience from which it originates (Schwandt, 1994). The observed situations involved participants, not only with different roles, but also of very different ages, which implied that their opportunities to evaluate the narratives were not at all comparable. Instead of returning the narratives to the participants then, the authors chose to stay close to the data—which is another way to enhance rigor (Alasad & Ahmad, 2005) through transcribing and developing the narratives themselves. Through repeated watching of the video material during the development of the narratives, and in the process of identifying relevant themes, the authors have put emphasis on coherence and consensus, which are ways to appraise for the "rightness" of narrative accounts (Eisner, 1991).

Transferability, or fittingness, concerns the extent to which the findings of one study are available for comparison in other contexts and the extent to which an audience views the findings as meaningful and applicable (Koch, 2006). The findings of this study can most likely fit into pediatric contexts involving medical treatment that is somewhat time-consuming and therefore also requires a high level of child cooperation, such as sitting still. Likewise, the discussion of the role that medical products can play seems to be relevant for different kinds of pediatric treatment involving medical products. The theoretical framework of pedagogical tact emphasizes relationships and is considered suitable for exploring caregiver–child interactions in different pediatric contexts.

The issue of dependability refers to the ways in which the research process can be audited (Guba & Lincoln, 1989; Koch, 2006). Through presenting a clear account of the decision trail by explicitly discussing decisions regarding theoretical, methodological, and analytic choices, the researcher can establish auditability (Koch, 2006). Besides the current discussion, the authors have thematized these matters throughout the different sections of the article.

Concluding Remarks

Facilitating and establishing shared focus, social rituals, interaction with comforting objects, and bodily closeness relate to adults' pedagogical tactfulness and children's willingness to cooperate. Adults can influence children through tact, but children and adults need to collectively feel whether these actions and relations harmonize with their experiences. In their efforts to establish cooperation with children, nurses also depend on cooperation with parents. If nurses are able to achieve cooperation with both the children and their parents, children are more likely to adhere to the prescribed medication and have more positive experiences related to medical treatment. Furthermore, designers should be encouraged to be attentive toward the role that medical products can play in supporting cooperation based on tact in pediatric contexts.

Medical treatment is highly dependent on cultural, professional, and geographical surroundings. The authors of this study do not thus claim totality or general validity of the findings of this study. We rather intended to shed light on a small section of medical practice to create insight for drawing conclusions. As previously argued, we regarded a small sample as beneficial because it enabled a thorough exploration of the multifaceted interactions that take place between children and caregivers in the course of a single nebulizer treatment. Future studies that include larger samples and follow patients through several treatments would be valuable. Furthermore, we have explored caregiver–child interactions in light of pedagogical tact and cooperation. However, in addition to adult tactfulness, a child's willingness to cooperate in medical treatment is likely to be affected by a number of other aspects such as the general condition of the child and the specific time of day when the treatment takes place. Studies that seek to further explore such aspects are needed as well.

Finally, the focus on young children as a patient group challenges the researcher's interpretations of their lived experiences. We have attempted to meet these challenges by narrating and interpreting the verbal and nonverbal expressions of the children similar to those of the caregivers. In summary, increased research on young children as users of health care services and medical products might contribute to greater awareness of this topic as well as improve ways of interpreting interaction and communication between young patients and their caregivers.

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Article III

Designing Healthcare Games and Applications for Toddlers

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ABSTRACT

Healthcare games are becoming increasingly popular because of their potential to improve patients' wellbeing before, during, and after medical treatment. Even though young children (here referred to as toddlers) make up a growing group of gamers, there is a lack of research focusing on healthcare games for this group. Since toddlers often express unmotivated behavior towards receiving medical treatment, the potential of healthcare gaming applications for this group should be explored. The purpose of our study is to provide a set of research-derived design considerations for healthcare games and applications for toddlers. Our approach included an initial best practices collection through a workshop involving experts from pediatric healthcare and pedagogy, and an affinity diagramming categorization by a focus group with HCI and health researchers. This resulted in a robust set of best practices that was further used for establishing a connection with game components and transformation into design considerations. As an illustrating example we present a prototype of a healthcare game developed to improve nebulizer treatment for toddlers. The final result of this work is a set of key aspects to consider when designing healthcare games and applications for toddlers. The results should be useful for designers and researchers who work in the intersection between health and young user groups.

Categories and Subject Descriptors

J.3 [**Life and Medical Sciences**]: Health; H.5.2 [**Information Interfaces and Presentation**]: User Interfaces, user-centered design; K.8.0 [**Personal Computing**]: General---games.

General Terms

Design, Human Factors

Keywords

Healthcare games, young children, toddlers, design considerations

1. INTRODUCTION

Healthcare games refer to digital games used in health-related contexts. Such games are typically developed in order to inform patients about particular diseases, to serve as a distraction while experiencing pain or discomfort, and to stimulate desired behavior and activities related to healthy lifestyles. Case studies from the

early 80's show that the medical field has a noteworthy history of embracing video games as a way of engaging patients to improve their health outcomes [19]. Today healthcare games are designed, used, and researched on an extensive level. The interactive potential of digital games offers distinct advantages over conventional methods of health education [22]. A compelling interactive game can, for instance, repeatedly expose players to essential content, as well as offer a social component that in turn can enhance motivation to improve health behavior [22].

A large body of research has documented that young children are particularly vulnerable to experiencing emotional distress during hospitalization (e.g. [35, 37]), making the potential of healthcare games particularly useful to this exact group. Although toddlers, a common term for young children between 1-3 years of age, make up a growing group of gamers (e.g. [38, 39]), there is a lack of healthcare games and applications for this group.

The work we describe here is part of a project called BLOPP (Norwegian acronym for *Children's pharmaceutical experiences*) which aims to explore how design and technology can contribute to the motivation of children with respiratory diseases to take prescribed medication and stimulate interactions between children and caregivers in order to increase adherence to medical treatment both in hospitals and at home. Serious respiratory infections caused by respiratory syncytial virus or related viruses lead to hospitalization of many young children [10]. The most common treatment is nebulizer treatment.
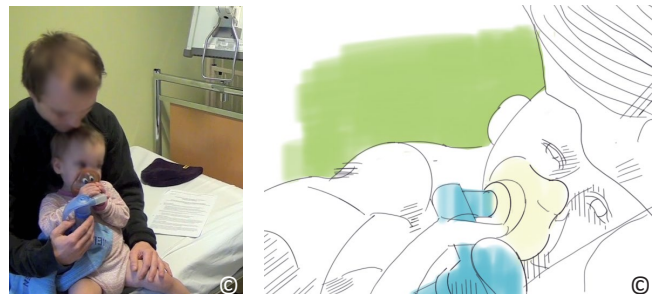
Figure 1. Nebulizer treatment (left); an illustration [3] (right)

Figure 1, obtained from our observational studies of hospitalized children receiving nebulizer treatment, gives an impression of this treatment. Nebulizer treatment is suitable for young children because it does not require special breathing techniques. Patients receive medications in the form of a mist through a mask that covers mouth and nose. The mask is attached to a nebulizer that converts the liquid medication into mist. The treatment lasts for 5-10 minutes and is typically repeated every 2-4 hours. Studies have shown that about 30% of young children are distressed during inhalation therapy [9]. Some reasons for children's resistance and distress, as addressed by nurses and parents that we have

interviewed, are: (1) that the facial contact with the mask can be perceived as uncomfortable and scary, (2) that the noise produced by the oxygen-driven nebulizers can be fear-provoking, (3) that the mist smells and tastes odd, (4) that children experience a lack of control, and (5) that the children must sit still for a long period of time. Poor collaboration often results in power struggles as well as reduced effects of the medications.

In our efforts to investigate how interactive products and applications could be designed in order to motivate toddlers for medical treatment of respiratory diseases, we conducted a series of qualitative user studies. The specific focus of this paper is on healthcare games and applications. This paper is based on findings from a workshop session wherein experts from pediatric healthcare and pedagogy shared their best practices and ideas for improved medical treatment of toddlers, which in turn have been analyzed in two steps. First, we organized the workshop data through the affinity diagram technique. Second, we used the organized data to create a set of design considerations for healthcare games and applications for toddlers. The rest of the paper is structured as follows: Section 2 presents an overview of relevant research in the areas of (1) game and play usage in pediatrics, (2) healthcare games and applications for children, and (3) frameworks and guidelines for designing children's games and applications. Section 3 describes the workshop and the methods used for analyzing the collected data. Section 4 presents the results as (a) an organized set of experts' best practices and (b) a set of design considerations for healthcare games and applications for toddlers. A prototype application (named BLAPP), that was developed to improve toddlers' nebulizer treatment, serves as an illustrating example. Finally, concluding remarks and directions for future research are given in section 5.

2. RELATED WORK

2.1 Game and Play Usage in Pediatrics

A substantial amount of research shows that toddlers and preschoolers are most in need of non-pharmacological interventions to decrease behavioral stress and pain during medical procedures [30]. In pediatrics, distraction is commonly utilized as a strategy for drawing a child's attention away from unpleasant pain stimuli [20]. There are two distinguishable forms of distractions: active distraction and passive distraction. Active forms of distraction, in clinical contexts, are typically interactive toys, Virtual Reality, controlled breathing, guided imagery, and relaxation. Passive forms of distraction include listening to music or watching a movie. Most studies evaluate interactive toys, such as electronic and video games, as effective in reducing anxiety and distress of pediatric patients who undergo preoperative care and invasive procedures (e.g. [8, 34]). On the contrary, the results of a study on pediatric venipuncture indicate that a passive distraction strategy might be most effective for children who receive this kind of treatment [27].

As emphasized by Koller and Goldman [20], the range of interactive toys and electronic games is broad, and careful selection with regards to the types of games offered to pediatric patients is vital. There are mixed and inconclusive findings concerning comparisons between active and passive forms of distraction [20]. Because there is limited research comparing types and forms of distractions, it is difficult to outline best practices concerning design considerations. In other words, studies within pediatric research provide little exploration into the specific properties or characteristics of the employed distractions.

2.2 Healthcare Games and Applications for Children

Healthcare games and applications that aim to increase the motivations of patients fall into three categories: games for learning, games for distraction, and games for coaching [45]. These games target broad age ranges and are used in relation to cancer treatment, anxiety management, physical therapy and fitness, burn pain, diabetes, asthma, and bladder dysfunction [19]. Many healthcare games are directed toward children and adolescents [33]. Some relevant examples that are available on the commercial market are provided below.

The videogame *Bronkie the Bronkchiasaurus* is developed to teach children about asthma self-management by covering topics such as the respiratory system, identifying and avoiding triggers, recognizing and responding to early warning signs, the purpose of asthma medications, and how to handle common social situations [22]. In this game, children must help two dinosaurs in the search for pieces of a broken machine while also managing their asthma by making sure that they take medication, use the device correctly, and avoid asthma triggers [22]. Other examples related to asthma are *Watch, Discover, Think & Act*, *Wee Willie Wheezie* and *The Asthma Files*, all games that have been developed for children aged seven years and older [4]. *SpiroGame* is a collection of two interactive minigames developed to teach children about different breathing techniques by controlling an animated caterpillar through their breathing [19]. Research findings show that *SpiroGame* facilitates successful spirometry, which is a test for measuring lung function, in preschool children [44]. *SISOM* is an interactive communication tool designed to help children with cancer elicit and report their symptoms through spoken text, sound, animation, and intuitively meaningful metaphors and pictures [43]. The target group is children between seven and twelve years, but the child-friendly communication style makes the tool relevant for even younger children who cannot read [43]. In *SISOM* children can go on a journey visiting various islands which each represents a different symptom or problem [36]. This tool is unique because, unlike other applications designed for informational or educational purposes, the purpose is to elicit personal information from children [36]; however, when it comes to design of healthcare games, toddlers constitute a user group that has yet received little attention.

2.3 Frameworks and Guidelines: Designing Games and Applications for Children

Within the emerging app market, toddlers and preschoolers are the most popular age category, and their gaming applications experienced the greatest growth in 2011 [39]. Despite this, research about these young players and their preferences, from a design point of view, is currently very limited [49]. For instance, a full review of the research papers from the Interaction Design and Children community concludes that the majority of research deals with children between the ages six to twelve years, and furthermore includes no papers with a focus on children under the age of two [48].

According to one of the few existing studies focusing more specifically on how young children approach, play, and learn with age-appropriate applications, "the game" for toddlers is about "making things happen" such as tapping an object that responds with a sound [31]. The following taxonomy is proposed for considering similarities and differences between applications for young children, including toddlers: (1) *game play/mechanics or activity*, (2) *characters*, (3) *narrative* as defined by the game and

as experienced by the child, and (4) *curriculum* [31]. Here, play/mechanics or activity refer to a range of challenges, actions, and reactions leading to skill acquisition and achievement as the game is played and mastered; characters can be understood as avatars; narrative refers to the story, and curriculum can be regarded as the thematic content and may be more or less explicitly embedded in narratives and activities. In addition, Hengeveld et al. [15] have developed a play-and-learning system to stimulate the language and communication skills of toddlers with multiple disabilities and present a number of design guidelines related to social interaction, tangibility, challenge, familiar materials, control, and flexibility.

Abeele and Zaman [1, 50] offer *The Likeability Framework* for designing applications for preschoolers. The framework connects basic needs, contextual societal factors, and individual characteristics to five gratification areas that children seek in terms of fun and likeable products: (1) challenge and control, (2) social experiences, (3) fantasy, (4) creative and constructive expressions, and (5) body and senses. Similarly, Lieberman [23] focuses on game design for children between three and six years old, providing a list of instructional strategies to consider, such as: demonstrations, stories, role models, interactive questioning, challenges, repetition and rehearsal of skills, social interaction, personalization and fun, humor, fantasy, and entertainment. Based on an ethnographic study in a kindergarten, Wyeth [47] proposes that technology for playful interactions should be transformable, flexible, and portable in order to augment children's play. Since preschoolers can use a teddy bear as a baby in one moment and as a pirate in the next, technologies should support rather than narrow such imaginative play. Furthermore, designing technology that supports social and emotional connections should be prioritized [47]. Antle [2] introduces *The Child Tangible Interaction Framework* to inform the design of interactive technologies for children aged between four and twelve years. This framework connects concepts from cognitive development and educational theories with design aspects of tangible systems.

3. METHODOLOGY

Figure 2 shows the approach that forms the direct basis of this paper. The workshop with the experts resulted in a large number of best practices and ideas regarding ideal/improved pediatric treatment. Subsequently, a focus group organized the best practices to greater detail by using an affinity diagram technique. Next, the affinity diagram was used as a starting point for transforming the best practices into design considerations for healthcare games and applications. For clarifying purposes, we present a brief account of the studies conducted at the hospital, as preliminary analysis of these set some direct premises for the workshop.
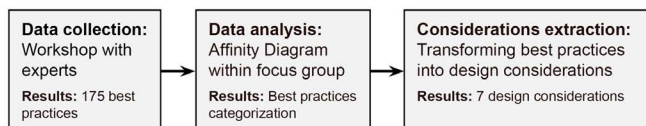

Figure 2. Overview of research process

3.1 Studies Conducted at the Hospital

We observed hospitalized children who received nebulizer treatment and conducted semi-structured interviews with their parents and the health personnel who administered the medication. A workshop with two girls aged four and five years old was also conducted in order to gain insights into their experiences as regular users of nebulizers. The overall purpose of these studies was to gain a better understanding of how children, nurses, and parents experience nebulizer treatment. Preliminary content analysis of the semi-structured interviews indicate that the following four categories are central with regard to enhancing young children's willingness to cooperate during nebulizer treatment: (1) *prepare*, (2) *motivate*, (3) *distract,* and (4) *reward*.

3.2 Data Collection: Workshop with Experts

Five professionals from the sectors of healthcare and pedagogy participated in the workshop that lasted just under two hours. Five members from the BLOPP project organized and facilitated the workshop. In selecting the participants, the facilitators focused on people's professional expertise in the domains of health and children (Table 1). The aim of the workshop was to brainstorm around the experts' best practices with regard to medical treatment of toddlers. The facilitators showed the participants some video clips of nebulizer treatment obtained from the observational study, and mentioned some of the problem areas that had been identified so far. The facilitators asked the participants to focus on their best practices as well as ideas for improved treatment. The participants were also informed that the specific aim of the BLOPP project was to explore how design and technology can contribute to the motivation of children with respiratory diseases to take prescribed medication. To encourage a broad variation of aspects, the four aforementioned categories were used as a framework. The relevance of these categories were discussed with and acknowledged by the participants.

Table 1. Workshop participants and facilitators

Participants	Affiliation
Nurse, male	Trondheim University Hospital
Hospital clown, female	Clown organization in Norway
Physician, male	General practitioner
Public health nurse, female	Norwegian Asthma and Allergy Association
Pedagogue, female	Kindergarten leader and project leader of "Children and ICT"
Facilitators	**Role**
Pharmacist, female	Group facilitator
Interaction designer, male (PhD)	Group facilitator
MSc student, industrial/interaction design, female	Group facilitator
MSc student, industrial/interaction design, male	Group facilitator
PhD student, industrial/interaction design, female	Workshop facilitator

The participants were divided into three groups. One or two facilitators assisted each group. The task of the group facilitators was to stimulate the brainstorming process by asking questions and ensure that all ideas were written down. The facilitators had prepared four posters for each group. The posters hung on the wall in separate rooms and had titles such as "How to prepare toddlers for something they don't want to do". The best practices/ideas were written or drawn on post-its and pinned to each category. After 10-15 minutes, each group moved on to a new poster. All the participants spoke Norwegian. The workshop ended with a joint session, which lasted for about 30-60 minutes, where each of the three groups highlighted important best practices/ideas. The workshop session resulted in a collection of 175 best practices/ideas from experts with regard to medical treatment of toddlers.

3.3 Data Analysis: Affinity Diagram Technique within Focus Group

As the best practices and ideas of the experts could be relevant for several purposes, it was considered useful to sort them on a more general level to start with. A focus group consisting of five participants (PhD research students and academics, all experts in the domain of HCI and health) organized the best practices to greater detail by employing an affinity diagram technique [11, 46]. Four of the participants had also participated in the workshop as BLOPP members.

Using a focus group enables a wide variety of collective views and often leads to results based on a consensus among participants [28]. The affinity diagram is a tool used to organize ideas and data from a large amount of data. This tool is commonly used within project management and ethnographic studies as it allows large numbers of ideas stemming from brainstorming and other qualitative data to be sorted into groups, based on their relationships, for review and analysis. In many cases, the best results tend to be achieved when a multidisciplinary team that includes key stakeholders completes the activity. The main steps of the technique are: (1) record each idea on cards or notes, (2) look for ideas that seem to be related, and (3) sort cards into groups until all cards have been used.

The 175 best practices and ideas were translated into English, reprinted onto post-it notes and stuck onto the wall, so that they were visible to all team members. The participants were then asked to review and reposition the best practices within each category (prepare, motivate, distract, and reward) in order to construct sub-categories. This was an iterative process that consisted of adding or removing post-its until a pattern was discovered. Post-its were duplicated in the few cases wherein best practices were considered to part of two sub-categories. Finally, the participants made headings for the constructed sub-categories.

Since we were interested in viewing the best practices more specifically in light of healthcare games and applications, the affinity diagram was used as a starting point for constructing design considerations. The diagram provided us with a revised and more robust set of best practices. In order to investigate how the best practices could be specifically relevant for healthcare games and applications, the authors matched the affinity diagram

categories to connect the best practices to the four central "design" components of toddlers' gaming applications: (1) game play/mechanics or activity, (2) narrative, (3) characters, and (4) curriculum [31]. This process was also iterative and consisted of repeating the following steps: (1) study best practices that supplement each other with respect to a gaming component within each sub-category, (2) propose design consideration, (3) confer with considerations incorporated in the prototype application BLAPP, and (4) seek motivation from relevant literature. The results from this process allowed us to connect the robust set of best practices with the game components and transform these into design considerations.

4. RESULTS

4.1 Results of the Experts' Best Practices: Affinity Diagram

The workshop with the experts resulted in 175 best practices and ideas distributed in four categories. The number of best practices/ideas within each category was fairly even, ranging from 36-53. Through the affinity diagram technique, we found that the best practices, within each original category, corresponded to three sub-categories: approach, settings, and means. 170 best practices were sorted, while 5 were removed because they were considered irrelevant or incomprehensible. Figure 3 shows the structure of the affinity diagram in terms of categories and sub-categories, number of best practices within the categories, some examples of best practices, and an illustration of what the sub-categories address. The three sub-categories are described and exemplified with best practices from each category below.

1. Approach

Description: The attitudes and acts that professionals should aim to perform in order to contribute to a successful treatment. In order to find out whether a best practice belonged to this sub-category, we asked the question: is this something that a nurse can decide on or strongly contribute to influence?

Examples: In order to **prepare** and **motivate** toddlers for medical treatment, the experts emphasize the importance of *viewing the child as an expert* and *the main person*. Furthermore, *building a relationship* with the child through *respect*, *sincerity,* and *body*

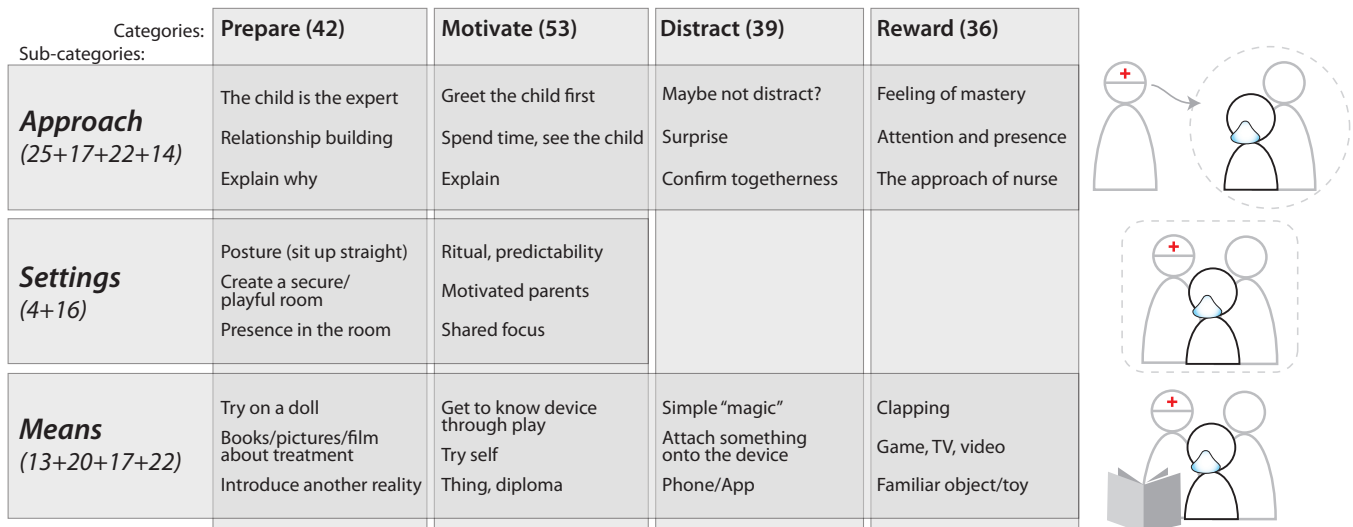| Categories: Sub-categories:	Prepare (42)	Motivate (53)	Distract (39)	Reward (36)	
Approach *(25+17+22+14)*	The child is the expert Relationship building Explain why	Greet the child first Spend time, see the child Explain	Maybe not distract? Surprise Confirm togetherness	Feeling of mastery Attention and presence The approach of nurse	
Settings *(4+16)*	Posture (sit up straight) Create a secure/ playful room Presence in the room	Ritual, predictability Motivated parents Shared focus			
Means *(13+20+17+22)*	Try on a doll Books/pictures/film about treatment Introduce another reality	Get to know device through play Try self Thing, diploma	Simple "magic" Attach something onto the device Phone/App	Clapping Game, TV, video Familiar object/toy	

Figure 3. Affinity diagram structure with some examples

language is emphasized. It is important to *spend time with* and *listen* to the child, give *genuine answers*, and *explain what* the treatment entails and *why* it is necessary. The use of **distraction** was questioned by some of the experts. Rather than trying to deliberately distract the children, the experts argued that medical staff should help children to *refocus*. One example of this is that nurses try to assist children's mindset *from "this is dangerous" to "this is good"*. Moreover it is important to *confirm togetherness, take emotions seriously,* and *give genuine answers*. In order to **reward** children, experts point out the importance of seeking to support children with a *feeling of mastery* and providing *genuine attention and presence*.

2. Settings

Description: All the preconditions that help children enroll with the treatment more willingly. This sub-category includes aspects that depend on all the stakeholders' attitudes; for instance, adults' ability to facilitate a shared focus depends on children's readiness to realize this. In addition, the physical environment is understood as part of the settings.

Examples: In order to **prepare** toddlers for medical treatment, the experts address the importance of supporting a *correct sitting posture* of the child. Furthermore, an ideal setting includes a *safe and playful room* that is designed with the needs of children in mind. In order to **motivate** children, the experts address the importance of *motivated, confident, determined, and sincere adults*. Moreover, the importance of a *shared focus, rituals,* and *predictability* is emphasized.

3. Means

Description: The concrete methods and materials to prepare, motivate, distract, and reward toddlers in relation to medical treatment. The best practices in this sub-category are essentially practical solutions for enhancing the child's willingness to cooperate during the treatment.

Examples: For **preparing** children, the use of *pictures, books and films related to the treatment* are typical means. *Letting the toddler treat a doll* is regarded as important. Furthermore, *introducing another reality* by "transforming" the mask into something else, for instance, is also a way to prepare children for medical treatment. In order to **motivate**, experts again emphasize the importance of *getting to know the medical device through play*. Children are encouraged to *actively participate by assembling the device and holding it themselves*. In addition, *rewards* are considered important motivational means. With regard to **distraction**, experts address ideas such as *attaching an interesting toy onto the device*, showing *simple magical tricks,* or offering the opportunity to *play games or watch films during the actual treatment*. **Rewarding** means can be *physical objects*, such as *familiar objects and toys*, as well as *non-material rewards* such as *praise*, *clapping,* or *gameplay*.

4.2 BLAPP: Prototype of a Healthcare Game for Toddlers' Nebulizer Treatment

In this section, we briefly describe BLAPP, which is a prototype application of a healthcare game developed to improve toddlers' experiences with nebulizer treatment in a hospital setting [3]. The prototype application is based on insights from a user-centered design approach, which included investigations such as observations, interviews, dialogues, and workshops with children, parents, nurses, and other medical experts.

The application is intended to be used before, after, and during nebulizer treatment and can be played on a patient terminal or on a mobile device such as a tablet; as depicted in Figure 4. As an introduction to the application, a narrator welcomes the toddler to the hospital and provides explanations, descriptions, questions, and information along the way. The application consists of two parts: the information part, in which the toddler and the parent can familiarize themselves with the treatment and different aspects of being at the hospital through an interactive story; and the treatment part, which is intended for play during the actual nebulizer treatment and seeks to provide toddler and parent with a shared focus. One of the main characters, *Mulle*, is exploring a landscape by train on his way to the final destination: a star. The treatment part is an interactive journey with a fixed length of 7.5 minutes. This length is an estimation of the average length of a nebulizer treatment. The goal of the journey is to reach the star. After the treatment is completed, the star is placed in a treasure chest on the main menu. The prototype is made in Flash and is available at [5].

©

Figure 4. BLAPP: Healthcare game for nebulizer treatment

4.3 Design Considerations for Toddlers' Healthcare Games and Applications

Table 2 shows how the experts' best practices have provided the basis for a set of seven design considerations. 85 best practices were specifically addressed, selected by studying best practices that supplemented each other with respect to a gaming component. In addition to these best practices, relevant literature and user studies conducted during development of BLAPP also provide support for the proposed design considerations. Next, the seven design considerations are described in terms of examples and motivation.

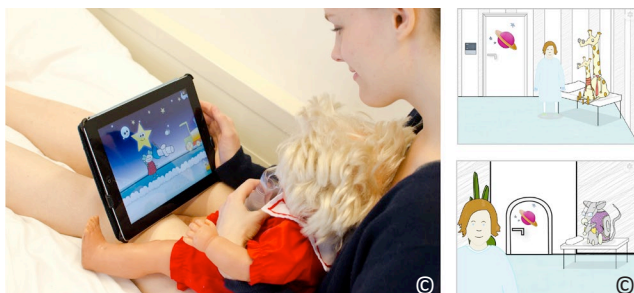### 1. Provide treatment-relevant play activities (Game play/mechanics or activity)

Description: Healthcare games and applications should provide relevant play activities so that toddlers can explore various aspects of the disease and the treatment.

Examples: A challenge in medical treatment for toddlers is the caretakers' explanation and the children's comprehension of the treatment. Treatment-relevant play activities, such as *treating a character* or *assembling medical equipment by sliding components*, can familiarize toddlers with the disease and prepare them for the treatment on their own terms. They can become familiar with the hospital environment by exploring it in a game. Games should be *flexible* in terms of how much toddlers are expected to engage in order to be able to play. Some gaming applications achieve such flexibility by including an auto-play feature. In this way, the gaming application is accessible to

Table 2. From best practices to design considerations

Examples of best practices and their relation to categories and sub-categories (#)	Act.	Narr.	Char.	Curr.	Design Considerations
Prepare: Means (2) Try on a doll; Give inhalation to doll — *Motivate: Means (8)* Get to know the device through play; Assemble device; Physically hold; Try themselves; themselves, e.g. on doll; Let object become part of the child's world; Child holds it; Get to know the device	●				Provide treatment-relevant play activities
Motivate: Approach (3) Participating parents; Child-child relation; Children instruct children — *Motivate: Settings (4)* Shared focus; Confident adults; Motivated parents; Shared positive focus — *Distract: Approach (1)* Shared focus — *Reward: Approach (2)* Attention and closeness/presence; Play game together with parents	●				Support social/family-centered activities
Prepare: Means (1) Mirroring — *Distract: Approach (3)* Tell stories/fairy tales; Take emotions seriously; Confirm togetherness		●	●		Use stories that confirm togetherness
Motivate: Approach (1) Ritual, predictability — *Motivate: Settings (1)* Ritual, predictability		●	●		Use repetitive elements
Motivate: Settings (4) Security, feel safe; Calmness; Mastery; Grows on mastery — *Motivate: Means (8)* Reward; Thing, diploma; Specific praise; Brag to others; Recycle praise — *Distract: Approach (4)* Unexpected surprises; Surprise; Create different kind of experience — *Reward: Approach (5)* Feeling of mastery; Get to choose one thing; "Achievement"; Should be integrated in treatment — *Reward: Means (13)* Funny things; Ice cream, Positive experience; Clapping; Non-material		●	●		Use elements that have potential as meaningful rewards
Prepare: Means (1) Another reality (more than a mask) — *Motivate: Approach (1)* Fantasy character (e.g. clown nose) — *Distract: Means (1)* Simple "magic" — *Reward: Means (2)* Strange/funny experience; Familiar object/toy		●	●		Mix reality and fantasy
Prepare: Approach (6) Explain why; Reality orientation (consequence and consistency) — *Prepare: Means (6)* Books/Pictures/film related to treatment; Introduce object ahead — *Motivate: Approach (4)* Explain; Prepare what is going to happen; Prelude to the stage — *Motivate: Settings (4)* Dont' fool them; Don't lie; Be sincere in what you are doing				●	Provide practical and informative information

children's preferences and interactive abilities regarding their medical condition. In order to support recognition and access, interactive elements should have *touch indicators* and *big hit areas*. As gameplay for toddlers is about "making things happen", gaming goals should *facilitate processes of evident cause and effect*. For example: tapping a target causes the game to start or placing a mask onto a character's face causes it to breathe more easily. In the information part of BLAPP, the toddler and the parent can familiarize themselves with the nebulizer treatment and different aspects of being at the hospital through an interactive story. Here, the toddler meets animal characters who personify roles of the child, the parent, and the nurse, as shown in figure 5.

Figure 5. BLAPP: Treatment-relevant play activities

One character is a little mouse that does not want to use the nebulizer. The narrator suggests that the toddler can help by stroking her a bit. Another character, the little hippo, is coughing, and the narrator suggests that the toddler can help by giving him the nebulizer.

Motivation: Exploring aspects of medical treatment through playful activities can provide children with a safe outlet for expressions of fear and fantasy and give them opportunities to assimilate new experiences [18]. Exploring and playing with different aspects of the treatment can be important for supporting the meaning-making processes of the toddlers. In addition, such activities support caregivers in their efforts to explain and comfort. For siblings, relevant play activities are also considered to be important in terms of learning and adapting to disease and treatment. Preparation for procedure, recognized as a cognitive intervention type, involves giving information about a procedure through visual and sensory prompts, such as photographs; touching and trying an anesthesia mask/medical equipment; or demonstrating on dolls and puppets [18]. However, children may

to a large extent be at the mercy of their caretakers concerning their time and motivation to facilitate such play with such traditional prompts. Games may afford increased access to relevant exploratory play activities because of their interactive potential and because they can be available again and again. This might also somehow relieve the burden of caretakers.

2. Support social/family-centered activities (Game play/mechanics or activity)

Description: Since toddlers are always together with caretakers, healthcare games and applications should support social activities.

Examples: In order to facilitate social activities, games can be designed for *multi-play*. The experts' best practices emphasized that *peer-collaboration* can be important for motivating toddlers. For example, games can be designed so that hospitalized children can play together even though they are treated in isolated rooms. In addition, games can support social activities by including elements that are more directed towards parents with the intention to *trigger dialogues*. In BLAPP, the progression is visualized (Figure 6). This provides the parents with cues for dialogue and explanation. The narrator also draws attention to the progress by describing the main character's location in the landscape.
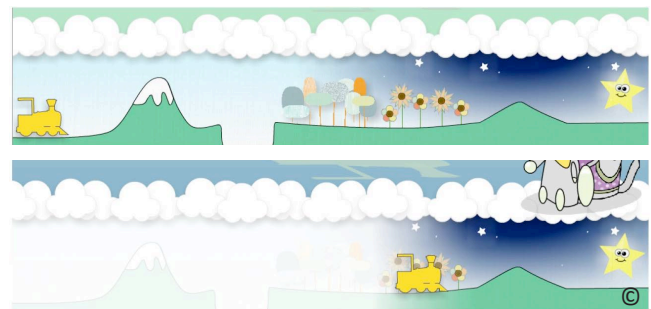
Figure 6. BLAPP: Visualization of progression

Motivation: Besides technical medical care, the presence of parents and skilled nursing care, as well as the provision of play, are considered top priorities for a sick child's recovery and wellbeing [41]. A game that engages parents or other caretakers may be very important for the toddler's sense of control and for sharing experiences. Furthermore, preparing parents and siblings is considered a key component in preoperative preparation programs and support programs for hospitalized children [32].

Designers of healthcare games and applications should recognize the caretakers as important stakeholders in the case of young patients. Whereas dominant play theories used to view play in relation to children's developmental stages, more recent views on children and childhood emphasize play in relation to social and cultural contexts [24]. Mason et al. [29] argue, that simple intervention that occupies both parent and child in an activity without requiring any training has the potential to reduce distress of young children during medical procedures. In line with the experts' best practices of taking a playful approach, a game might enhance toddlers' acceptance of the treatment if social interaction can produce cooperation.

3. Use stories that confirm togetherness (Narrative or Characters)

Description: Healthcare games should convey to the toddler that they share the treatment with someone else.

Examples: Stories can confirm togetherness by using principles of *mirroring* or by *addressing specific emotions*. The toddler can perform the treatment together with a character that also performs the treatment. In BLAPP, the character *Mulle* receives nebulizer treatment and meets other characters that also use nebulizers (Figure 7). Stories dealing with *recognizable situations* can show to the toddler and her family that others also commonly experience what they are going through. Characters can be sad, angry, or insecure and, in this way, clarify to toddlers that others also have similar emotions. The story should meet the toddlers on their premises by *communicating in ways that appeal to them*. When designing technologies for young children, particular attention should be paid to support their roles as both *storytellers and story-listeners* [6]. For example, a game can offer stories that can be modified in some way. Toddlers and caretakers can combine pictures, sounds, music, and recorded dialogues to *co-create* a story.

Figure 7. BLAPP: *Mulle* receives nebulizer treatment

Motivation: For toddlers, it may be comforting to process their experiences through stories that have some relation to the medical treatment. Stories are commonly used as therapeutic means for providing relief, enhanced self-understanding, promotion of coping skills, and personal growth [21]. Research has shown that young children use television texts for pleasure and for making sense of their worlds in the same ways that older children do [16]. Children under the age of two appreciate traditional aspects of storytelling, such as the creation of suspense and excitement about a mystery that is about to unfold [16]. Research has also shown that telling the child a story featuring their favorite hero, who helps the child to cope with the situations, reduces the child's distress during treatment [21]; however, as traditional narrative therapy methods are very much cognitive and language-based, some researchers claim that in the case of young children, these may be rather exclusive [13]. In family therapy, the co-creation of storybooks by telling stories in picture form has been shown to be a successful technique that also engages younger children [13].

4. Use repetitive elements (Narrative or Characters)

Description: Healthcare games and applications should offer repetitive elements to support predictability and the establishment of rituals.

Examples: Repetitive elements, which in turn may facilitate repetitive actions, can be important for the toddlers' interest in the gaming application. Examples of repetitive elements include *images*, *sounds*, and *rhythms* that familiarize the toddler with the gaming application. In BLAPP, the pacing of the game has been designed according to principles used in *Teletubbies,* which was the first television program designed specifically for children under the age of two [16]. Each segment lasts for approximately one minute to *facilitate toddlers' attention span* (Figure 8). Within this minute, elements such as characters or actions repeat themselves, before the scenery changes and new elements are introduced. The first minute of the journey will be a repetitive session of sheep farting as they are touched, while in the forest the rabbits jump around when touching them.
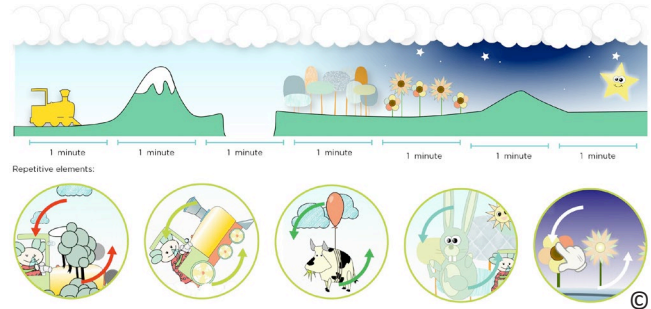

Figure 8. BLAPP: Repetitive elements

Motivation: Toddlers' games and routines are typically characterized by joyful repetition of simply structured actions [24, 26]. Imitation and repetition are important elements in toddler's play, although typically modified with a personal 'note' [25]. The episodes in *Teletubbies* are connected in a unified way by repetition of some distinctive images and themes [16]. A research study dealing with young children's responses to *Teletubbies* found that the children recognized familiar patterns and that these patterns served as cues to anticipation [16].

5. Use elements that have potential as meaningful rewards (Narrative or Characters)

Description: In order to motivate toddlers for medical treatment, healthcare games and applications should offer elements that are perceived as meaningful rewards.

Example: Rewards can be the introduction of different elements and may be more or less tangible. For example, *digital objects* such as stickers, diplomas, or points that can be collected during a period of time may serve as rewards. Important catalysts for preschoolers to obtain an enjoyable game play experience are opportunities to collect something such as digital objects [49]. According to the experts' best practices, *intangible or non-material rewards*, such as enhancing a positive experience through encouragement is considered crucial for toddlers' willingness to cooperate in medical treatment. A game character can add to the caretakers' efforts of *praising* by being an additional actor that motivates the toddler during treatment through *cheering*, *clapping,* or encouraging in other ways. It is also important to view *play*, *humor*, and *surprises* as rewards, given that such activities and expressions relate to and may influence intrinsic motivations. BLAPP includes various elements that can be perceived as meaningful rewards for toddlers. One example is the star, which is collected in the treasure chest at the end of the treatment. The toddler also meets different characters that cheer and celebrate by high-five gestures (Figure 9, left).

Motivation: Rewards are a common aspect of children's medical treatment; however, rewards should be understood in a broad sense – as means to motivate and possibly distract the toddler for the medical treatment. Research dealing with the relation between praise and children's intrinsic motivation suggests that the effects of praise can be both helpful and harmful: ranging from beneficial to negligible to detrimental [14]. For praise to influence motivation in a positive way, it must be perceived as sincere and credible. A number of theorists agree that play is intrinsically motivated from an early age [24], and furthermore that play is typically more internally than externally motivated [40]. Toddler play is characterized by autonomy, spontaneity, and pleasure [24]. Facilitating opportunities for such play in relation to medical treatment may therefore be regarded rewarding in itself.

6. Mix reality and fantasy (Narrative or Characters)

Description: Healthcare games and applications should provide a mix of reality and fantasy in order to communicate on toddlers' terms.

Example: Reality and fantasy can be combined in design of characters, elements and story. Figure 9 (middle-right) shows two examples from BLAPP: flying cows and farting sheep. Familiar characters can for instance be *toddlers* or *animals*. The way such characters behave can make their appearance more or less recognizable for toddlers. In *Teletubbies*, the main characters have the *proportionality* of very young children and imitate the *body language* and *linguistic communication styles* of this age group [16]. Elements such as *objects, music, rhythm, sounds, events,* or forms of *humor* can also be designed to be intentionally familiar. *Magical and mysterious qualities* of characters and elements may for example be related to *patterns of cause and effect*.
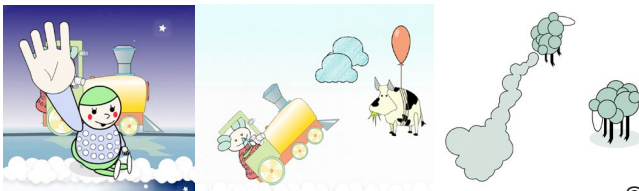
Figure 9. BLAPP: High-five (left); flying cows and farting sheep (middle-right)

7. Provide practical and informative information (Curriculum)

Description: Healthcare games and applications should offer practical and informative information in order to empower toddlers and their caregivers.

Example: Information about the medical treatment needs to be presented in ways that are suitable for toddlers. General information about the disease and the treatment can be explained by *combining visualizations and verbal language*. The information that is presented should be *truthful*. Explanations as to why treatment is necessary can be given in various ways by showing what is going to happen, whether it is going to hurt, and what the desired consequences are. The language should be adapted by using *familiar terms* that toddlers know from other contexts. A variety of spoken languages should also be available in order to meet the needs of patients with multicultural backgrounds. Presenting a *range of examples* can help the toddler become acquainted with the situation and prepared for the treatment. A narrator can for example *address important issues* as well as *ask important questions*, thereby presenting useful cues for increased understanding among both toddlers and caregivers. Practical information such as *time* and *progression* of a specific

treatment can be difficult to explain to young children. Time aspects can be visualized in order to provide toddlers with a more concrete idea about the treatment course (e.g. Figure 6).

Motivation: The understanding and the anxiety of all members participating in the treatment influences the child patient's experience [42]. Therefore, it is crucial to inform and educate both the patients and their families in effective ways to reduce stress, anxiety, and frustration [42]. Information technologies that utilize user-centered design principles and interactive capabilities to facilitate sharing of information have the potential to empower children and their families, as well as physicians [7]. According to Play Therapy techniques, children need age-appropriate explanations prior to painful and invasive procedures on the following six aspects: *who* is going to perform the procedure; *why* the procedure being done; *how* the procedure will be performed; *what* the procedure will feel like; *when* the procedure will take place; and *where* on the body, as well as where in the department, the procedure will be performed [12].

5. CONCLUDING REMARKS AND FUTURE WORK

Little research has focused on how healthcare applications should be designed in order to motivate toddlers during medical treatment. This is probably partly due to a general lack of healthcare applications for this patient group; however, there is also little knowledge about games and applications for toddlers, even though they make up a growing group of gamers.

Our findings based on the affinity diagram technique show that experts seek to prepare, motivate, distract, and reward toddlers for medical treatment in terms of approaches, settings, and means. Technology and products can never replace human relationships. Hospitalized children and their families are especially vulnerable and depend upon empathic human care from healthcare professionals. The experts' best practices reflect precisely this and, in that sense, support designers in establishing a design perspective for addressing young children as patients and users of medical products. Acknowledging children as "human beings" and adapting a more socio-cultural perspective by focusing on their agency, competence, and participation in the world are increasingly being recognized as important premises for designing children's products (e.g. [17, 49]). The affinity diagram can also serve as inspiration for opening up areas wherein designers can contribute to support desired relations between children and healthcare professionals.

We have viewed the best practices more specifically in light of healthcare games and applications. A set of key aspects to consider when designing healthcare games and applications for toddlers has been proposed in terms of seven design considerations. We constructed the design considerations by extracting best practices from the affinity diagram and connecting these to central game design components. The design considerations stem directly from 85 of the experts' best practices and are also motivated by relevant literature, as well as a prototype of a healthcare game for toddlers.

With regard to game play/mechanics or activity, healthcare games and applications for toddlers should support exploration of treatment-relevant play activities, as well as social/family-centered activities. Exploring and playing with different aspects of the treatment together with caretakers or peers can enhance the meaning-making processes of toddlers. Narratives of healthcare games should use stories that confirm togetherness in some way.

It may be comforting to process experiences through stories that have some relation to the medical treatment. Stories can have an important role in establishing a positive link between the treatment and the perceived experience of the treatment. Furthermore, healthcare games and applications should offer repetitive elements and elements that have potential as meaningful rewards. Repetitive elements can support predictability and the establishment of rituals, whereas elements that are perceived as meaningful rewards can contribute to motivate toddlers for the medical treatment. With regard to characters, as well as narratives, healthcare games should offer a mix of reality and fantasy. Characters, elements and situations can be designed to be intentionally more or less recognizable. A combination of the known and unknown can support and enhance toddlers' pleasure in games and applications. In terms of curriculum, healthcare games and applications for toddlers should offer practical and informative information in order to empower them along with their caregivers. Information about the medical treatment needs to be presented in ways that are suitable for toddlers. Not all information is relevant for young children, but the information that is presented must be reliable.

The presented design considerations can serve as useful guidance in the design process of healthcare games and applications for toddlers; however, according to acknowledged user-centered design principles, design teams should always seek to consult users directly in order to get a better understanding of their needs and the potential use contexts. These proposed design considerations have been composed on the basis of experts' best practices from a pediatric and pedagogical point of view. The absence of the toddlers' voices in this work may be regarded as a limitation. As part of the BLOPP project, observations of hospitalized toddlers who received nebulizer treatment and semi-structured interviews with their caretakers and administering nurses have been conducted. In addition, we have consulted some older children to learn about their experiences with regular nebulizer treatment. These studies have given us valuable knowledge about the users and context. In that sense, we are confident that our understanding from these other studies influenced the topics, questions, and choices that have characterized the current study. Since the experts worked with categories that are relevant to general pediatric treatment, the best practices and hence design considerations should be relevant beyond the specific case of nebulizer treatment. For example, some suggestions are: hospital treatments that are time consuming (e.g. echocardiogram), painful (e.g. burn treatment), or scary (e.g. anesthesia), treatment of chronic diseases (e.g. asthma or diabetes), general medicine use (e.g. pills or creams) as well as regular hygiene routines (e.g. brushing teeth).

Working with toddlers as a user group presents designers with some challenges in terms of gaining understanding of their experiences. In the case of healthcare contexts the challenges also increase in terms of ethical considerations. Nevertheless, taking toddlers seriously as a user group implies that designers need to face such potential challenges. Our future research will concentrate on further refinement of the proposed design considerations by inviting toddlers and caretakers to test concepts of healthcare games and applications in realistic treatment situations. The design considerations will also be evaluated through further investigation of relevant guidelines for healthcare games and gaming applications for children. Furthermore, healthcare application designers and developers should evaluate the proposed considerations in order to ensure their understanding and seek their suggestions in phrasing them.

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Article IV

"Now We are Going on a Journey":

Meaning-Making with a Healthcare Game During Toddlers' Medical Treatment

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"Now We are Going on a Journey":

Meaning-Making with a Healthcare Game During Toddlers' Medical Treatment

Marikken Høiseth and Marit H. Hopperstad

Abstract

This study explores how toddlers and caregivers make meaning with an interactive healthcare game on a tablet during medical treatment. The data material consists of video recordings of 6 nebulizer treatments of 2 children. By using a social semiotic perspective and multimodal analysis, the study identifies how children and caregivers make meaning with the game, defined as a multimodal text, through creating text events. The findings illustrate how the participants' meaning-making in the text events appears to have a narrative and an analytical orientation. It is suggested that the potential of healthcare games lies in the creation of text events where the game constitutes a shared focus. When children and caregivers share their meaning-making orientations, the medical treatment can be brought into the background.

Keywords: caregivers, children, healthcare games, meaning-making, medical treatment, multimodal text, social semiotics, toddlers, qualitative research

Digital games that are used in health contexts for purposes beyond mere entertainment are often referred to as healthcare games. Application areas for such games include recovery and rehabilitation, disease management, and distraction during medical treatment (Susi, Johannesson, & Backlund, 2007). The use of healthcare games is increasing. While children represent an important target group, little is known about how such games can benefit toddlers (children aged 1–3 years) and their caregivers during medical treatment. Considering that medical procedures on children can be highly distressing for the children themselves as well as for their parents (Johnston, Rennick, Filion, Campbell-Yeo, Goulet, Bell, Tucci, & Ranger, 2012) and that interventions that engage both parent and child in an activity have the potential to reduce children's distress during medical procedures (Mason, Johnson, & Woolley, 1999), exploration of healthcare games used in real clinical settings appears to be an important research area.

Previous research has indicated that a shared focus, understood as a mode where children and adults direct their attention towards the same situation, might work as a domain for potential, positive relations between children receiving nebulizer treatment used for serious respiratory diseases and their caregivers and that a shared focus that is significant to the children might influence their willingness to cooperate in the treatment (Høiseth, Keitsc, & Hopperstad, in press). This article explores children and caregivers' meaning-making with a healthcare game as an example of shared focus during nebulizer treatment. The term *caregiver* refers to parents and nurses who interact with and take responsibility for children during medical treatment. Because there are few healthcare games available for young children, the healthcare game was designed as a prototype for the study. The data material consists of video recordings documenting its use during six treatments of two children.

In the article, the game is regarded as a text. The children and caregivers' engagement with the game is understood as text events (Burn & Schott, 2004, p. 217) where the game is

experienced and made meaningful. Building on social semiotic theory (Hodge & Kress, 1988; Jewitt, 2003; Kress & van Leeuwen, 2006) in which the concept of text is not limited to verbal representation, the article explores the meaning-making orientations that the children and caregivers appear to take towards the game. By conducting multimodal analysis (Flewitt, Hampel, Hauck, & Lancaster, 2009) of the children and caregivers' engagement with the game and applying concepts of Kress and van Leeuwen (2006) to describe the features of the game they attend to, two forms of meaning-making orientations are presented, *narrative* and *analytical*. The children and caregivers' ways of collaborating and sharing their meaning-making orientations, thus creating a shared focus, are discussed. The role of caregivers in the creation of text events is also discussed. Conclusively, the article reflects on the potential that healthcare games might hold for improving children's experiences of medical treatment.

Research in social semiotics has explored children's meaning-making with and through different kinds of activities and media such as drawing (Anning & Ring, 2004; Mavers, 2008), model making (Fredriksen, 2011; Pahl, 1999), and computer-based learning (Jewitt, 2003; Roberts, Djonov, & Torr, 2008). Roberts et al. (2008) studied 4- and 5-year-old children's interactions with a digital game, showing how the children's engagement with the game varied according to the social context, the textual features of the game, and the children's computer skills. Most research on children's activities with digital texts has focused on the educational context and school-aged children, positioning technology as a deliverer of literacy, site for interaction around texts, and medium for meaning-making (Burnett, 2010). A few studies have addressed toddlers. Recently, Danby, Davidson, Theobald, Scriven, Cobb-More, Houen, Grant, Given and Thorpe conducted an in-depth ethnographic study of interactions between a father and his two children, aged 18 months and 3 years, using a mobile phone and a tablet. The study showed how the toddlers used technology for their own purposes and that the focus in the emergent talk was about

producing and manipulating screen images rather than about commenting on actions such as browsing and multitasking (Danby et al., 2013). Howard and Roberts (2002) demonstrated the diverse ways in which children between 14 and 24 months responded to a television text and suggested that they used the text for pleasure as well as for making sense of their worlds.

Hospital care is a different context with a potential value for using digital texts as a medium for meaning-making. There has been widespread support for the concept that distraction, such as digital games, can help paediatric patients cope with medical treatment (Chambers, Taddio, Uman, & McMurtry, 2009; Koller & Goldman, 2012). Related studies have focused predominantly on the connections between children's distress and different distractions in terms of physiological responses. There is a lack of qualitative research exploring *how* children and caregivers initiate and engage in distraction techniques (Koller & Goldman, 2012).

Social semiotics offers a framework for studying the use of a healthcare game in terms of meaning-making and to understand how meaning-making is socially situated. The term *meaning-making* indicates a meaning-making subject that uses meaning-making resources with an intention to convey meaning (Kress, 1997). This point applies to children as well as adults. Kress (1997) goes on to argue that we need to treat young children's meaning-making with the same seriousness as we treat adults' (p. 36). The present study attempts to recognize the children's perspectives and agency as meaning-makers within the medical setting by studying how they, together with their caregivers, use the healthcare game as a medium for meaning-making. The article aims to illustrate, through multimodal analysis of text events observed during nebulizer treatment of two children, the potential that a digital healthcare game might hold for constituting a shared focus. At a more general level, the article aims to contribute to the knowledge of how children's healthcare experiences might be improved.

The work described is connected to a project called BLOPP (a Norwegian acronym which translates as 'children's pharmaceutical experiences'). Taking human-centred design (Steen, 2011) as its point of departure, the project aimed to (1) explore how design and technology can motivate children with respiratory diseases to take prescribed medication and (2) promote positive interactions between children and caregivers, thereby increasing adherence to medical treatment. Many children refuse to cooperate during nebulizer treatment (Janssens & Tiddens, 2006). One of the prototypes developed in the project, an interactive healthcare game called BLAPP (a Norwegian acronym that translates as 'children's pharmaceutical application'), was designed for toddlers who receive nebulizer treatment (Asheim, 2012; Høiseth, Giannakos, Alsos, Asheim, & Jaccheri, 2013). BLAPP was used in a real clinical setting. In human-centred medical product design, small clinical pilots are valuable because they provide initial indications of how the technology fits the needs of people in a particular medical setting (Doherty, Coyle, & Matthews, 2010). Figure 1 displays BLAPP on a tablet, showing the main character, Mulle, who takes a journey by train while wearing a nebulizer mask.

**Figure 1. BLAPP: A Healthcare Game for Nebulizer Treatment**

The Healthcare Game

BLAPP[1] was designed for use before, during, and after nebulizer treatment. Through the combination of visual imagery, animation, speech, sound effects, and music, BLAPP

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[1] Available at http://folk.ntnu.no/jonasa

provides an ongoing narrative. In the first minute of the game, the narrative stage is set
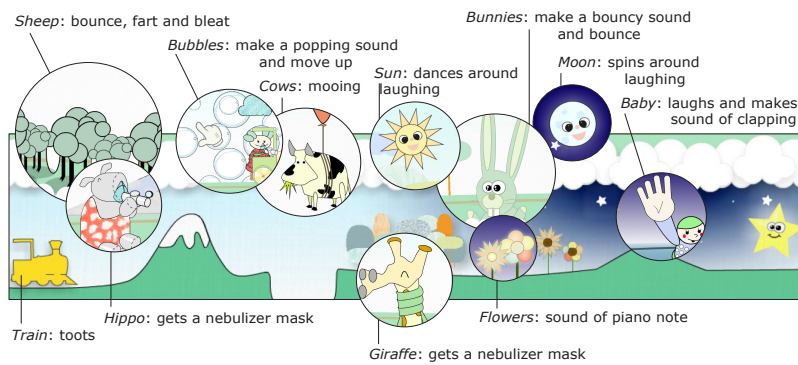
(Figure 2).
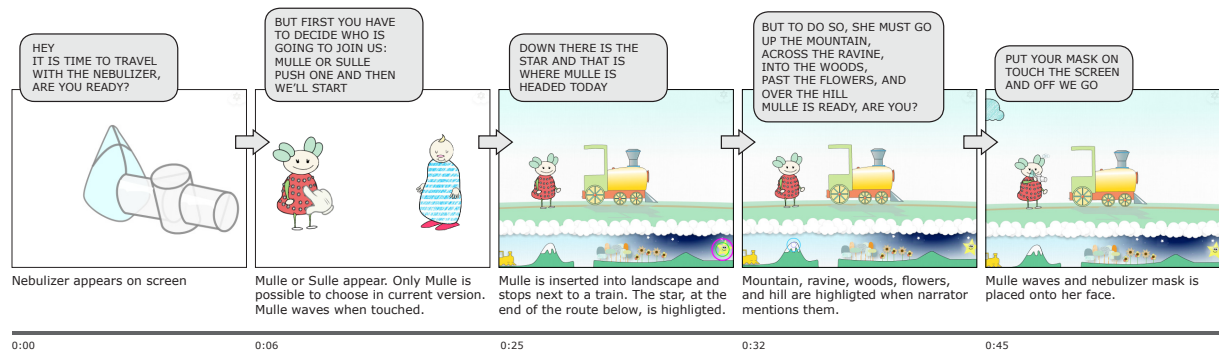
Figure 2. Setting the Narrative Stage

A narrator introduces the game as a journey 'with the nebulizer' (0:00). The next

screen invites the player to choose between two characters, Mulle and Sulle (0:06). In the

current version of the prototype, only Mulle can be chosen. Mulle waves when she is touched.

Next, Mulle is inserted into a landscape beside a train, and the narrator explains that her final

destination is the star (0:25). The narrator explains the route of the journey in terms of

milestones: the mountain, the ravine, the woods, the flowers, and the hill (0:32). A pulse

rainbow visually highlights the milestones. Finally, the narrator tells the player to put on the

mask before the journey can start. Mulle waves while a nebulizer mask is placed on her face

(0:45). The journey starts in the morning. Here the combination of the cheerful music, the

characteristics of the different characters, and the train's speed assemble a faster-paced text.

Towards the journey's end, Mulle moves into a quiet night scene wherein the moon and the

stars appear, and the song of birds and grasshoppers replaces the background music.

BLAPP also contains interactive elements that respond to a user's input (Salen &

Zimmerman, 2004). Various interactive elements appear on the screen as Mulle's journey

progresses: sheep, a hippo, bubbles, cows, the sun, a giraffe, bunnies, the moon, a baby doing

a high-five, flowers, and Mulle's train. Figure 3 shows how these elements respond to touch

and their order related to the journey's milestones. The sheep, for instance, appear before the

train moves up the mountain and are present on the screen for approximately one minute.

Then the scenery changes and bubbles appear.

Figure 3. The Interactive Elements: Their Response and the Order in Which They Appear

Throughout the journey, the milestones, the progression, and the goal (the star) are

visible in a timeline at the bottom of the screen (Figure 4). The journey has a fixed length of

six minutes, which is an estimation of the average length of a nebulizer treatment. After the

treatment is completed, the star is placed in a treasure chest on the main menu.
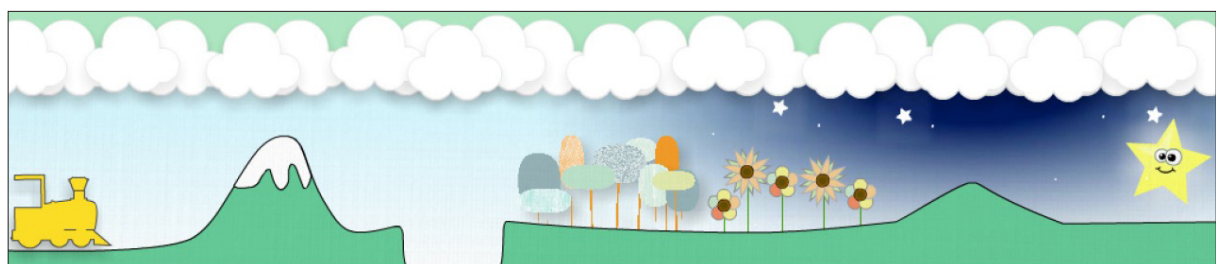
Figure 4. The Timeline Depicting the Route, Progression, and Goal

Theoretical Background

In social semiotics, the term *text* is not limited to a piece of verbal representation that

is written down. Kress (2010) defines text as communication; a text has a message that is

communicated in and through itself. For this purpose, culture provides a range of modalities.

A key concept to understanding texts and how people interact with them therefore is multimodality (Kress, 2010). The concept refers to the wide range of meaning-making or semiotic resources that people hold and employ, such as gesture, gaze, speech, posture, image, and writing (Jewitt, 2009; van Leeuwen, 2005). Rather than being mono-modal, texts are in most cases combinations of modes that are brought together for representational and communicational purposes.

Computer-mediated texts, or texts that appear onscreen, such as the healthcare game in this study, also belong to the multimodal repertoire of meaning-making resources and can be defined as multimodal texts (Jewitt & Kress, 2003). BLAPP is a combination of images, animation, speech, sound effects, and music. According to Burn and Schott (2004), a digitally mediated game is a text that the player(s) 'weave on the spot' (p. 217) when they interact with it. Meaning-making in the context of games can therefore be understood as text events where the text—the game—is experienced and made meaningful (Burn & Schott, 2004). This study conducts a multimodal analysis of children and caregivers' engagement with a digitally mediated text that draws on a multiplicity of modes, thus aiming to understand how it comes to constitute a shared focus.

The semiotic potentials (van Leeuwen, 2005, p. 4) of a multimodal text contribute to the meanings that can be made (Jewitt & Kress, 2003). Kress and van Leeuwen (2006) present a framework for analysing images and visual design that is applied in a range of studies of multimodal meaning-making processes involving children (e.g. Flewitt, 2005; Jewitt & Kress, 2003; Ormerod & Ivanic, 2002; Roberts et al., 2008). Their framework is also relevant for studying meaning-making with digital games, as shown for example by Roberts et al. (2008). Concepts within their framework were applied in the present study to interpret the features of the game that the children and caregivers were found to pay attention to and engage with, and they aided the understanding of their meaning-making orientations.

Kress and van Leeuwen (2006) relate their framework to Halliday's (1994) three different types of meaning, suggesting that features of visual and multimodal texts convey meaning about a topic (ideational meaning), address the viewers or readers in some way or another (interpersonal meaning), and signal how the text should be read (textual meaning). The properties of BLAPP can also be related to these types of meaning. The timeline showing the milestones, progression, and goal of the journey can be related to textual meaning (Figure 4). The narrator conveys interpersonal meaning when addressing the viewer and instructing him/her to 'push one and then we'll start' (Figure 2, 0:06). In the text events presented and discussed in this article, the children and their caregivers were found to respond to and make use of those properties of BLAPP that can be said to carry ideational meaning: the multimodal representation of *Mulle's journey* and *the interactive elements* that emerge onscreen throughout her journey. Motivated by the interests of the research participants, meaning-making that concerns these specific properties has been studied. They were related to Kress and van Leeuwen's (2006) concepts in the following way:

Mulle's journey can be described as a series of narrative elements, i.e. elements that 'present unfolding actions and events' (Kress & van Leeuwen, 2006, p. 59). When touched, Mulle jumps on the train and waves. The train is shown in profile, indicating direction. It drives in a landscape that, marked by a contour line, goes uphill and downhill. Together, the jump, the wave, the profile form, and the contour line are signals of narrative meaning. The role of the narrator is also important. She directs attention to the journey and its progress through her questions and comments such as 'Soon we will jump', and she encourages the users of BLAPP to experience and engage in the event.

The interactive elements move and make sounds in response to touch. As such, they too are narrative. However, they also seem to coincide with features of visual design that Kress and van Leeuwen (2006) call analytical. The concept refers to representations of things

(animate or inanimate) as carriers of typical attributes. Its relevance for BLAPP is related to the way interactivity works. When touched, each interactive element can be attended to over and over again and scrutinized in detail. Meaning-making might unfold as processes of 'getting to know' the elements and building up understanding of their typical appearances and doings. BLAPP as a multimodal text thus appears to be a telling case of the idea that 'specific representations can merge two or more structures—for instance, the narrative and the analytical' (Kress & van Leeuwen, 2006, p. 95).

Social semiotics is interested in the social dimensions of meaning-making (Hodge & Kress, 1988). A basic idea is that meaning-making takes place in and is influenced by the social situations surrounding it. Consequently, meaning can be understood not as static and given but as something that occurs through dynamic and productive processes (Hodge & Kress, 1988). In the present study, the social situation of meaning-making is nebulizer treatment. The children and caregivers' ways of sharing their meaning-making orientations and working 'in concert' (Mavers, 2011, p. 50) to pursue them during the treatment are discussed.

Research Process

The article is based on an analysis of six video observations documenting nebulizer treatment of two hospitalized children. In these treatments, the children and their caregivers had BLAPP at their disposal. Video recording was considered appropriate for documenting the participants' use of BLAPP. Generally, video recordings provide researchers with access to the fine details that characterize people's conduct and interaction and enable repeated scrutiny of such 'situated' action (Heath & Hindmarsh, 2002). Video observation is considered particularly useful for capturing the young child as a meaning-making actor primarily relying on non-verbal modalities (Harder, Christensson, & Söderbäck, 2009).

Research Context, Participants, and Data

The study was approved by the Regional Committee for Medical and Health Research Ethics of Central Norway and by the hospitals' head physicians. The head nurse at the department of infection at the children's clinic was essentially responsible for the first round of selection among the patients who were hospitalized for nebulizer treatment. The treatment, which involves inhalation of vaporized medication through a mask covering the patient's mouth and nose, usually lasts for 5–10 minutes and is typically repeated every 2–4 hours.

When the head nurse considered participation appropriate, she informed the first author, who in turn contacted the families to provide information about the project. Participants were recruited for a period of eight weeks from October to December 2013. The selection criteria for the participants were that they were older than 12 months and were expected to receive a number of nebulizer treatments while hospitalized, so that the use of BLAPP could be studied over time. The recruitment resulted in participation of two children: Alice (21 months) and Billy (23 months). All participants have been given pseudonyms.

Given the time of the year, eight weeks of recruiting was expected to yield more participants. This proved not to be the case. All of the families approached agreed to participate. The low number of patients hospitalized with respiratory diseases may have been related to the mild winter conditions, which are unusual in this particular Nordic region.

The first author observed the treatments. Table 1 provides an overview of the video data related to participants and treatments.

Table 1. Overview of Video Recording Duration (in Minutes), Active Participants Present in the Nebulizer Treatment, and Passive Participants (Marked with Brackets)

Patient	Treatment 1	Treatment 2	Treatment 3
Alice	Video recording (4:41)	Video recording (10:14)	Video recording (2:28)
	Mother	Grandmother	Mother
	Nurse Anne	Nurse Anne	Nurse Agnes
	[Observer]	[Observer]	[Father, observer]
Billy	Video recording (5:58)	Interrupted video recording (1:22)	Video recording (6:14)
	Father	Mother	Mother
	Nurse Bob	Nurse Bob	Nurse Brenda
	[Mother, observer]	[Observer]	[Observer]

To avoid imposing pressure on the families during the process of recruiting, the first author did not bring the tablet along when she first met with them to provide information. Therefore, the children's first meeting with BLAPP took place shortly before the treatment started. The nurses' familiarity with BLAPP varied. A number of nurses had been involved in the design process that resulted in BLAPP. However, this process had been initiated almost two years earlier and also involved other nurses. Whereas some nurses did recall BLAPP, others had little or no direct knowledge about the game. Before the treatments, the first author provided the nurses with a demonstration and encouraged them to briefly explore BLAPP. Moreover, the nurses were prompted to act as they would normally and to use the game in the same way as similar kinds of interventions. The children and their parents could explore BLAPP while the nurse prepared the medication. Figure 5 shows BLAPP inside a protective case that was used for disinfection purposes.

Figure 5. BLAPP in Protective Case

After the treatments were video-recorded, semistructured interviews were conducted with one of the parents and the administering nurse. Field notes were also written. The results presented in this article build on the observational data.

A small set of video observations might usually be considered a limitation. For the present study, however, the set proved suitable for in-depth exploration through multimodal analysis. According to Morse (1995), a crucial principle for qualitative researchers to appreciate is that 'Richness of data is derived from detailed description, not the number of times something is stated' (p. 148). In line with Morse's (1995) description of saturated data as 'rich, full, and complete' (p. 149), the video-recorded treatments were found suitable for full and extensive description that in turn made it possible to capture meaning-making orientations that could contribute to an understanding of the potential of healthcare games.

Data Analysis

For the multimodal analysis, three steps recommended for reviewing video data were followed: preliminary review, substantive review, and analytic review (Heath, Hindmarsh, & Luff, 2010).

The preliminary review was carried out to get an initial understanding of the recorded treatments and to identify fragments where BLAPP was core to the children and caregivers' attention. These fragments were defined as text events. Through repeated viewing, the first author became gradually more familiar with the data. Moreover, two group sessions were held

in which the first author and three members of the BLOPP project group collectively

reviewed the video recordings. Building on the approach of Roberts et al. (2008), the

categories of attention level, pleasure, and action around the tablet were used to identify text

events. All categories had to be present to qualify as a text event. Figure 6 illustrates the

selected text events from the total treatment duration. For ethical reasons, the video recording

of Billy's second treatment was interrupted because extensive resistance characterized the

treatment.

Figure 6. Overview of Treatment Duration and Selected Text Events (Marked in Black)

The substantive review involved a deeper exploration of the selected text events. The

first author transcribed the selected events into running text. The transcripts included a

thorough verbal representation of the modalities the participants utilized: speech and visible

conduct such as gestures and gazing. Facial expressions and intonations that were assumed to

be helpful for the interpretation of the data were also included. Next, the transcripts were

discussed in collaborative discussions (van Manen, 1990) with members of the BLOPP

project group and the second author. The discussions revealed that the children and the

caregivers related to the game and to one other in many different ways, both across treatments

and within a single treatment.

Finally, the authors conducted an analytic review of the selected text events. Based on

the framework of Kress and van Leeuwen (2006) the review was guided by the following

questions: what do they do with the multimodal text, which features of the text do they orient

towards, and how do they do it? The analysis was an iterative process in which these

questions were explored. Multimodal transcriptions of selected examples were then created by

presenting data in the form of image and writing (Flewitt et al., 2009; Roberts et al., 2008).

For the multimodal representation, the dimensions of time, video still, screen capture, game

sounds, visible conduct, and speech were used (Roberts et al., 2008) in a so-called comic strip

format that enables the researcher to identify key actions and transitions of a particular

segment in a frame-by-frame process (Plowman & Stephen, 2008).

To reach a deeper understanding of the meaning-making orientations in the text

events, the authors alternated between studying the multimodal transcriptions of the selected

examples and revisiting the video observations. As a result, two forms of meaning-making

orientations were identified: narrative orientation and analytical orientation. These

orientations capture the specific features of the multimodal text that the participants attend to

and make meaningful. In the following sections of the article, they are presented and

illustrated with excerpts from the multimodal transcriptions. It is important to stress that the

meaning-making orientations are interrelated and not mutually exclusive. Together, they

make it possible to 'unpack' (Pahl, 1999, p. 8) the text events as processes of meaning-

making.

Findings

Narrative Orientation in the Text Events

In text events with a narrative orientation, meaning-making with BLAPP related to the

multimodal and sequential representation of Mulle's train journey to the star. The

participants' modalities included pointing to and tapping on the screen, gazing, waving,

commenting on, and talking to the character Mulle.

Figure 7 is an illustrative example from Billy's treatment. The father initially tapped

Mulle, causing her to jump onto the train while music was being played. Nurse Bob joined in,

saying 'Now we are driving', while the father used the same words, saying, 'We are driving

on the train' (4:24). The father then drew attention to the rainbow (4:27) that appeared as the

train moved through the terrain ('Oh look the rainbow too, huh?') and a sheep (4:33) that

appeared in the bottom right corner of the screen ('Is that the sheep? Huh? Is it baa?'). 'Mm',

said Billy. With his comments, the father drew attention to and included the progress of

Mulle's journey in the text event. The sequential feature of her journey was brought into

focus. Billy participated in the text event, saying 'Mm' and paying close attention to the
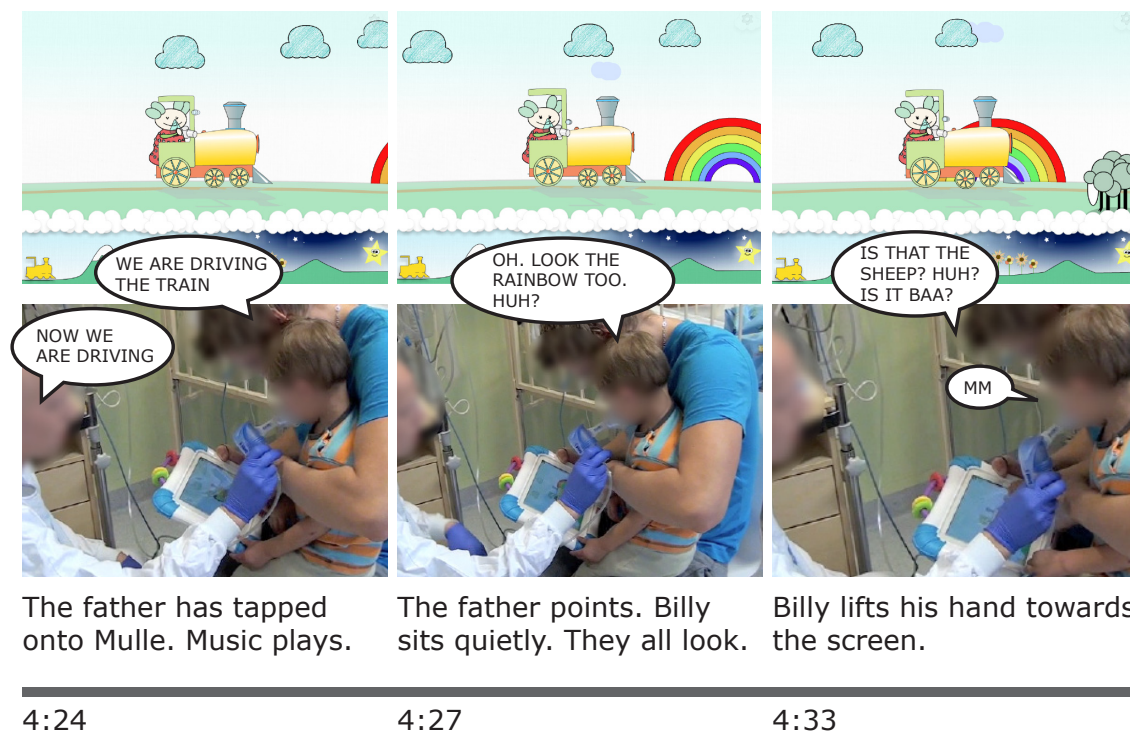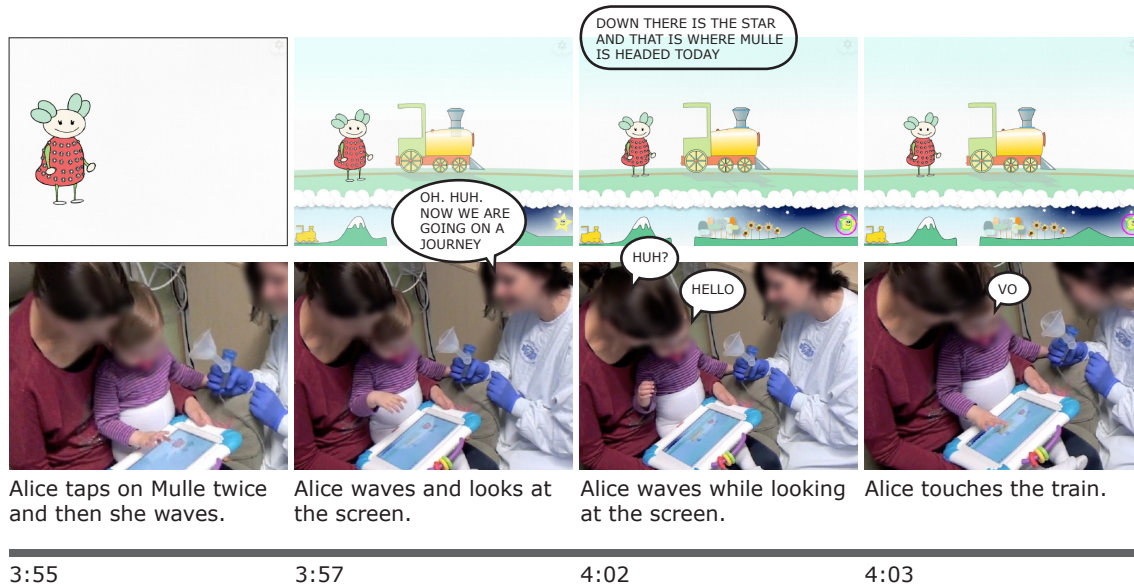
screen.

Figure 7. Narrative Orientation in Billy's Treatment

Figure 8 shows narrative orientation at the beginning of Alice's treatment, when the

nurse prepared the nebulizer mask. Alice tapped on Mulle and waved to her twice (3:55), then

she waved again and looked at the screen (3:57) while the nurse smiled and commented, 'Oh

huh, now we are going on a journey'. Alice then greeted Mulle verbally ('Hello') and waved

at her for the third time (4:02). Her mother's 'huh' can be seen as a confirmatory reply to

nurse Anne's earlier comment. The narrative orientation continued as Alice looked at the train, touched it and said, 'Vo' (4:03).

|			
Alice taps on Mulle twice and then she waves.	Alice waves and looks at the screen.	Alice waves while looking at the screen.	Alice touches the train.
3:55	3:57	4:02	4:03

Figure 8. Narrative Orientation in Alice's Treatment

A few seconds later, Alice again touched the screen (Figure 9, 4:27), which the narrator also encouraged her to do ('Put the mask on, touch the screen, and off we go'). Alice thus caused Mulle to jump on the train. Nurse Anne pointed at Mulle (4:30). The mother commented on the actions caused by Alice's tapping ('Oh look, did she jump into the train?'). Her intonation and high-pitched tone of voice indicates surprise and a desire to experience the unfolding events on the screen together. Alice, her mother, and Nurse Anne looked at the screen (4:33). Nurse Anne then drew attention to the specific doings of Mulle, asking 'Does she also take medicine?' At this point, narrative meaning-making was not only oriented toward Mulle's journey as such. For a moment, Mulle's journey was made meaningful as a process of getting medicine, as a nebulizer journey. Nurse Anne's question and her use of the word 'also' can be interpreted as an initiative to establish a relationship between Mulle's doings on the train and the activity Alice was involved in: The process of taking medicine.

The narrative orientation continued as Alice looked at the screen, waved and again made the verbal greeting, 'Hello' (4:36). Her waving and greeting can be understood as a direct reaction to Mulle, who waves several times at the beginning of the game (4:27). Nurse Anne verbally repeated Alice's greeting ('Bye') while smiling and laughing (4:36). Through multiple modalities, Alice, the mother, and the nurse joined Mulle's journey, commented on it, pointed at Mulle in the train, imitated some of Mulle's actions (the waving), and talked to her. They, so to speak, brought Mulle and her journey to life.
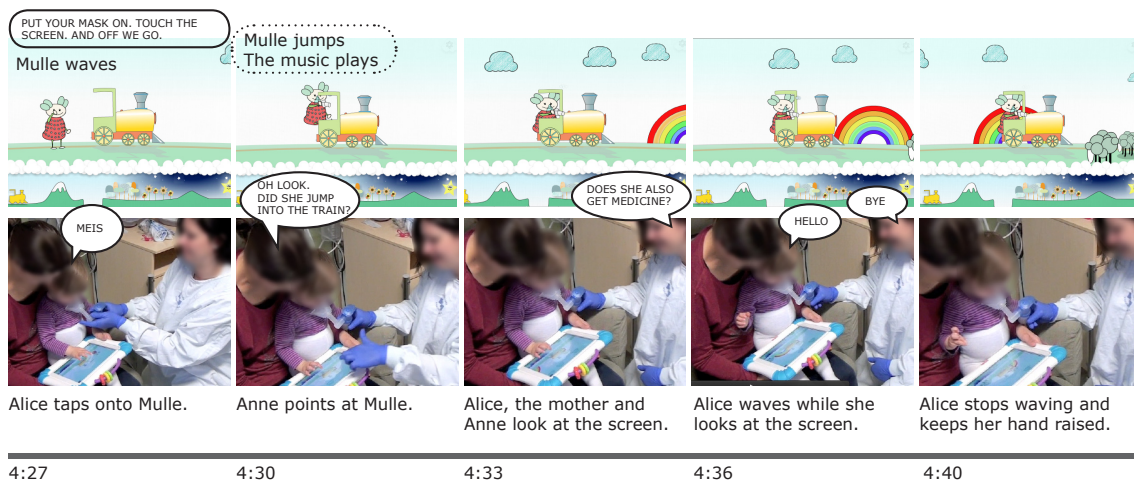

Figure 9. Narrative Orientation in Alice's Treatment

Analytical Orientation in the Text Events

In text events with an analytical orientation, meaning-making concerns the individual game elements that surround Mulle's journey and that respond to touch. On these occasions, meaning-making unfolds as processes of finding out or exploring what the elements are about, what their characteristics or possessive attributes are (Kress & van Leeuwen, 2006, p. 87 ff.), and to what uses the elements can be put. The participants' modalities include gazing, talking, pointing to, and tapping on the screen. On these occasions, meaning-making appears to have an analytical orientation, as children and caregivers attend to the game as an inventory of elements that can be scrutinized and tested.

Figure 10 is from Billy's first treatment. The father's way of directing his attention towards the sheep ('Is that the sheep? Huh? Is it baa?') can be interpreted as an invitation to explore what the sheep could do (4:33). Billy accepted the invitation both verbally ('Mm') and through tapping the sheep (4:35). Both the father and nurse Bob then encouraged Billy to tap the sheep once more ('Touch the sheep', 'Want to touch?'). Billy tapped another sheep while looking in silence at its response to his touch.
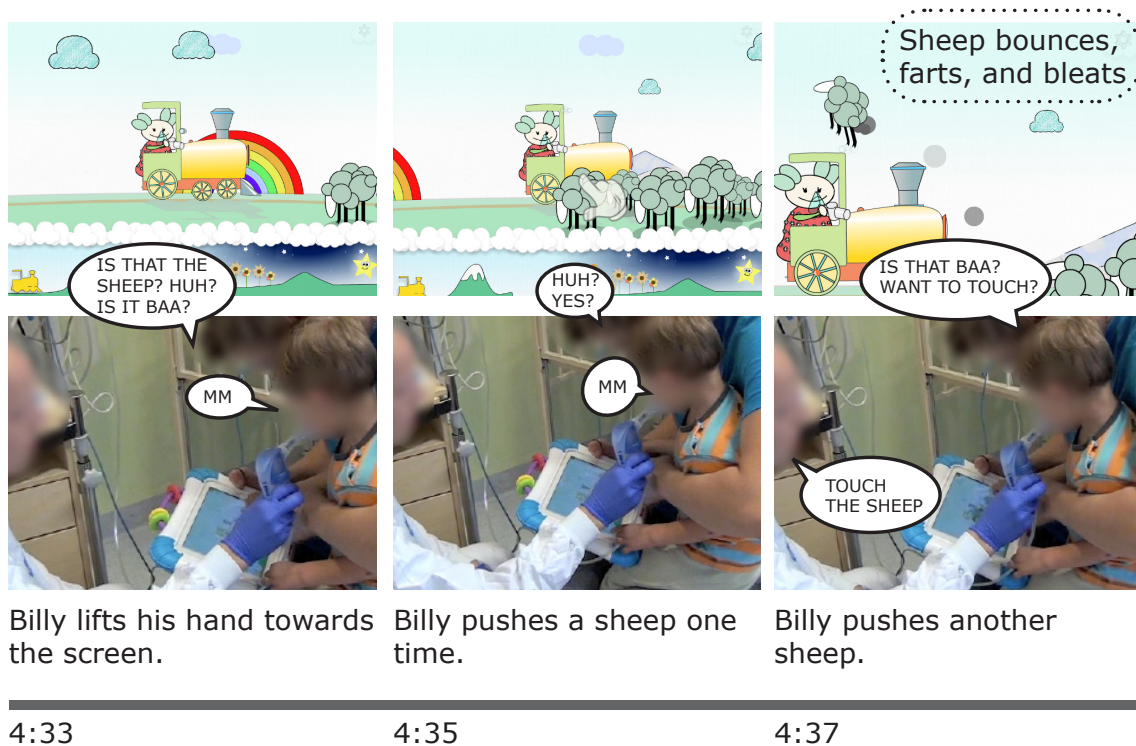
Figure 10. Analytical Orientation in Billy's Treatment

The analytical orientation persisted as Billy and his father continued to explore the sheep (Figure 11). Initially, the father encouraged Billy to tap, saying 'Tap it, we have to hurry, tap it' (4:49). Both Billy and his father touched the sheep and watched them bounce into the air while farting and bleating (4:49). When Billy touched the sheep once more, the father praised him ('Oh. Yes like that', 4:51). They continued to pay close attention to the screen. Nurse Bob also verbally encouraged Billy to tap the sheep, using the same words as

the father (4:54). When the sheep bleated, Billy imitated the 'baa' sound, as did his father ('Yeah, baa. Yeah', 4:54).
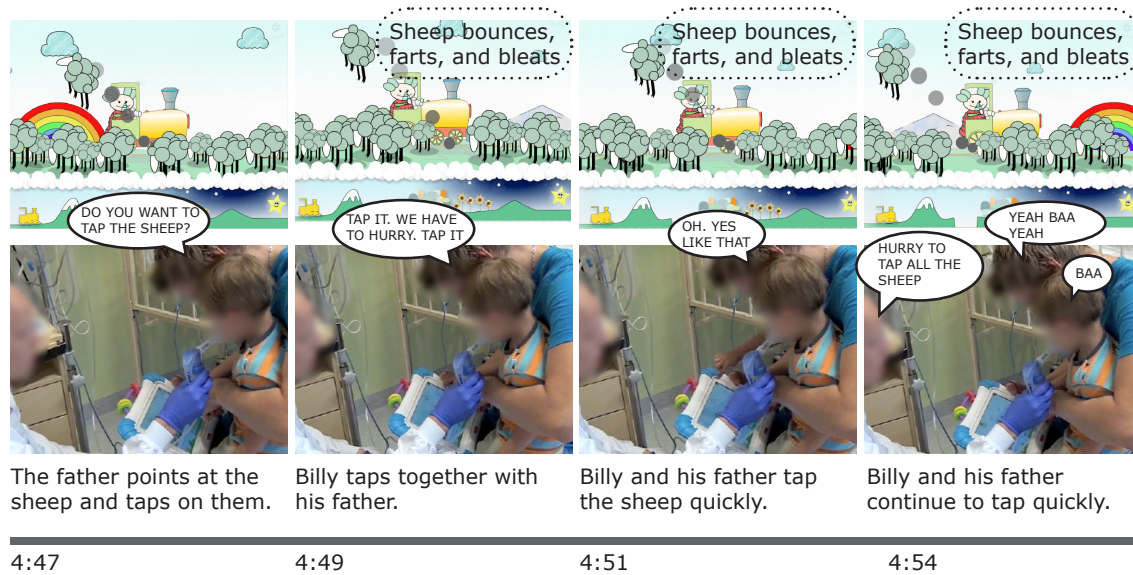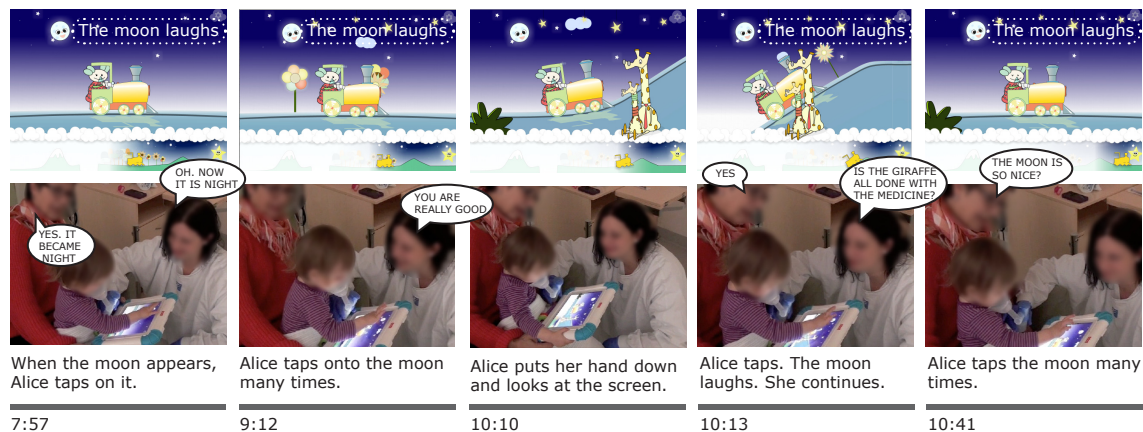

Figure 11. Analytical Orientation in Billy's Treatment

In this example, meaning-making concerned what the sheep are capable of doing (bouncing and farting) and the sound they make (bleating). It appeared to unfold as a process of getting to know about the characteristics of the sheep. The participants' repetitive touching of the same game element and their close scrutiny of the effects of tapping them are supportive of this interpretation.

Alice paid attention to the moon, exploring and getting to know its way of laughing when touched (Figure 12). Her meaning-making with the element persisted over several minutes. She would typically press the moon, lift her hand as the moon started laughing, briefly explore some of the other elements passing by, and then return to the moon. Other times she would repeatedly press the moon and watch the screen in silence as the moon kept on laughing. Nurse Anne and the grandmother commented on the appearance of the night scene (7:57). The grandmother also directly commented on Alice's interest (10:41), and Anne

praised her (9:12). They also talked about the other characters and suggested that Alice could

press these as well. Through smiling, laughing, leaning over, and cheerful tones, the

caregivers clearly joined her experience and contributed to the development of a text event

where meaning-making had an analytical orientation.

| When the moon appears, Alice taps on it. | Alice taps onto the moon many times. | Alice puts her hand down and looks at the screen. | Alice taps. The moon laughs. She continues. | Alice taps the moon many times. |
| 7:57 | 9:12 | 10:10 | 10:13 | 10:41 |

Figure 12. Analytical Orientation in Alice's Treatment

Discussion

The findings illustrate how the children and caregivers make meaning with the

healthcare game in terms of their meaning-making orientations and how text events are thus

created. Meaning-making with a narrative orientation is related to those segments of the game

that tell a story about Mulle's journey. The caregivers express a narrative orientation through

verbal comments such as 'We are driving the train' (Figure 7) and 'Oh look, did she jump

into the train?' (Figure 9) and by tapping and pointing at Mulle. The children use gaze, touch,

and speech to show their narrative orientation, illustrated for example in Figure 7. In some

cases the child waves at Mulle and greets her, thus 'moving into' the game as a lived and

dynamic world (Figures 8 and 9), much in the same way that children might do when drawing

(Hopperstad, 2008; Mavers, 2008). Waving at Mulle can also be seen as a parasocial response

directed towards the media character, as described by Howard and Roberts (2002).

An analytical orientation in the meaning-making is related to the interactive elements of the game that appear onscreen throughout Mulle's journey, such as the moon, the sheep, and the giraffes. Meaning-making unfolds as processes of finding out what the elements typically can do and of becoming familiar with their characteristic attributes (Kress & van Leeuwen, 2006). The participants are found to express an analytical orientation through repetitive tapping on the elements accompanied by verbal comments and gazes (Figures 10, 11, and 12). When Billy, his father, and Nurse Bob touched and paid attention to the sheep, for example (Figure 10), they echoed (Howard & Roberts, 2002) its 'baa' sound. This approach enabled them to explore and familiarize themselves with the element. The sheep was made meaningful as the carrier of the specific attribute of the 'baa' sound.

BLAPP shows Mulle's journey as a nebulizer journey. This medical perspective contained within the game was made relevant in only a few of the text events (Figures 9 and 12). In these cases the nurses and parents took the initiative to address the medical theme. For them, talking about the treatment they were administrating 'through' the doings of Mulle was perhaps felt to be significant. As to the children's experiences, no specific comments can be made, and further research is needed to explore meaning-making with the features that parallel the children's treatment. It is also worth noticing that Alice and Billy were experienced users of tablets and attached meaning to using such devices. This might have influenced their engagement in the text events and their meaning-making orientations. As children and caregivers get used to having access to a healthcare game during treatment, their meaning-making might also change. Future studies will be helpful to explore this.

Collaboration in the text events: Creating a shared focus

The text events came about in a social context where the game as text constituted a shared focus of attention for the children and their caregivers. Thus, meaning-making unfolded as a social process. Similar to the findings of Roberts et al. (2008), the children and

caregivers collaborated or worked together in their meaning-making. Their collaboration can be understood as a joint process of meaning-making where the participants share the meaning-making orientations and through which the text events develop.

The collaboration appears to be embedded sometimes in a lively form of sharing and other times in an immersed form of sharing. Within a lively collaboration, the children and caregivers create text events in a cheerful way through talking to Mulle, imitating the sounds of other game characters, expressing pleasure in terms of smiling and laughing, tapping rapidly on the screen, and making verbal comments in a high-pitched tone of voice. As such, their collaboration reflects shared liveliness. Figure 11 is an example. In immersed collaboration, the children and caregivers seem to share their meaning-making orientations through concentration, silence, and rapt gazing, illustrated for example in Figures 7 and 12. The lively and immersed forms of collaboration tell us something about the mood of the text events that enables the children and caregivers to find each other and share the experience of meaning-making. A digitally mediated game can be defined as a text that is woven 'on the spot' (Burn & Schott, 2004, p. 217). It is suggested that the lively and immersed forms of sharing meaning-making orientation describe qualities of the 'spot' in which the game is made meaningful.

There is no guarantee that the children and caregivers manage to find each other and join to make meaning with BLAPP. This study explored meaning related to using a specific game in a specific social context, namely medical treatment of young children with serious respiratory infections. This context involves sick children who might feel tired and uncomfortable and unable to direct their attention towards a healthcare game for anything more than a few moments. In Billy's first treatment, text events were short and frequent (Figure 6). Here, meaning-making was reflected through and based on his divided attention and the caregivers' attempts to bring the game into focus to create a more persistent text

event. While the caregivers talked and pointed to the screen, Billy showed moderate attention, reflected through his interrupted gazing, fiddling with other things, and whining. In this treatment, text events seemed to commence, yet they did not persist over time. According to Kress (1997), the 'affective state of a child' will always influence how the child 'will and can respond to an explanation, a task' (p. 110). Kress related his argument to the school context. However, it is equally pertinent for meaning-making within a medical situation and a reminder that in some situations a healthcare game might not be relevant to the child.

The Role of Caregivers

When BLAPP did appear to be relevant and text events came about, the caregivers seem to have played a crucial role. The multimodal analysis indicates that their often surprised comments on what they see on the screen, as well as ways of pointing at and tapping on elements and asking if the child wanted to tap too, supported the development of text events. Figures 10 and 11, for example, illustrate how the caregivers encouraged Billy to tap the sheep and how Billy responded to the encouragement. The caregivers also commented on the elements the children chose to attend to and echoed (Howard & Roberts, 2002) their modalities, exemplified in Figures 9 and 12. While such comments show respect for the children's control of the activity, they might also support the children to relate to the game in ways that are meaningful to them.

Caregivers have, by virtue of their position and expertise, a powerful role in the medical treatment of children. Through following the children's lead and thus supporting text events, caregivers can use their power constructively to facilitate meaning-making. However, caregivers need to be sensitive towards the child's overall experience of the situation and adjust their approach accordingly.

In the observed text events, the parents and nurses also related to each other's initiatives. The caregivers demonstrated sensitivity toward what the other adult was saying,

repeating each other's comments and thus collaborating through BLAPP. In Figure 7, the

father immediately picked up Nurse Bob's comment, 'Now we are driving'. Familiarity with

the game before treatment starts is probably beneficial for this kind of collaboration.

Considering that nurses and parents have the same goal—to ensure that the child receives

medical treatment—the collaboration between them is important. Together, the caregivers are

in a position to designate the game as a significant and valid object for meaning-making

within the specific social context. In turn, this might facilitate the children's interest in and

ability to attend to the game.

Concluding Remarks

The children and caregivers' meaning-making with the healthcare game seems to

indicate the potential that such games might hold for constituting a shared focus during

children's medical treatment. When text events come about and children and caregivers share

their meaning-making orientations—be they narrative or analytical, or in a lively or immersed

way—the nebulizer treatment appears to become a less relevant aspect of the context. This

does not mean that the children forget about the treatment. Rather, it means that their

attention, for a while, is directed towards something beyond it. Text events where children

and caregivers share their meaning-making orientations can thus be said to reflect moments

during treatment when the nebulizer treatment becomes background. From this perspective,

children might have some chance of experiencing at least *parts* of the treatment as meaningful

with and through a multimodal text such as a healthcare game.

The present study can perhaps inspire caregivers to explore the potential of healthcare

games in medical treatment with children. Hopefully, it might also encourage researchers as

well as designers of healthcare games to pay increased attention to the healthcare experiences

of toddlers and their caregivers through addressing how they make meaning with and through

multimodal texts in different medical treatments.

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