Playscapes

Creating Space for Young Children's Physical Activity and Play

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Playscapes: Creating Space for Young Children's Physical Activity and Play

Dissertation

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Chapter 1:

Introduction

Lana, 5 years old,
spending her weekend at home

It's Saturday afternoon. After spending a lazy morning on her parents' tablet, Lana goes outside to see who else is playing in the courtyard. "Don't stray away too far!" her mother calls after her. Lana sees Tim and another boy, and runs towards them. They're taking turns on the slide. Lana joins them. After his turn, Tim says: "If you slide more on your back you go faster!" Lana gives it a shot and as she goes down shoots of the slide and rolls over on the ground. Lana is laughing, and soon the other two follow and roll over in exaggerated ways while laughing. "Let's play hide and seek!", Lana suggests, "Tim, you're it!" As Tim starts counting down, Lana sees the other boy running towards the bushes. Lana runs to the tree at the corner of the courtyard. She quickly climbs into the part where the leaves cover her. When Tim finally finds her, Lana comes down, jumps from a low branch, and runs after Tim back to the slide where they start another game of hide and seek.

Robert, 5 years old,
during his stay in a pediatric hospital

It's Saturday afternoon, and Robert is in bed. He has been watching television from his bed all morning, but now TV time is over. "Maybe you can play with the cars that we brought?", father suggests. Robert isn't interested and feels tired. "Or we can go for a walk to the playground?", father suggests, referring the playground near the entrance of the hospital. Robert does not make a move, and says "I want to go pet the animals!", referring to the animals that are occasionally brought for the children in the hospital. "We'll have to wait a little longer," father replies, "because that only starts at three o'clock." Robert gets out of bed and walks into the room. After looking around for a bit he walks towards the door and peeks into the hallway. "Hi Robert!", says nurse Amy as she passes by, "what are you doing today?" "Nothing much", Robert replies, and he turns around, picks up his toy cars, and brings them to his bed. Here he drives them over the hills that his blankets form.

1.1 Introduction

This dissertation is about designing opportunities for young children to engage in physical activity during periods of hospitalization. The anecdotes at the top of this page illustrate that such opportunities are often lacking compared to the daily lives of healthy children. The places in a hospital in which a child spends most of his or her time, such as patient rooms or waiting areas, are designed primarily for other purposes than being physically active, such as resting, treatment and care, or sitting and waiting for a consult with the doctor. While a child can play in these environments, few opportunities are given to them to play in an active way. In this dissertation we explore how to *create space* for young children's physical activity in these types of places.

Children with chronic diseases often show low levels of physical activity compared to their healthy peers, in particular during hospitalization. However, despite their disease, treatment and other limiting factors, children are often quite able to be physically active. In this light, stimulating physical activity is a matter of giving children the right opportunities. But what are 'the right' opportunities? And how, for example, can a patient room offer these to children, while also serving many other purposes? How should designers design these opportunities for physical activity in similar healthcare contexts?

This dissertation attempts to address these questions in two ways: first, by tackling the challenge head-on, namely through the development and implementation of design solutions for children with cancer during hospitalization; second, by developing and evaluating a 'design perspective' that can support other designers in coming up with their own design solutions for stimulating physical activity in healthcare as well as in other contexts. We call this perspective 'Playscapes', which supports designers in turning children's environments, such as hospitals and rehabilitation centers, but also schoolyards or playgrounds, into *landscapes for physical activity and play*.

1.2 Stimulating children's physical activity during hospitalization

Physical activity is broadly defined as "any bodily movement produced by skeletal muscles that requires energy expenditure" (World Health Organization, 2015). Taking this definition, children are physically active in all kinds of ways, such as walking up the stairs, playing a game of tag, playing ball, digging sand, but also simply walking or carrying a glass of

lemonade. Physical activity has important health-benefits for children, in particular when it is of a moderate or large amount of effort. Besides its importance for children's health, physical activity also plays a major role in their motor development. In early childhood, children develop a basic set of motor skills upon which they rely on in later life (Maude, 2010; Strong et al., 2005; Timmons et al., 2007). Considering these benefits, it is important for children to be physically active, and design can play a supportive role in this.

While it is important for healthy children to be physically active, this is even more so for children with chronic diseases. Unfortunately, this group of children often shows very low levels of physical activity, in particular during periods of hospitalization. Many chronically ill children are admitted to hospitals or rehabilitation centers on a frequent basis and they may stay there for several days or, in extreme cases, up to several months. Stimulating physical activity in such situations can have many benefits for children. In the case of childhood cancer, there is increasing evidence that regular physical activity can reduce fatigue, improve sleep efficiency, increase muscle strength, improve cognitive function, and have an overall positive effect on functional capacity, quality of life, physical well-being, and health status (Baumann et al., 2013; Götte, Kesting, et al., 2014; Götte, Taraks, et al., 2014; Huang & Ness, 2011; San Juan et al., 2011). Besides these important health-related benefits, and the aforementioned benefits to children's motor development, there are also potential gains in terms of the child's experience during hospitalization.

Current approaches in design and healthcare to promote physical activity are often exercise-based. In pediatric healthcare, children can take part in exercise programs. In interaction design there is much attention for exercise-based solutions, particularly in the form so-called 'exergames' (a contraction of 'exertion' and 'games') – i.e. games that require a level of physical exertion from the child. Exergames are increasingly implemented in pediatric healthcare, as they fit nicely into exercise programs and give the therapist a tool to motivate and challenge the child at the right level and to adjust parameters to his or her therapeutic needs (e.g. see Janssen et al., 2017). While these exercise-based approaches have their merits, they come with limitations when it comes to stimulating young children, in particular below the age of six. It is only around the age of 6 that children start to play activities with predetermined rules and structure (e.g. Smith, 2010). Younger children generally find it

hard to adhere to rules and structure and tend to be physically active in an unstructured and spontaneous way (Burdette & Whitaker, 2005; Pellegrini & Smith, 1998).

This research focuses on this age group between 2 and 6 years, and proposes an alternative to exercise-based approaches, by focusing particularly on designing opportunities for children's physical activity in the form of unstructured and spontaneous play. This alternative approach is called 'Playscapes', expressing the aim to design children's environments as landscapes full of opportunities for physical activity and play.

1.3 Research goals and -questions

Two main goals drive the research presented in this thesis. The first is to improve the situation of young children with cancer when they are hospitalized, in particular by stimulating their physical activity in a way that they enjoy. This thesis can be regarded as an initial step in pursuing this goal, in which we take the first steps of implementation during the research project. A second goal is to offer guidance to other designers in creating their own solutions for stimulating young children's physical activity, in healthcare as well as in other contexts.

In line with the design goals, three research questions were asked. The first question focuses on physical activity in children more generally, in order to inform what might be lacking in hospital environments:

> ***RQ1:*** *What stimulates young children to be physically active?*

The second research question asks what stimulates children with cancer to be physically active during hospitalization:

> ***RQ2:*** *What stimulates young children with cancer to be physically active during hospitalization?*

The above questions are answered through the development of the Playscapes perspective. The third question centers on evaluating the generative value of Playscapes:

> ***RQ3:*** *Does Playscapes support designers in generating appropriate design solutions for stimulating young children's physical activity?*

1.4 Project background

The work presented in this thesis was part of the research project 'Meedoen=Groeien!' (in English, 'Participating=Growing!'), which is part of a collaboration between the Delft University of Technology (TU Delft), the Princess Máxima Center for Pediatric Oncology and HandicapNL. This collaboration aims to generate design solutions for children with chronic diseases in order to stimulate children's development, and to develop design tools that support other designers with a similar goal. The focus on children's development is derived from the program of 'development-based-care' as formulated by the founders of the Princess Máxima Center for Pediatric Oncology (Aarsen et al., 2012). This integrative form of care concentrates on children with cancer and their families as a whole, aiming to foster the normal development of children, in spite of their life-threatening illness and the invasive treatment they have to endure. The Meedoen=Groeien! project consisted of two PhD research projects, each with its own focus. The focus of the research project presented in this thesis is centered on fostering children's *physical development*. This broad scope was narrowed down to a focus on young children (2-6 y/o) with cancer and stimulating their physical activity during hospitalization (see Chapter 3).

Throughout the research project, the researcher engaged with the particular context of pediatric oncology in several ways: he performed initial contextual inquiries, developed concept designs and prototypes, conducted field studies with prototypes, and organized a design workshop and design exhibition, all focused on children's physical activity and play during hospitalization. The work was supervised by a promotor and co-promotor from the StudioLab at TU Delft, a promotor from the Princess Máxima Center for Pediatric Oncology, a Chef de Clinique of the inpatient ward of the same oncology center, and an external advisor from the Child Development & Exercise Center in the Wilhelmina's Children's Hospital in Utrecht, the Netherlands. This collaboration facilitated design and research activities in a hospital context, and also helped integrating different forms of content concerning design, pediatric oncology and young children's physical activity and development.

1.5 Reading guide

The thesis consists of seven chapters in total, with the development of Playscapes serving as a main thread. Two chapters are paper-based (Chapter 3 and 4); in these chapters only minor adaptions were made to the original papers.

Chapter 2 presents the research approach, which is broadly characterized as 'doing design as part of doing research' (Stappers, 2007). We elaborate on what is designed in the research, and what for.

Chapter 3 introduces and positions Playscapes, a design perspective on young children's physical activity and play. Based on two of its instantiations, Fizzy and Stickz, we compare Playscapes to exercise-based approaches to children's physical activity in design and healthcare, in particular, 'exergames'.

In **Chapter 4** we apply Playscapes by implementing prototypes in a pediatric hospital. This chapter results in a collection of design strategies that make Playscapes more actionable, together with the suggestion of more general design directions in the form of 'Playscape elements'.

Chapter 5 examines how Playscapes is used by designers to generate ideas in an ideation workshop. Furthermore, the chapter examines how the resulting ideas are valued by stakeholders from a pediatric oncology hospital. Based on the findings, we formulate recommendations for developing a set of Playscape tools and techniques.

Chapter 6 presents a Playscapes brochure, which brings together different levels of intermediate-knowledge based on five Playscape designs. This chapter will be most relevant for design practitioners and other professionals that seek actionable insights for promoting young children's physical activity.

Finally, **Chapter 7** concludes with a general discussion of the value of the presented work, the methodological strengths and limitations, and directions for future research.

Introducing and positioning Playscapes

DESIGN PERSPECTIVE

'FIZZY' AND 'STICKZ' AS INSTANTIATIONS

Applying Playscapes in a pediatric oncology center

FIELD STUDY WITH STICKZ IN A HOSTITAL WAITING AREA

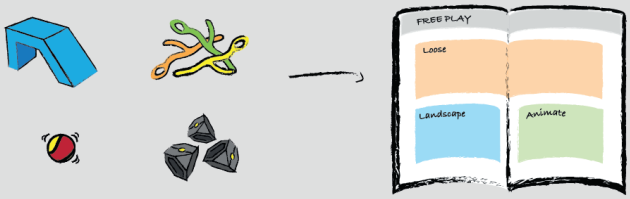
FIELD STUDY WITH FIZZY IN A PATIENT ROOM

Towards tools and techniques

DESIGN WORKSHOP WITH STUDENTS

EXHIBITION IN PEDIATRIC HOSPITAL

The solution space of Playscapes



WIDER RANGE OF PLAYSCAPE DESIGNS

PLAYSCAPES BROCHURE

Chapter 2:

Research approach

2.1 Introduction

This chapter describes the research approach, which is characterized by the central role of design actions. After describing the research approach on a general level, the subsequent sections will elaborate on particular characteristics of the approach, how these came with particular implications and how the researcher dealt with these.

As presented in the previous chapter, the first goal in this thesis is to improve the situation of young children with cancer, in particular by stimulating their physical activity in a way that they can enjoy. This goal not only requires an understanding of the current situation, but also efforts in making changes towards a preferred future situation. In this dissertation, such efforts are made through *design actions* (see Section 2.2). In Section 2.3 we explain how the goal to stimulate young children's physical activity implies designing for the purpose of *behavior change.* The second goal of this thesis is to develop guidance for designers to come up with their own solutions for stimulating young children's physical activity in hospital environments or other contexts. Pursuing this goal requires that the knowledge generated in this thesis is made *actionable* for designers. This is done by centering the research on the development of a *design perspective*, which will be elaborated upon in Section 2.2 and 2.4.

2.2 Design actions as an integral part of the research

As mentioned in the previous section, the research approach in this dissertation is characterized by the integral role of design actions. This approach, in which doing design is a fundamental part of doing research (Stappers, 2007), has been given several names, including 'constructive design research' (Koskinen et al., 2012), 'practice-based design research' (Vaughan, 2017), or, as in this thesis, 'research through design' (RtD; Stappers & Giaccardi, 2017). Aligned with the two goals mentioned in the previous section, design actions are integrated on two levels. At one level, the researcher generates design solutions for stimulating physical activity and implementing these in real world hospital contexts. At another level, the researcher develops a design perspective to support other designers in designing for young children's physical activity.

Another consideration for taking a research through design (RtD) approach relates to the project background of this research (see Section 1.3). Next to the goal of generating knowledge, another aim of the over-

arching project is to deliver design solutions that are implementable in pediatric healthcare, or that will be in the future. This dual aim makes RtD a very suitable approach, as it can deliver both knowledge and design solutions through the same process.

Developing a 'design perspective' for designers

As mentioned above, a design activity central to the research approach is the development of a 'design perspective' that can support designers in their design work. By 'design perspective' we mean a conceptual framework that can support designers in *understanding a phenomenon in a particular way,* and to *design solutions according to this understanding*. It points in a certain direction, and thereby opens up a particular solution space. This also means that it necessarily excludes certain types of solutions. A design perspective is a perspective *on* something, which in this case is young children's physical activity.

To give an example, take the notion of 'Pleasurable Troublemakers' introduced by Laschke and Hassenzahl (e.g. Laschke et al., 2015; Laschke & Hassenzahl, 2014) With their notion, the authors share a particular take on behavior change that emphasizes *friction* as a way to suggest behavioral alternatives to people's established routines. With this particular focus, they point out a particular direction for designers – i.e. behavior change can be achieved through friction. By doing this, they demarcate a particular solution space. As a result, certain types of solutions are an unlikely outcome of a design process, such as solutions that gently nudge a user towards a particular behavior by pointing out particular benefits. Laschke & Hassenzahl (2014) offer a set of principles that underlie their concept of friction and how it can be integrated in design, such as making friction more pleasurable and in line with a person's ideal self. A design example is 'The Never Hungry Caterpillar' (Laschke et al., 2015): this extension cord is designed in the form of a caterpillar that expresses its suffering when a device it is connected to is switched to stand-by modus. The purpose of the design is to improve energy behaviors in the home, and it does so through, what the authors call, frictional feedback. Although the authors do not use the terms 'design perspective' and 'solution space' to describe their work, their proposal of Pleasurable Troublemakers nonetheless fits the description.

Developing a design perspective as part of this research is beneficial in two ways. The first has already been mentioned: the design perspective

addresses one of the two main goals of this thesis, namely to develop a form of guidance to other designers when designing for young children's physical activity during hospitalization or in similar situations. The second benefit concerns the research process. By developing a design perspective, the researcher is oriented in a particular direction. The design perspective, in other words, forms an initial frame or foundation that structures the research, eventually allowing multiple studies to form a coherent unity (Binder & Redström, 2006; Stappers et al., 2015)research methods have become an accepted, even standard, part of design practice and (academic.

Designing opportunities for children's physical play

Parallel to developing a design perspective, the second level in which design activity takes place in the research focuses on generating concrete design solutions for stimulating young children's physical activity. Design solutions are made in the form of concept designs and working prototypes. As will become clear in Chapter 3, the Playscapes perspective focuses on stimulating children's physical activity in hospital environments in the form of unstructured and spontaneous play. The actual things that are designed, are things to play with, or what will be referred to as 'playthings' (Sicart, 2014). While a more commonly used term is 'toys', this often refers to models or replicas of something, as in a 'toy car'. The term 'plaything' hints at a more open definition of things to play with. For example, a couch can be a plaything by affording children to jump on it, as well as a stick, which can serve as an imaginary sword in a child's play narrative. It is these spontaneous and imaginative interactions that are of interest in this thesis.

The playthings that we develop in this thesis serve particular research purposes. First, they allow us to empirically ground the design perspective by implementing working prototypes of playthings in real world hospital settings. By observing the interactions of children with these prototypes, we can gain an understanding of how the design solutions contribute to physical activity and play and at the same time show whether Playscapes can lead to appropriate design solutions (RQ3). Second, through the design of playthings by the researchers, as well as design students supervised by the researcher, we create a wider range of design examples. This overview serves not only as a collection of examples of the design perspective (i.e. 'this and that are examples of a Playscape design'), but it allows for building up a palette, so to speak,

of different ways to design for physical play (i.e. 'you can design from a Playscapes perspective in this and that way'). In other words, the overview allows us to convey generative knowledge at an intermediate level, in between concrete instances and general theory, which speaks the language of designers (B. Gaver & Bowers, 2012; Höök & Löwgren, 2012; Löwgren, 2013).

2.3 Designing for behavior change

By designing playthings in order to stimulate physical activity, this research is concerned with *designing for behavior change*. In the field of Design for Behavior Change (DfBC), many approaches and perspectives have been developed, commonly informed by theories from the behavioral and social sciences (for an overview, see Niedderer et al., 2018). A theory can help in understanding what might cause a behavior to change or how behavior change occurs over time. The design work in this thesis is informed and inspired by Gibson's theory of affordances (Gibson, 1979) and subsequent work on affordances and children's environments (e.g. Fjørtoft, 2004; Heft, 1988). In this theoretical framing, stimulating physical activity is a matter of *bringing the right opportunities* within children's proximity in hospital contexts. Furthermore, a Gibsonian perspective emphasizes *interaction* rather than action. We are interested not only in *whether* children engage in physical activity because of the playthings, but also *how* the playthings contribute to this, and how interactions take shape.

Behavior change and empowerment

By designing playthings for physical activity in the form of unstructured and spontaneous play, we aim to *empower* children to be physically active in the way that they otherwise would enjoy when playing outdoors. In this light, this research takes a *possibility-driven* approach (Desmet & Hassenzahl, 2012; Desmet & Pohlmeyer, 2013) to designing for behavior change, in which offering children positive experiences on the one hand, and stimulating their physical activity on the other hand, are equally important. While the starting point of this thesis is a problem – i.e. children's low levels of physical activity during hospitalization – it is not the sole aim to reduce or neutralize this problem. By bringing opportunities for physical activity and play to the hospital, we mean to enable chronically ill children to have the experiences that young children generally tend to enjoy.

2.4 Performing multiple design and research roles

In this thesis, the researcher takes three main roles. The first is that of a 'researcher', in which aim is to understand what stimulates young children's physical play in interaction with playthings, in particular during hospitalization. The second role is that of a 'product designer', where the interest is in designing playthings for children that are engaging to them and that stimulate their physical activity. The third role is that of a 'tool developer', where the aim is to develop a design perspective that allows other designers to design engaging and activating playthings. The combination of these different roles adds a certain value to the research, but it also brings tensions.

An inherent tension to RtD, concerning the role of (product) designer and researcher, is that the research findings cannot easily be separated from the designed solution (e.g. Storni, 2015). This makes generalizability a challenge; other designers might be dealing with different contexts requiring different types of solutions. In this thesis, this is addressed in two ways. First, we build on multiple design solutions in the research, showing that the generated knowledge is more broadly applicable. Second, based on these design examples we generate more abstracted knowledge contributions that are more broadly applicable, such as design strategies. These contributions are forms of 'generative intermediate-level knowledge' – 'generative' in that they can be used in the creation of new design solutions, and 'intermediate-level' in that they are "more abstracted than particular instances [i.e. design solutions], yet [do] not aspire to the generality of a theory" (Höök & Löwgren, 2012, p. 23:2).

Another possible tension of taking multiple roles concerns the relation as a designer and researcher to the design solutions. As a product designer, for example, one may have a conviction that one's own design solutions will or should work, involving a sense of ownership and pride with respect to the solutions. As a researcher, however, one has to take distance and put these design solutions under scrutiny, being critical in one's evaluation of them. The beliefs of a designer that his or her work is good, might be in the way of the ability to evaluate the work critically. Another way in which tension may surface is with respect to the work of other designers involved in the researcher. The three roles combined give the researcher of this thesis the unique position to design playthings with a relatively high level of background knowledge on the topic and the design perspective. This may result in high expectations

when studying how other designers apply the design perspective. Here as well, some distance needs to be taken. This is done by including the views from other researchers, in particular the supervisory team, who are less personally engaged with the design solutions and the design perspective. Furthermore, by clearly defining research questions and, in particular, methods, the more distant role of a researcher can be performed more easily when doing data collection and analysis. Moreover, to increase the reliability of our findings of the field studies, we make use of video recordings. This allows us to check consistency of findings by shifting back and forth between early and later observations, but also to have part of the recordings coded by a research assistant.

The added value of performing multiple roles in this research is that they complement one another in various ways. For example, developing novel solutions – the role of product designer– makes it possible study a future situation – i.e. to explore new ways in which children 'can be' stimulated, rather than current ways in which children currently 'are' stimulated (i.e. researcher's interest). The other way around, gaining an in-depth understanding as a researcher of the phenomenon under study allows for designing better solutions. Another example is how the role of a tool developer allows the work of the product designer to be put in a broader perspective, in particular by engaging with other designers that have their own ways of working and come up with their own design solutions; this in turn feeds the work as a researcher. Finally, the role of a tool developer and product designer also help the dissemination of the research findings, by making them attuned to, and actionable for, design researchers and practitioners.

Chapter 3:

Introducing and positioning Playscapes

This chapter is based on:

Boon, B., Rozendaal, M. C., van den Heuvel-Eibrink, M. M., van der Net, J., & Stappers, P. J. (2016). Playscapes: A Design Perspective on Young Children's Physical Play. In *Proceedings of the The 15th International Conference on Interaction Design and Children* (pp. 181–189). New York, NY, USA: ACM. http://doi.org/10.1145/2930674.2930713

3.1 Introduction

During early and middle childhood, children develop a diversity of basic motor skills. These skills form the basis of further development and future engagement in physical activity (PA). Sometimes, children's physical development stagnates, potentially having acute and long-term consequences. This can happen, for instance, when children enter a period of treatment and rehabilitation due to illness or injury. In these cases, children may be admitted to hospitals or rehabilitation centers for extended periods of time ranging from a few days to several months. Children might also develop a chronic health condition that warrants frequent hospital visits and treatments.

Although being in this predicament, it is important for children to remain physically active. This involves various challenges. Where the decreased abilities resulting from the disease or injury already limit the child in his or her PA, hospitalization can further deteriorate the situation. Many children feel anxious for being in an unfamiliar setting where unpleasant medical procedures are performed. Furthermore, parents might be overprotective, keeping a close eye on the child at the expense of his or her self- initiated activity. The physical environment also plays an important role. The interior of hospital settings is designed for safety and comfort, rather than stimulating children to move: medical equipment limits the child's mobility and beds in patient rooms discourage children to come into action. We believe interaction designers have a significant contribution to make in dealing with these challenges.

In the field of human-computer interaction (HCI) there are several approaches to stimulating children's PA. One popular approach gaining attention in pediatric healthcare is that of 'exergames'; games that require a certain level of exertion (Sinclair et al., 2007) generally involving structured and repetitive movement. Exergames are useful as they can require of the child specific types of movements or levels of exertion that are desirable in a therapeutic sense (Janssen et al., 2017; Landry et al., 2013). Also, a therapist can potentially change basic variables, which allows setting the right target and level of difficulty for each individual.

Other approaches for stimulating children to be physically active are 'Head Up Games' (HUGs) (Soute et al., 2010) and 'open-ended play' (Bekker et al., 2010; de Valk et al., 2013). HUGs are "outdoor, co-located, multiplayer pervasive games that encourage social interaction, stimulate physical activity and support adaptable rules, creating a fun experience"

(Soute et al., 2010, p. 437). HUGs as an approach is less exercise-based than exergames and explicitly avoids screen-based interaction. De Valk et al. (2013) position 'open-ended play' as being in the grey area between games and free play, allowing for players to create their own rules and meanings in interaction with the design. Like HUGs, open-ended play is focused on tangible play objects (de Valk, 2015). Open-ended play has been used as an approach to stimulate children meeting daily PA norms (Bekker et al., 2010).

In this paper we wish to contribute to this body of research by focusing on the PA of young children (2-6 years old) and by combining some of the characteristics of the above approaches. Like HUGs and open-ended play, we focus on tangible playthings. Furthermore, we see value in exergames as an approach, as it can be used to elicit specific therapeutically relevant interactions. However, due to the rules and structure involved we deem the approach less suitable for young children, in particular below the age of six, as their PA is typically intermittent and spontaneous. The approach of open-ended play does allow for this spontaneity and aims to enhance children's imagination. However, open-ended play is generally focused on rules and rulemaking and it does not aim for specific therapeutic goals. We develop a new design perspective on young children's physical activity and play that incorporates the strengths of both approaches: it addresses the challenge of designing for specific bodily movements while at the same time letting young children play freely.

3.2 Activities that informed the development of Playscapes

The initial idea for the design perspective was developed in an integral way, involving various design and research activities in parallel. These activities can be summarized as *exploring context*, *literature research*, and *ideation and conceptualization*.

Exploring context

Different measures were taken in order to get familiar with hospital environments and care practices and to understand better how children with chronic diseases undergo treatment, spend their time in hospitals, what they are capable of, and how physical activity is encouraged in the hospital. The researcher shadowed healthcare practitioners from different disciplines throughout their day, asking questions about their practice and asking about their views and experiences with children with

cancer. The researcher got to witness multiple consultation hours with patients and oncologists, getting a feel for various issues with respect to medication, hygiene and symptoms. He interviewed physiotherapists and joined them in pediatric physical therapy sessions, getting a feel for children's capabilities through first- and second-hand experience. He also joined nurse specialists in their daily practice, and was guided by them through the clinic and policlinic. He also joined a child and family during their hospital visit.

Literature research

Besides learning from contextual research, a basic understanding of young children's physical activity was gained through literature research. The literature also inspired potential solutions to stimulate physical activity. Topics of interest included levels of physical activity in healthy and diseased children, the role of physical activity in the development of healthy and diseased children, the form in which physical activity occurs in early childhood, important dimensions that influence young children's physical activity during hospitalization, and contemporary approaches in design and pediatric healthcare to stimulate children's physical activity.

Ideation and conceptualization

While getting a feel for the problems and solutions already available, first ideas about an alternative perspective started to arise. This creative activity took place on two levels, as described in Chapter 2. On one level, the design perspective was developed, and on another level the development of concrete design solutions. Literature on outdoor play and informal observations of children's outdoor play inspired and directed both levels of design. Two potential design solutions, Fizzy and Stickz, were selected and developed further into concept designs. This was done through sketching, making initial scale models, and eventually building 1:1 prototypes that functioned to the extent that children and others could interact with them. Developing the two concept designs helped in formulating the design perspective. Furthermore, the designs allowed us to show the merits of the design perspective in comparison to other approaches.

By means of the above activities a design perspective was developed. Below we introduce and position this design perspective, starting with its underlying motivation to foster children's physical development.

3.3 Young children's physical development

Physical development is a process of continuous change in the human body covering our entire lifespan. The most notable changes during childhood (0 to 18 years old) occur in body length and weight. Next to the anatomical level, we can further distinguish changes in health-related fitness and motor skills, both of which progress significantly during childhood. Young children are in a stage in which they acquire many basic motor skills upon which they build later in life. In other words, they are at the root of developing a physical literacy: the "motivation, confidence, physical competence, knowledge and understanding to maintain physical activity throughout the lifecourse" (M. E. Whitehead, 2010, pp. 11–12). Whitehead describes physical literacy as the core purpose and value of PA. It is a fundamental capability, "a potential that all human beings possess" (M. E. Whitehead, 2010, p. 17). The concept offers a holistic conception of development; the deployment of physical literacy is seen as affecting all other human dimensions. We focus on a particular aspect of physical literacy, physical competence (more commonly referred to as motor skills). Early childhood can be seen as "the breeding ground for the physical competence attribute of physical literacy" (Maude, 2010, p. 110).

Three elements are central in developing physical competence: movement vocabulary, movement memory, and movement quality (Maude, 2010). Similar to a verbal vocabulary encompassing many different words, the movement vocabulary encompasses many different movements. Maude proposes a set of movement categories: balance (e.g. on one foot, handstand, rocking) locomotion (e.g. rolling, crawling, walking), flight (e.g. hopping, jumping over, landing), manipulation (e.g. holding, gripping, picking up), projection (e.g. throwing, kicking, spinning), construction (e.g. arranging, stacking, assembling) and communication (e.g. clapping, waving, bowing). The movement memory refers to the internalizing of the experienced movements, allowing children to recall them in different situations and in various sequences. Movement quality is the outcome of this memorization, so that movements can be executed "with poise, coordination, efficiency, accuracy and usually with the minimum of effort" (Maude, 2010, p. 109).

3.4 Stimulating young children's physical activity

Through children's engagement in PA, they develop their physical competence. Nevertheless, stimulating PA is often more thought of in terms

of its health-related benefits (e.g. fighting obesity). From this point of view, stimulating PA seems a matter of 'the more the better.' Indeed, the amount of PA in children is important albeit not only for the purpose of health benefits. According to various authors (e.g. Strong et al., 2005; Timmons et al., 2007) the emphasis of PA in young children is more on motor skills. In stimulating young children's PA, this needs to be taken into account.

A common approach to increase PA in the context of pediatric care is through the use of exercise (e.g. Huang & Ness, 2011; van Brussel et al., 2011). Exercise is a subset of PA that is planned and structured, consisting of repetitive bodily movement (Caspersen et al., 1985). We deem exercise unsuitable for stimulating young children. First of all, children, in particular below the age of six, have difficulties following exercise programs. A possible explanation is that young children's physically activity is typically spontaneous and is characterized by short bouts of activity (Strong et al., 2005; Timmons et al., 2007; Winter et al., 2009). This suggests that opportunities for PA should be more in the proximity of the child. Moreover, 'exercise' does not represent a holistic approach to children's wellbeing and development. Based on the above, we place our focus on play. Play is the main form in which young children are physically active (Burdette & Whitaker, 2005; Pellegrini & Smith, 1998; Timmons et al., 2007). Also its positive impact on wellbeing and development has been well documented (e.g. see Frost et al., 2012; Tonkin, 2014).

Play is an intrinsically motivated activity, having no purpose apart from itself, from the perspective of the player. In other words: play is autotelic and it is characterized by a state of 'flow'; i.e. the complete absorption of a person in the present moment (Nakamura & Csikszentmihalyi, 2002). We acknowledge the role of parents, who can be co-players, offer guidance and show new opportunities that expand a child's play repertoire.

Outdoor play

We consider outdoor play a great inspiration for understanding how to naturally stimulate PA in young children. Children are generally more active when being outdoors (Gray et al., 2015). Natural elements are often considered to play an important role. For example, an exploratory study on the effects of greening school grounds shows that by replacing turf and asphalt with a diversity of natural and built elements children more spontaneously engage in physical activity (Dyment & Bell, 2008). The

authors point out "the potential to encourage moderate and light levels of physical activity by increasing the range of enjoyable, non-competitive, open- ended forms of play at school" (Dyment & Bell, 2008, p. 960). A study by Baranowski et al. (1993) describes how three to four year olds are significantly more active when they play in nature. Others suggest that in nature children play with more complexity (Kirkby, 1989) and imagination (Rivkin, 1990). Concerning children's physical competence, Fjørtoft shows how natural environments can have a significant positive effect on motor skills, in particular with respect to balance and coordination (Fjørtoft, 2004).

In short, outdoor play has a positive impact on young children's PA and physical competence. As depicted in Figure 1, our research aims to translate qualities of outdoor play to hospital settings. In line with this aim we developed a design perspective called 'Playscapes'.

Figure 1: Outdoor environments are varied and full of opportunities to explore and play with. Hospital environments are often slick and sterile, offering little opportunities for physical activity and play. How can we bring qualities of outdoor play to hospital environments?

3.5 Playscapes

Playscapes is a design perspective inspired by children's outdoor play in natural environments or 'natural playscapes' (Carr & Luken, 2014; Fjørtoft, 2004; Keeler, 2008; Kochanowski & Carr, 2014; Kuh et al., 2013). The perspective can be used in a generative and descriptive way. It offers designers a solution space that helps them generate designs that are attuned to the way in which young children naturally engage in physical activity, namely through spontaneous and unstructured play. Furthermore, it brings about a shift of focus from health-related fitness to physical competence. With Playscapes we wish to realize hospital

environments that children can start to perceive and use as a landscape for physical activity and play that challenges them at the right level. We describe three play qualities, also depicted in Figure 2, that are particularly relevant in the designing for young children's physical activity: (1) bodily play (2) dispersed play and (3) free play. These qualities also allow for a descriptive use of the perspective, as will be illustrated later in the paper.

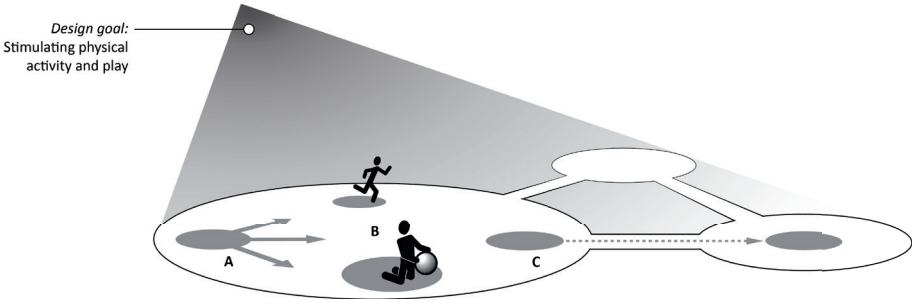


Figure 2 The design perspective of Playscapes accounts for three key qualities: free play (A), bodily play (B) and dispersed play (C)

Bodily

Bodily play is play that involves full body movements, making use of the large muscles. Examples of bodily play are rolling of a hill, balancing on a log, climbing a tree, throwing stones, etc. (e.g. Keeler, 2008; Kochanowski & Carr, 2014). Bodily play is important in children's development of physical competence. Furthermore, bodily play touches upon Whitehead's idea of overall body management, characterized by moving with poise and grace (M. E. Whitehead, 2010). The categories of movement vocabulary by Maude (Maude, 2010) can guide designers in designing for children's bodily play: i.e. designing for balance, locomotion, flight, manipulation, projection, construction or communication.

Dispersed

We define dispersed play as play beyond the boundaries of a single dedicated (play) area. A characteristic example is how children tend to expand their play area by incorporating in their play the bushes and trees that surround a playground. Another example is how children like collecting loose materials, such as pinecones, autumn leaves and rocks, and then transport these from one place to another (e.g. Kochanowski

& Carr, 2014; Kuh et al., 2013). In literature, such materials are often referred to as 'loose parts' (Daly & Beloglovsky, 2015; Maxwell et al., 2008; Nicholson, 1971), i.e. materials that can be moved, manipulated, controlled, and changed in play. Dispersed play is relevant for locomotion – i.e. the vocabulary to enhance travel (Maude, 2010). Also spatial and directional awareness (Frost et al., 2012) can be developed. But most importantly, dispersed play allows children to expand their play narratives, have exploratory experiences and make locomotion purposeful (Kuh et al., 2013, 2014). Thinking of destinations and pathways can help in designing for dispersed play. Also loose parts provide interesting design opportunities.

Free

Free play is play that is unstructured, spontaneous and self- directed. Caillois [9] referred to this type of play as 'paedia'. Its opposite 'ludus' refers to structured play activities with explicit rules. A forest has no rules, offers many opportunities for play without structuring it and allows a child to explore in a self-directed way. Children can use their imagination, using sticks as swords, rocks as goods to sell, leaves as ingredients for a magic soup, etc. The relevance of free play in terms of physical competence is less obvious than the other two qualities. Free play does offer opportunities for decision-making, problem-solving, creative thinking, and social interaction (Burdette & Whitaker, 2005). These situations can require physical competence in multiple ways: e.g. problem-solving through manipulation, decision-making through spatial awareness, social interaction through bodily expression, etc. In designing for free play, starting points might be: leaving things open for interpretation (i.e. ambiguity (W. W. Gaver et al., 2003)), making things unstable or erratic (i.e. unpredictability), providing many variables (i.e. variety (Nicholson, 1971)), allowing things to be manipulated or rearranged (i.e. manipulability), or by leaving out pre-defined goals and rules (i.e. open-endedness (de Valk, 2015)). The concept of loose parts (Daly & Beloglovsky, 2015; Maxwell et al., 2008) can provide concrete examples to learn more about some of these characteristics.

3.6 Two Playscape designs for children with cancer

We applied the design perspective of Playscapes in the context of pediatric oncology and developed two design interventions. Childhood cancer is a clear example of a disease that affects children's physical develop-

ment while at the same time requiring admission to the hospital and, when necessary, to a rehabilitation center. Childhood cancer significantly impacts the child and family's way of life. Life is no longer safe, secure and certain as routines, roles and relationships get disrupted (Woodgate, 2006). Furthermore, the course of life of survivors is often hampered (Ness & Gurney, 2007; H. Stam et al., 2005). Most of the childhood cancer cases concerns young children. For example, the most common form of childhood cancer, leukemia, peaks between the ages of two to five. Fostering the physical development of children with cancer is a significant challenge, as issues are diverse depending on the disease, treatment, and responses to these by the child and family. A common issue that is well studied is a lack of physical activity (PA). Children with cancer generally show a lower amount and intensity of PA than their healthy peers (Bekkering et al., 2013; Winter et al., 2010). Stimulating PA is important, as it can have many benefits, including improved quality of life and overall health status (Baumann et al., 2013; Götte, Kesting, et al., 2014; Götte, Taraks, et al., 2014; Huang & Ness, 2011; San Juan et al., 2011). Below we present two Playscapes interventions, Stickz and Fizzy, that were designed to stimulate physical activity in children with cancer.

Stickz

Stickz (Figure 3: left) are a collection of soft branch-shaped objects of varying size, shape, and color. They are inspired by the sticks that children find in parks and forests. The combination of organic and artificial shapes, together with a soft and glossy material finish, gives Stickz a distinct character. Further, Stickz have several ring-shaped ends that make building easier and serve as handles for dragging. The size and shape of Stickz can make these activities challenging. Children can create their own constructions or give the objects roles in their play narratives.

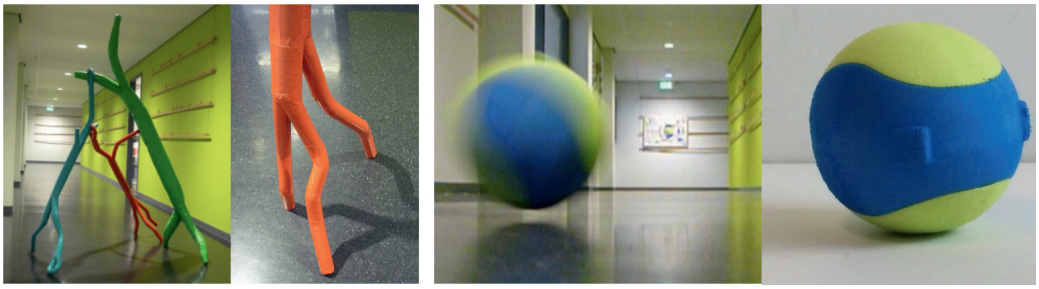


Figure 3 Stickz are soft branch-shaped objects that can be used for building constructions (left) and Fizzy is a soft robotic ball that propels itself, inviting children to follow (right)

Fizzy

Fizzy (Figure 3: right) is a soft spherical object that moves and behaves autonomously, inviting the child to follow. It functions according to six rules: (1) rolling away when being approached, (2) stop rolling when bumping into something, (3) wiggling when lying still for too long, (4) shaking when being picked up, and (5) purring when being stroked. A final rule (6) applies in the case of personal use by a single patient: Fizzy can adapt its behavior to the level of vitality of the child. When vitality is low, Fizzy moves calmly, and is content with staying in the patient room and being picked up. When vitality increases, Fizzy starts to get more active. Through these six rules, Fizzy aims to get children to move throughout the hospital.

3.7 Playscape- and exercise-based designs

Above we have presented Playscapes as a design perspective on young children's physical activity and play, together with two design interventions: Stickz and Fizzy. We now make a comparison between these interventions and two exercise-based interventions (see Table 1) in order to point out the merits of Playscapes. A first simple observation is that child-sized fitness equipment involves none of the key qualities of Playscapes. It is bodily in a limited sense, requiring one particular repetitive movement, but it does not involve play. The Fisher-Price Smart Cycle in Table 1 illustrates how exergames add an element of bodily play (e.g. cycling). However, the movements are still monotonous and repetitive.

This is in sharp contrast with the examples of Stickz and Fizzy. Stickz afford various movements of manipulation, construction, and locomotion. As they form obstacles on the ground, Stickz also afford movements of balance and flight. Following Fizzy around requires movements of locomotion, catching it requires additional movements of balance and manipulation, and using it as a ball involves projection (e.g. throwing, kicking). Besides rich bodily play, Stickz and Fizzy also involve free and dispersed play. Where the Smart Cycle is stationary, Stickz and Fizzy are mobile and allow dispersed play: Stickz are large loose parts that and can be dragged and carried around; Fizzy is more proactive in inviting the child to follow it around. Both interventions allow children to expand their play narratives beyond a dedicated area. Concerning free play, Smart Cycle requires the child to follow rules in order to attain a goal. Stickz and Fizzy involve no rules, have no inherent goal, and leave room for multiple interpretations. Stickz have various shapes that allow

multiple interpretations (ambiguity) and lets children build their own constructions (manipulability). Fizzy can be used for making up games (open-endedness) or can add a level of unpredictability to basic games such as rolling a ball toward each other.

3.8 Discussion

Stickz and Fizzy show how specific bodily movements can be achieved in young children's free play. They also enable free and dispersed play. We acknowledge that there are exercise-based interventions that involve more diversity in bodily movements or that might be organized in such a way that they are more dispersed. However, such efforts would still ignore the value of free play for young hospitalized children. Playscapes as a design perspective adds this value. However, it does come with a set of new challenges.

Challenges

Designing for a particular context comes with particular challenges. Applying Playscapes in the context of childhood cancer brought to light many aspects to take into account in designing for physical activity and play. From the literature we identified several dimensions that affect children's engagement in PA: the *disease and treatment* (e.g. intensive therapy resulting in nausea, dizziness or decreased exercise capacity (Götte, Taraks, et al., 2014; van Brussel et al., 2005)); the *child's mentality* (e.g. anxiety, depression or changed risk-benefit estimations (Götte, Kesting, et al., 2014; Götte, Taraks, et al., 2014)); the *social environment* (e.g. parents' overprotectiveness (Bekkering et al., 2013; Götte, Kesting, et al., 2014; San Juan et al., 2011)); and the *physical environment* (e.g. IV-poles or spatial restrictions (Götte, Kesting, et al., 2014; Winter et al., 2010)). Dealing with this complexity is challenging. Some of these factors might conflict with Playscapes. To give an example, bodily play might conflict with the dimension of disease and treatment, as it can be risky for children with cancer that often have increased risk of bleeding, infection or fracture (Bekkering et al., 2013; van der Sluis et al., 2002). In Stickz and Fizzy this resulted in using soft and cleanable materials.

There are two other challenges of Playscapes that are inherent to it. The first concerns *dispersed* play. Such play implies play throughout (parts of) the hospital. Intervening at this level can have implications in terms of hospital infrastructure. A simple example is the corridors of which

Table 1 A comparison between two Playscape designs (Stickz and Fizzy) and two exercise-based designs (Smart cycle and a weight training machines). Per design, bodily dispersed and free play is described using concepts introduced in the paper

	Playscapes interventions		*Exercise-based interventions*	
	Stickz 	Fizzy 	Smart Cycle 	Exercise equipment 
Possible activities	Building a hut, collecting parts, playing swords, …	Following it around, catching it, playing ball, …	Games that require cycling, steering and pushing of buttons	Particular types of exercises
Bodily play	Picking up, lifting, holding, carrying, dragging, assembling, stacking, jumping over, …	Walking, running, catching, picking up, holding, placing, throwing, rolling, …	Cycling, gripping, pushing (buttons), turning (steering wheel).	N/A
Dispersed play	Collecting and transporting (*loose parts*)	Hospital rooms as *destinations*. Hallways as *pathways*.	N/A	N/A
Free play	Multiple interpretations (*ambiguity*), making various constructions (*re-arrangability)*	Inventing games (*open-ended*), autonomous behavior of object (*unpredictability*).	N/A	N/A

two functions might conflict: pathways for children's dispersed play on the one hand, and efficient passage for medical staff with hospital beds on the other hand. The second challenge concerns φρεε πλαψ and the aim to increase PA and enhance physical competence. How can the design remain 'open' while at the same time help in achieving the desired behavioral and developmental effects? We suggest that concepts such as *variety* or *ambiguity* in combination with other design parameters (e.g. weight, size) can result in solutions that allow physical play to emerge.

Future steps

In order to further operationalize and evaluate Playscapes, we will explore its potential further in the context of pediatric oncology. For this, two main steps will be taken. First, we will implement Stickz and Fizzy in real life hospital settings. The main goals are to how children's interactions with the designs show free, dispersed and bodily play. Achieving these goals can help further develop Playscapes as a design perspective that is more evidence-based. Second, we aim to continue the dialogue with various stakeholders making use of Stickz and Fizzy as carriers for interdisciplinary discussions (Stappers, 2014). Given that the stakeholders will have experienced the designs in the first step, and by using additional video material of the interactions, we hope to identify different stakeholder perspectives on physical play. This will help us gain insight on the acceptance and embedding of interventions for free and physical play in hospital settings.

Finally, we see possibilities for the broader application of Playscapes in stimulus-deprived settings other than hospital environments. Each young child benefits from opportunities for physical play and there are many situations in which these are not at the child's disposal. We envision urban environments, schoolyards, and childcare centers as potential areas of application.

3.9 Conclusion

In this chapter we have introduced Playscapes as a design perspective on young children's physical play. We have highlighted the importance of physical activity for young children's physical development and discussed relevant dimensions that might hinder this. In young children, the emphasis of physical activity is on developing physical competence.

Playscapes accounts for (1) bodily play, involving use of the full body, (2) dispersed play, expanding play beyond a designated area, and (3) free play, allowing the child to self-direct his or her play with spontaneity and imagination. We presented two concept designs developed for children with cancer that show how the three qualities of Playscapes can be embodied. The three qualities together form a unique perspective that can help designers generate interventions that invite children to perform specific physical movements while playing freely. As such, the design perspective of Playscapes is attuned to young children's natural way of engaging in PA, thereby fostering their wellbeing and development.

Chapter 4:

Applying Playscapes in a pediatric oncology center

This chapter is based on:

Boon, B., Rozendaal, M. C., van den Heuvel-Eibrink, M. M., van der Net, J., van Grotel, M., & Stappers, P. J. (currently under 2nd round of review) Creating Space for Physical Play: Applying Playscapes in a Pediatric Oncology Center. Manuscript submitted to *International Journal of Design*

4.1 Introduction

During early childhood (2-6 years of age), children develop a set of motor skills that form the basis of their future physical activity, health, and competences (Frost et al., 2012; Maude, 2010; San Juan et al., 2011). This development is largely dependent on the interactions that children have with their physical environments. Some environments are more likely to elicit physical activity than others and some might stimulate particular kinds of gross motor movements. For example, children are more active in outdoor environments than in indoor environments (Gray et al., 2015; Raustorp et al., 2012). Not only the higher amount of available space explains this difference (Ridgers et al., 2010); it also depends on what specific opportunities for play are available. For example, the simple presence of a ball can restructure an environment into a playful setting (Csikszentmihalyi & Bennet, 1971). Studies have shown how natural features, such as grass, shrubs, trees and cliffs have a stimulating effect on children and invite particular bodily movements (Dyment & Bell, 2008; Fjørtoft, 2004).

The above examples illustrate that characteristics of products and environments affect whether and how children play and move. Furthermore, they make apparent the potential for designers to make a valuable contribution; with the right guidance, designers can create young children's environments that stimulate physical activity and, ultimately, support them to become healthy and physically competent individuals.

Designing for children's physical activity and play

We position our work in the field of interaction design research, in which several design approaches to stimulate children's physical activity and play have been proposed. Some approaches are more oriented towards games, involving structured, rule-bound and goal-directed play, while other approaches are directed at unstructured and spontaneous play.

A wide range of efforts in interaction design research is directed at the development of 'exergames', referring to games that lead to a certain level of exertion of the player (e.g. Sinclair et al., 2007). These games are often screen-based and occur in a single location (with exceptions; e.g., see Landry et al., 2013). Through the use of game elements (e.g. rules, goals, rewards) designers can create stimulating experiences that activate children. Exergames have received interest in pediatric healthcare, as they give therapists control over certain parameters, which allows them to

challenge patients at the right level of physical performance (e.g. Janssen et al., 2017). There is a growing body of literature on exergames, which offers designers concrete guidance with respect to stimulating physical activity in the form of games (Hernandez et al., 2013; Landry et al., 2013; Sinclair et al., 2007). Other work on games for physical activity and play involves the integration of interactive technologies in traditional play activities or objects. Karoff et al. (2012) integrated sensor technologies in trampolines, and emphasized how physical activity, social interaction and safety affect one another. Soute and colleagues developed the concept of 'Head Up Games', referring to traditional games enhanced with interactive technology while avoiding the use of screens (Soute et al., 2010).

Whereas existing research on games forms a valuable resource when designing for children's physical activity, games are mainly applicable to children that are able to play rule-based games or doing structured exercises. This makes exergames and other game-oriented approaches less suitable when designing for young children, in particular below the age of 6. Children of this age find it difficult or are unable to follow structured activities. Instead, they tend to be mostly active by engaging in unstructured and spontaneous play, characterized by short bouts of activity (Pellegrini & Smith, 1998). A design approach that takes such unstructured play as its starting point is developed by de Valk, Bekker and Eggen (2014, 2015, 2013), centered on the concept of 'open-ended play'. Their approach supports designers in creating interactive play objects that allow children to make their own rules and set their own goals. Although some design cases described by de Valk and colleagues focus on children's physical activity, the overall approach is oriented towards rule making in play, thereby giving little guidance with respect to stimulating physical activity. Other work on open-ended play is by Back and others (Back et al., 2018, 2016), who focus is on enhancing outdoor environments with embedded interactive technologies in order to offer rich and varying play activities to children.

In earlier work we proposed to combine the merits of exergames and open-ended play, and introduced Playscapes – a design perspective on young children's physical activity and play (Chapter 3; Boon, Rozendaal, van den Heuvel-Eibrink, van der Net, & Stappers, 2016). On the one hand, Playscapes is similar to exergames in terms of its directionality – i.e. it is an approach that pursues a behavioral outcome, namely physical

activity. On the other hand, Playscapes is similar to open-ended play in terms of the openness – i.e. it aims to create space for children's self-directed play (see Boon, Rozendaal, & Stappers, 2018).

Contribution of this paper

Playscapes argues that stimulating young children's physical activity is a matter of creating opportunities for play that is free, bodily and dispersed (see next section). Fizzy and Stickz are two playthings that were developed in parallel with Playscapes. They are *instantiations* of Playscapes, being designed specifically to bring about the three play qualities in children's interactions. In this paper we observe how children's interactions with Fizzy and Stickz actually reflect the three play qualities in real life. Based on these empirical findings we discuss the contributory role of the designs and formulate a set of *design strategies*.

Our aim in formulating design strategies is to make Playscapes better actionable. We use the term 'design strategy' to describe 'ways to achieve a goal', similar to how others use the term in interaction design research (e.g. Marshall et al., 2016; Sengers & Gaver, 2006). We consider design strategies as a generative form of *intermediate-level knowledge* (Höök & Löwgren, 2012; Löwgren, 2013). They are 'generative' in that they support designers in the creation of new designs and they are 'intermediate-level' because they are "more abstracted than particular instances, yet [do] not aspire to the generality of a theory" (Höök & Löwgren, 2012, p. 23:2). Intermediate-level knowledge can reside on different levels of abstraction. The Playscapes perspective resides at relatively high level of abstraction, offering designers a *perspective* on things and suggesting what goals are valuable to pursue. Fizzy and Stickz, are located at the most concrete level, being concrete instances designed for particular contexts (i.e. "ultimate particulars"; Stolterman, 2008). The design strategies developed in this thesis are at an abstraction level in between Playscapes and its instantiations (see Figure 4). Where Playscapes proposes generic goals for designers to pursue, the design strategies are concrete ways to achieve these goals. Compared to Fizzy and Stickz the design strategies are at a higher level of abstraction, being generic enough to be used to generate solutions in different ways and in different contexts.

In related work, comparable forms of intermediate-level knowledge have been generated. Concepts such as 'open-ended play' (de Valk et al., 2013) and 'Head Up Games' (Soute et al., 2010) are contributions on a

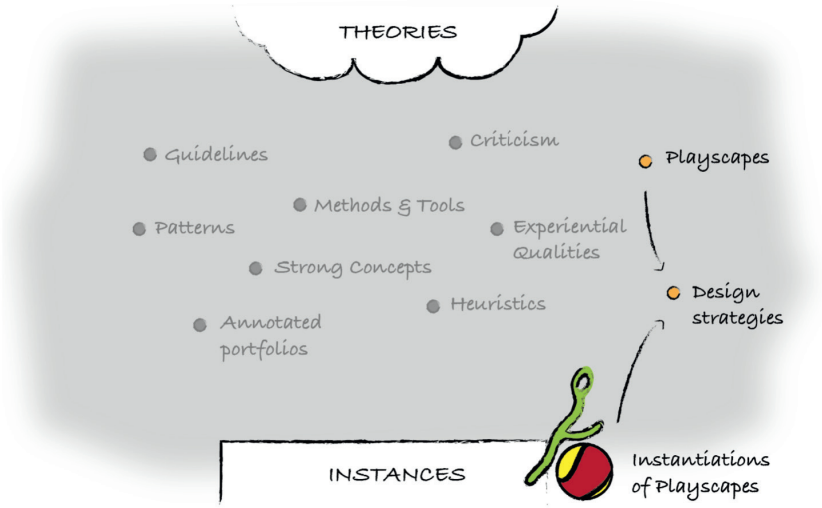


Figure 4 To make Playscapes actionable to designers, this paper develops design strategies that are concrete enough to invite design actions and generic enough to be used in different ways and in different contexts. Figure adapted from Höök & Löwgren (2012).

similar level of abstraction as Playscapes. These concepts, as in our case, form a broader framing that is supplemented with more concrete forms of intermediate-level knowledge, such as 'design tools', 'guidelines', 'implications', and 'interaction styles'. As we already pointed out above, Playscapes is different from these related works, and we expect that the design strategies that we develop here will form a novel contribution. Some overlap may occur with work on open-ended play, as one of the play qualities of Playscapes, 'free play', is closely related to this concept. We return to this point in the 'Design Strategies' section towards the end of this paper.

4.2 Playscapes as a design perspective

Young children generally engage in physical activity in the form of unstructured and spontaneous play, or what we will refer to as physical play. Playscapes is a design perspective that directs designers towards designing playthings and environments that create space for such play. It builds on the view that children perceive their environments as landscapes for play (Fjørtoft, 2004; Talbot & Frost, 1990). In a Gibsonian frame (Gibson, 1979; Heft, 1988), it views playthings and environments

as offering various possibilities for action (i.e. affordances). During play, children actualize many familiar and new affordances and through this process they develop their skills.

The underlying motivation of Playscapes is for designers to contribute to children's physical development. This development is a dynamic process in which the child's motivation, physical competence and interaction with the environment play an important role (M. E. Whitehead, 2010). Therefore, an important question is how we can optimize children's environments to facilitate or enhance interactions that stimulate children's physical activity and foster children's physical development. Playscapes draws inspiration from outdoor environments to address this question. Children tend to be most active when playing outdoors and studies indicate that environments with natural elements are particularly activating. The physical play that occurs in these environments contributes to children's physical development (Frost et al., 2012; Maude, 2010), and particular features of the physical environment can play an important role in this (Fjørtoft, 2004). By drawing on literature on outdoor play and so-called 'natural playscapes', we identified three qualities that characterize physical play in outdoor environments: free, bodily and dispersed play (Chapter 3). Playscapes proposes that stimulating young children's physical activity is a matter of creating opportunities for these play qualities to emerge in children's interactions. Below we describe these qualities in more detail.

Free play

Free play is play that is unstructured, spontaneous and self-directed. It can be distinguished from more structured forms of playing, such as games and sports. Free play is the predominant form in which young children engage in physical activity (Pellegrini & Smith, 1998). In free play, children improvise and use their imagination, resulting in a variety of play activities over time. Structure might arise temporarily, for example through rule-making or creating a leading narrative; but often new ideas or spontaneous actions will break down the structure and lead into a different play direction (see de Valk, 2015). Free play may involve the supervision or participation of parents or other caregivers, as long as they do not insist on predetermined intentions or rules (e.g. going to the beach to fly a kite). Furthermore, for safety and other reasons, caregivers will often set certain boundaries to free play (e.g. telling children not to cross the street).

How can designers create space for free play to emerge? In earlier work we suggested the following general directions based on literature (Chapter 3): leaving things open for interpretation, leaving room for multiple courses of action, making things unstable or erratic, providing many variables, allowing things to be manipulated or rearranged, and avoiding pre-defined goals and rules. The above suggestions all point towards the importance creating a level of openness for children to self-direct their actions and to attach their own meaning to the playthings and situations.

Bodily play

Bodily play is play that involves the full body, making use of the large muscles – i.e., the muscles that are required for gross motor movements. With bodily play we do not only refer to the level of exertion (i.e. energy use) of bodily movements, but also to the diversity of movements. Bodily movements may occur as a play activity in itself (e.g. kicking a ball for the sake of kicking a ball) or in the form of operations that are part of a play activity (e.g. kicking a ball in in a game of soccer). While free play refers to the general form in which physical activity takes place, bodily play refers to the particular bodily movements that are involved in these activities.

Bodily play depends on the affordances in an environment in a very direct way; for example, climbing is only possible if there is feature available that is climb-able to the child. Along these lines, designers can think of surfaces that are 'run-on-able', objects that are 'lift-able' or obstacles that are 'jump-over-able' (see Heft, 1988). These affordances affect what parts of the body are likely to be used. Furthermore, these affordances can be shaped according to the level of exertion that is desirable. For example, making 'lift-able' objects heavier or bulkier will require increased exertion of the child. Maude (2010) describes various movement categories, such as balance, locomotion, flight, manipulation, and projection, which can help as an orientation for designers to integrate a diversity of affordances for bodily play in their designs.

Dispersed play

We define dispersed play as play that spans a wide area, potentially moving beyond the boundaries of a dedicated play area or other demarcated space. This quality increases children's radius of action and makes

locomotion purposeful, allowing children to have exploratory experiences and to expand their play narratives (e.g., see Kuh et al., 2013). Dispersion might work on different levels. Play may be more locally dispersed; for example, by occurring throughout a playground or schoolyard. It might also span a wider area, covering multiple places or spaces.

Designing for dispersed play requires an understanding of interaction on a *spatial* level. It implies that there should be at least some ground surface available for play; designing for dispersed play on the couch or behind a stationary screen does not make much sense. In order to stimulate dispersion in play, children should be able to identify goals or affordances that require them to move. In earlier work (Chapter 3) we suggested 'loose parts' (Nicholson, 1971) as a concept that is relevant for this purpose. Loose parts can be moved, manipulated, controlled and changed in play (Daly & Beloglovsky, 2015), and they typically invite collecting and transporting over a wide area (Kuh et al., 2013). Another way to support dispersed play is to think of destinations to go to and pathways to follow across a landscape (e.g., see Keeler, 2008).

Having described Playscapes and the three play qualities that are central to it, we now turn to the approach and methods that we used to take steps towards making the design perspective actionable.

4.3 Approach and methods

Our approach rests on two design cases in which methods were used that were specifically tailored to observe and analyze children's interactions from a Playscapes perspective. The design cases involved two Playscape designs: Fizzy and Stickz, both developed in order to promote free, bodily and dispersed play. We implemented prototypes of these designs in a pediatric hospital, analyzing how children's interactions with them reflected the three play qualities. From the findings we abstract the contributory role of the designs. Based on these contributory roles the design strategies are articulated.

Context of the design cases

The prototypes of Fizzy and Stickz were implemented in the Princess Máxima Center for pediatric oncology (PMC) in Utrecht, the Netherlands. The PMC positions children's development at the center of their healthcare services, in which children's physical development plays an important role (Aarsen et al., 2012). Children with cancer show very

low physical activity levels, in particular during hospitalization, which potentially hampers their physical development (San Juan et al., 2011; H. Stam et al., 2005; Winter et al., 2009). Patients often have to pay long or frequent visits to the hospital. In response to children's low levels of physical activity in such settings, exercise programs are a common intervention. However, young children have difficulties to adhere to the rules and structure of such programs. Creating opportunities for more spontaneous forms of physical activity in the hospital can thus make a valuable contribution. Fizzy and Stickz were designed for this purpose.

Design concepts: Fizzy & Stickz

Fizzy (Figure 5) is a pro-active self-propelled ball designed to trigger young children in the patient room to engage with it and play in a physical way. Fizzy was designed to be 'cheeky', 'playful', and to have a 'mind of its own'. This character is reflected in the behavioral repertoire that is designed into it, which consists of: i) wiggling to draw attention, ii) rolling away when being approached, iii) shaking wildly when getting stuck (e.g. being picked up), and iv) purring when it is caressed. Fizzy's embodiment, consisting of a robust and soft outer shell, allows for rough and physical play, just like any other ordinary ball.

Stickz (Figure 6) are a collection of large and soft, yet sturdy, branch-shaped objects, inspired by the sticks that children may find in a park or forest. Stickz were designed to enable children to engage in imaginative and constructive play, while inviting the use of the full body. Stickz achieve this through their ambiguous shape, the possibility to use them for construction purposes, and their sheer size and weight.

Fizzy aims to achieve free play by having no prescribed use designed into it. It is an interactive and, to some extent, unpredictable agent with which children can improvise. Furthermore, its purpose and behavior can be interpreted in multiple ways. Stickz are designed for free play by allowing for multiple interpretations of their shape, and the making of various constructions. Bodily play with Fizzy is expected to occur mainly in following behavior (i.e. locomotion) and playing with Fizzy as a ball, involving throwing, kicking and rolling. We expect Stickz to invite bodily play by their size and weight, requiring full body movements in order to play. For dispersed play, Fizzy rolls away from the child, hoping to invite the child to follow and play throughout the room and beyond. Stickz is intended to stimulate dispersed play by forming a set of loose parts that invite children to transport and collect them over a wide area.

Figure 5 Fizzy stimulates physical play through its behavioral repertoire (e.g. rolling away or shaking) and by being a simple ball

Figure 6 Stickz stimulate physical play by inviting children to drag them around, make constructions, and use their imagination

Figure 7 During the fieldwork, Fizzy was controlled with a joystick and buttons that were concealed in the hands and by standing with the arms crossed or behind the back.

Prototypes & setting

Fizzy was tested in single and double bed patient rooms in an inpatient ward. Using a Wizard of Oz approach, the researcher controlled Fizzy's behaviour without participants being aware of it (see Figure 7). The researcher in the field acted according to Fizzy's 'cheeky' character and followed a set of key behaviors (as described in the previous subsection). With this behavioral repertoire the researcher improvised according to the situation and in some cases decided to act divergently (e.g. rolling towards the child instead of only away). This improvisation allowed us to explore a wide range of ways in which to stimulate physical play. The prototype consisted of a Sphero 2.0, a shell with an outer diameter of approximately 14 cm, and an Arduino-based Bluetooth controller that could connect to the Sphero. The shell is made out of soft polyethylene foam covered with sturdy artificial leather. These materials were chosen for safety and hygiene reasons, but also made the prototype robust enough to be throw-able, kick-able, etc. The Bluetooth controller included a joystick for steering Fizzy and a three-button controller for purring, wiggling, and shaking behaviors.

Stickz were tested in a semi-public waiting area of an outpatient department of the PMC. More than 20 Stickz were present, ranging roughly from 50 to 160 cm in length, varying in form while adhering to a single form language. The prototypes consisted of welded aluminum pipe frames covered in insulation foam, and a finish of colored duct tape. As in the case of Fizzy, this finishing afforded rough play, as well as meeting safety and hygiene requirements for the study in the hospital.

Participants and recruitment

All participating families received an information letter and informed consent form and were approached with the help from hospital staff. The study was designed together with oncologists, research nurses and legal staff to ensure the participants' safety and privacy. The Medical Research Ethics Committee of the University Medical Center Utrecht reviewed and approved the research proposal (METC protocol number 16-658/C.)

The majority of children that participated in the fieldwork suffered from childhood cancer, most of which were non-CNS solid tumors (i.e. tumors not affecting the central nervous system) or leukemia. With Fizzy we visited 8 inpatients between the age of 3 and 6 years old, including

5 boys and 3 girls. With Stickz we included 21 children (12 boys and 9 girls), including inpatients, outpatients and 4 siblings between the age of 2 and 8 years old. Most of the participants with Fizzy were connected to an IV pole (7 out of 8), whereas with Stickz this was more variable (7 out of 21 were conntected to an IV pole at some point of their visit). Although the fieldwork with Stickz was performed at a later stage than the sessions with Fizzy, 3 patients participated in both studies. Two patients were excluded for parts of our analysis. One was excluded from the dispersed and bodily play analysis, as he was not mobile at the time of the visit. Another child did not engage in any play at all, and is therefore only described as part of our general findings, but excluded from the free, bodily, and dispersed play analysis.

Data collection, processing and coding

Data was collected using GoPro cameras and audio recorders. The GoPro cameras offered a wide angle, which was useful in capturing the interactions in small patient room settings. Furthermore, their size minimized obtrusion. High quality audio recorders were used to capture the verbal expressions of children and others during play. Audio and video data were combined and synchronized into single video files and anonymized using a 'find edges' filter in Adobe Premiere (see Figure 8).

The video material was coded and analyzed using Atlas.ti (see 8). The coding was performed mainly by the lead researcher, and consisted of four steps. The first step laid the basis for the other steps: the researcher made 'quotations' that indicate distinct activities with a particular timeframe. The end of one activity indicates the start of another. The start and end of a quotation was determined by a shift in the goal of the child (e.g. from trying to catch Fizzy to taking a sip of water). All activities of children were coded, including non-play activities such as eating or talking with parents. A research assistant independently made quotations in selected parts of the data, in order to check for consistency with the lead researcher (Robson, 2002, p. 340). The time frames of the quotations were largely aligned, with only minor inconsistencies.

The second step consisted of coding the quotations with *activity codes* (see blue codes in Figure 8), which indicate the type of activity that children were engaged in within that timeframe. We used 'open coding' (Robson, 2002, p. 194), yielding initial categories of children's activities to be turned in final categories later. We coded one activity code per

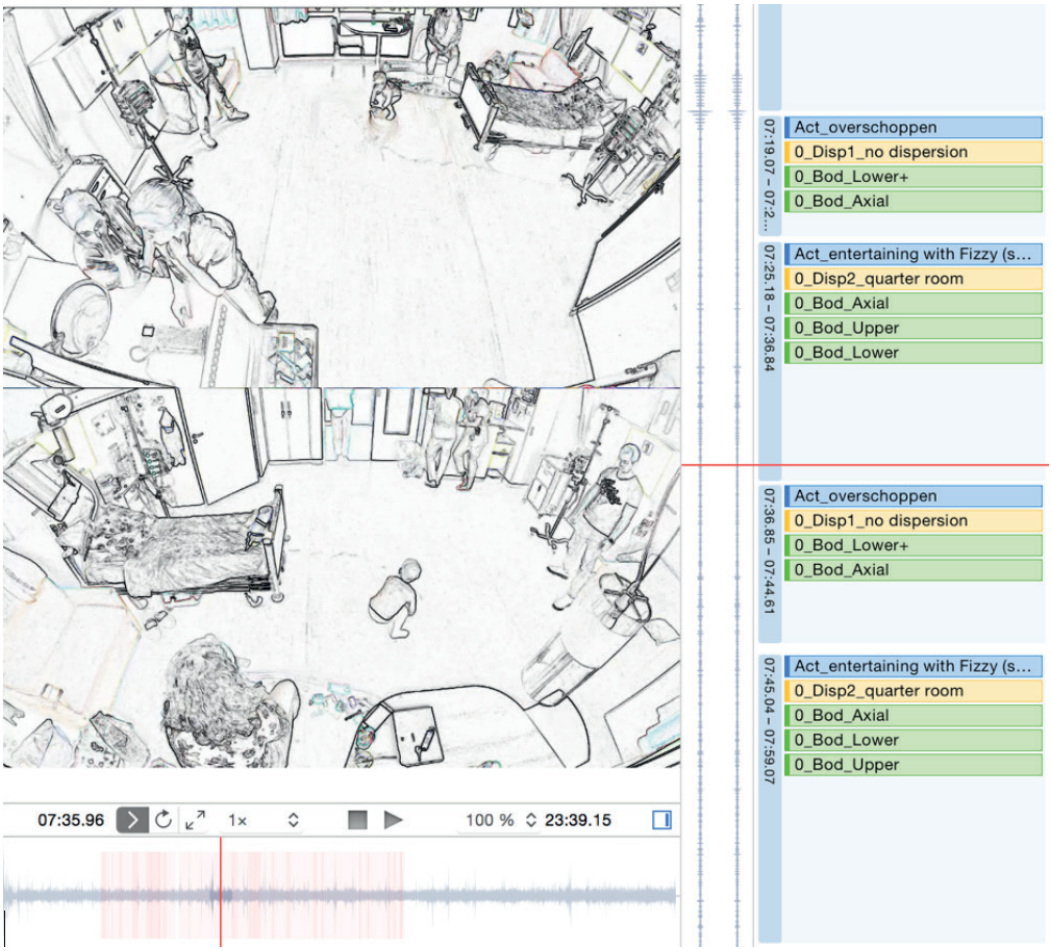


Figure 8 Video data of GoPro cameras was combined and anonymized. The resulting material was analyzed and coded in Atlas.ti, using 'quotations' (horizontal blue bars with time indication) to indicate an activity and coding these with activity codes (in blue), dispersion codes (in yellow) and bodily movement codes (in green).

quotation. Atlas.ti made navigating between ongoing and previous coding relatively easy, which allowed us to adjust codes for consistency. The resulting activity codes were then grouped into larger categories, called *play activities*, while also identifying non-play activities to be left out for subsequent steps. The identified play activities were then grouped again into *play types*. The lead researcher performed the grouping by using printouts of the quotations. Through peer support (Robson, 2002, pp. 174–175) of two other researchers, final decisions were made about

categories and labels. We analyzed free play by looking at the diversity of play types and their relative occurrence.

The third step was coding for bodily play (see green codes in Figure 8), using a coding scheme that indicates which parts of the body are being used, with a basic indication of the level of exertion (see Figure 9). *Axial* (A) refers to movements or postures that require the use of 'axial' muscles that keep the body upright (in particular trunk and neck muscles). Examples are sitting, standing, or any kind of locomotion. We use *upper* (U) and *lower* (L) to refer to movements that make use of the upper or lower extremities (i.e. arms and legs respectively). Examples are holding or carrying a light or small object within the body's support surface (U), walking (L), or crawling (U, L). We use the *plus* symbol (U+ or L+) to indicate movements with a relatively high exertion. Examples are carrying large or heavy objects outside the body's support surface or throwing an object (U+), and jumping, running or kicking an object (L+). A quotation may be coded with a variety of these codes (see Figure 8). Per play activity, each bodily movement was scored, leading up to a percentage that indicates the average occurrence of a bodily movement per play activity in a (given) time frame. For example, if 'Activity A' occurred five times, and in three out of these five occurrences children used their arms, the U score would be 3/5=60%. A human movement scientist was involved in creating the coding scheme, as well as in the early stages of coding in order to ensure accuracy and thereby reliability.

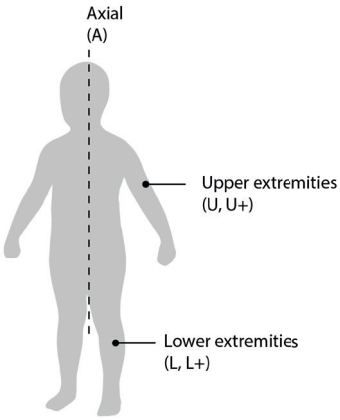


Figure 9 Bodily play was coded according to the use of axial muscles (A), arm muscles (U, U+) or leg muscles (L, L+)

The fourth step consisted of coding for dispersed play (see yellow codes in Figure 8), for which we used a coding scheme that reflects the floor area of the room used during a play activity, and whether the activity moved outside of the room (see Figure 10). Activities were coded either as occurring in one place (D0), occupying up to a quarter of the room (D1), half of the room (D2), or the entire room (D3). Each play activity was given a dispersion score between 0 and 3, which was the average dispersion of the occurrences of that play activity in a (given) time frame. For example, if 'Activity B' occurred three times, of which one occupied quarter of the room (D1), and two occupied the entire room (D3), the dispersion score for this play activity was (1+3+3)/3 = 2,33. Activities that moved beyond the room (e.g. into the hallway) were coded and analyzed separately, using the code DX.

Deriving design strategies

Based on the findings with Fizzy and Stickz for each of the play qualities, we discussed the contributory roles that the prototypes played. To do this accurately, parts of the video data were revisited. The empirical findings with Fizzy and Stickz, and our interim discussions of the contributory roles that these designs played, formed the basis of the design strategies that we articulate in this paper.

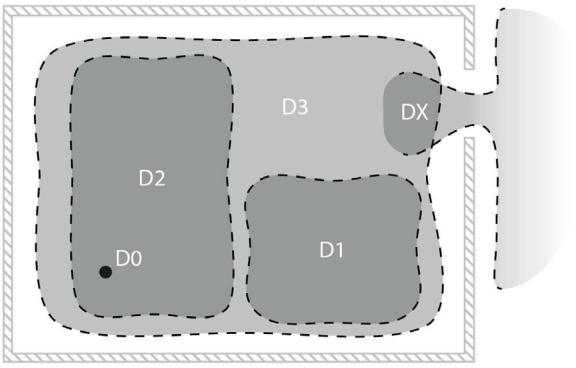


Figure 10 Dispersed play was scored according to the floor area covered in play in a particular room, ranging from no dispersion to dispersion throughout the room (D0, D1, D2 and D3 respectively) and dispersion beyond the room (DX)

4.4 Results and discussion

This section is structured as follows: First general findings are shared, followed by our observations of free, bodily and dispersed play. Each of the subsections presents the results of Fizzy and Stickz respectively, followed by an interim discussion of the contributory role of the designs in the interactions.

General findings

Interactions with Fizzy gave rise to physical activity in almost a continuous stream of alternating play activities. Whereas we expected this alternation, we did not anticipate continuous engagement. We have impression that Fizzy particularly activated younger children; older patients (6 y/o) were curious, but not always challenged. This can be explained by the relatively slow acceleration of Fizzy, meaning it could not always get away from older children. In two cases, children responded with some anxiety to Fizzy's presence. In the first, the father managed to comfort his son, making his son more confident to interact and play with Fizzy, whereas in the other case a boy kept holding back, observing how another participant played for almost a full hour.

The interactions with Stickz were characterized by short bouts of physical activity and play, alternated with more passive activities. The extent to which children engaged with Stickz in an active way differed strongly per child. Some children expressed enthusiasm and started playing with Stickz right away, whereas others scarcely engaged with Stickz although entering the room multiple times. There were short and long periods in which children did not play at all; children were often occupied talking to parents or caregivers, or engaged in other activities like eating and drinking. Younger children were the least engaged with Stickz; for them, Stickz were quite challenging to handle due to their size and instability when forming a structure. We also observed that patients tended to withdraw from play or hold back when another child (e.g. patient or sibling) would engage with Stickz as well.

Interactions with Fizzy resulted in a more continuous stream of play activities than interactions with Stickz; in the latter case, play activities alternated more with other activities. An explanation for this is that the sessions with Fizzy were planned, with Fizzy as the main reason for the visit. Contrastingly, Stickz were located in an open and shared space and, in many cases, they were not the primary reason for participants to be present. The waiting area was often an in between stop for families,

when moving from one activity (e.g. the taking of blood samples) to another (e.g. a consult with the oncologist).

Free play

For analyzing free play we first clustered activity codes into play activities and subsequently play types. For the interactions with Fizzy, 51 different activity codes were generated. After excluding non-play codes, the remaining activity codes clustered into 28 play activities. Through another step of clustering 11 different play types were identified (Figure 11, top). For an overview and more detailed description of the play activities and play types with Fizzy, see Appendix I. Total playtime with Fizzy was 3 hours and 2 minutes. All participating children engaged in creature play (7/7), ball play (7/7) and exploration (7/7), and the majority of children in games (4/7), transitory play (6/7), sensory play (6/7), functional play (4/7), and manipulative play (4/7). Fewer children engaged in dramatic play (3/7), sharing (2/7), and rough-and-tumble (1/7). For the interactions with Stickz, 50 activity codes were generated. After excluding non-play codes, the remaining activity codes were clustered into 17 play activities. Through another step of clustering, 6 different play types were identified (see Figure 11, bottom). For an overview and more detailed description of the play activities and play types with Stickz, see Appendix II. Total playtime with Stickz was 3 hours and 32 minutes. The majority of participating children engaged in constructive play (18/21), landscape play (12/21) and loose play (12/21). Fewer children engaged in dramatic play (7/21), rough-and-tumble (2/21) and sharing (4/21). In the results below, we only describe play types that occurred with a total playtime of 15 minutes or more.

Interactions with Fizzy were predominantly in the form of creature play and ball play. These two play types occurred in various forms, such as following, luring, and caressing (creature play), and throwing, kicking and rolling (ball play). Exploration occurred mostly during the first encounter with Fizzy; in these preliminary stages, children seemed to be still making sense of what to do with Fizzy and to see what were its possibilities. Games consisted of traditional games, such as tag and hide and seek, newly made up games, and games that emerged from other activities. In these games, Fizzy was either used as tool (e.g. object to hide) or viewed as participating player (e.g. tagger or hider). Whereas generally children tended to alternate quickly between activities (e.g. first kicking Fizzy around and then luring it), games often lasted longer.

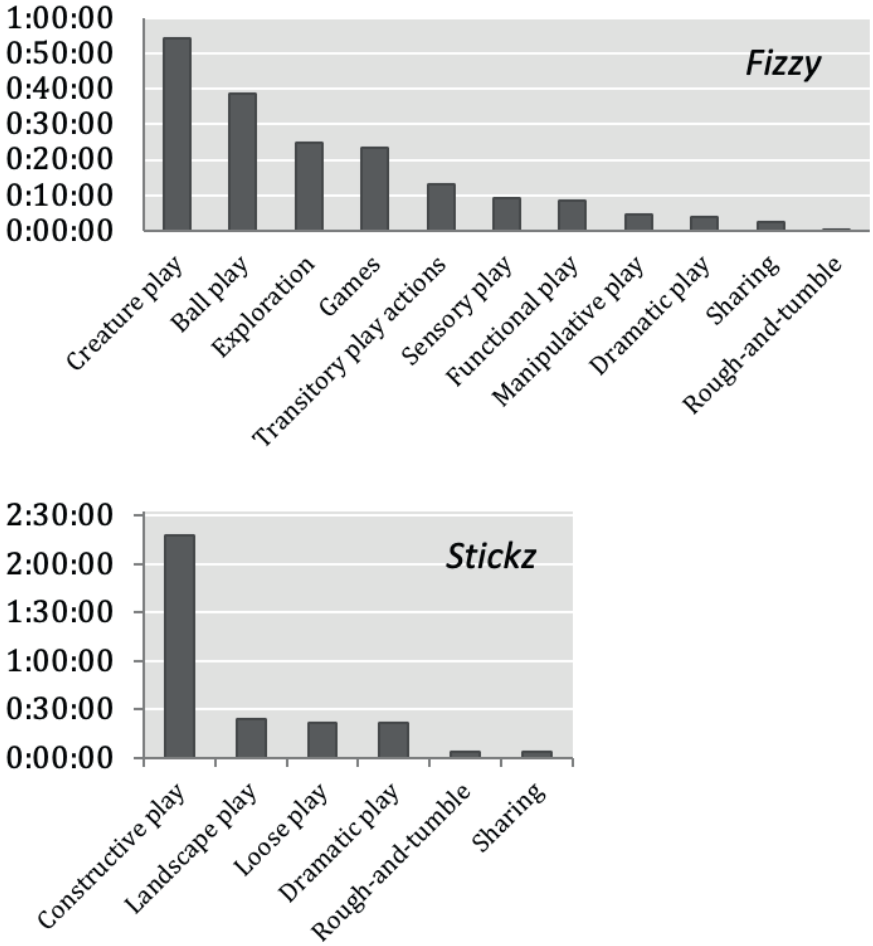


Figure 11 Dominant play types with Fizzy (top) were creature play and ball play. With Stickz (bottom) children mainly engaged in constructive play.

Interactions with Stickz occurred largely in the form of constructive play, in which Stickz were used as building elements. Constructive play consisted of constructing, deconstructing, maintaining, manipulating, and stacking. Most play time went into constructing, which was either done for the sake of constructing or with a particular goal in mind (e.g. building a hut or an apple tree). Constructing was a relatively long-term activity, whereas deconstructing and manipulating were often short-lived. Other play activities occurred relatively less. Landscape play consisted of playing in and around piles or structures of Stickz. Loose play largely consisted collecting Stickz and sorting them. Dramatic play consisted

of using Stickz as pretend objects, such as a walking stick, giant spider, weapon or vacuum cleaner.

Fizzy and Stickz enabled children to play freely in very different ways. Fizzy's ability to play different roles resulted in a wide variety of play activities to emerge. Two particular roles – that of a ball and a creature – opened up two very distinct play directions. Fizzy's embodiment as a ball (including its size, robustness, softness, and spherical shape) contributed significantly to various forms of ball play, including rolling, throwing, and kicking. In creature play, Fizzy's pro-active mobility led to various play activities, such as following it, catching it, playing hide and seek; it also allowed Fizzy to escape or 'break out' of ongoing activities, creating the possibility for a new activity to start. Furthermore, Fizzy's behavior was interpreted in different ways; this ambiguity led to variety in responses, which in turn led the play narratives into different directions. In the interactions with Stickz, the predominant type of play was constructive play; this inherently open activity allowed children to use their creativity to build what they wanted (e.g. apple tree or hut). On a more general level, Stickz served as loose elements that were rearrange-able, allowing children to collect, sort and construct. Also the quantity of Stickz available to the child formed a condition for these various play activities. The shapes of Stickz allowed for multiple interpretations, leading to them being used as pretend objects (e.g. a walking stick, weapon, or giant spider). Finally, Stickz also played various functional roles beyond that of a building element, such as a stick for poking another person, or for hitting a structure of other Stickz.

Bodily play

For analyzing bodily play we focused on what large muscles were used in play activities. With Fizzy (see Figure 12), most play activities involved the use the axial muscles (i.e. children's trunk and neck), meaning most children maintained an active posture. Also the use of the upper extremities was common, except in the case of ball play in the form of kicking. The arms were mainly used for picking up, holding, catching and projecting Fizzy (i.e. rolling or throwing). The use of the lower extremities varied significantly between activities. The activities of balancing and caring did not involve the use of legs at all, and also experimenting, fiddling, manipulating, rolling, sensing, sharing and throwing involved little use of the legs. Activities of collecting, following, traditional games and kicking did involve the lower extremities to a large extent, in par-

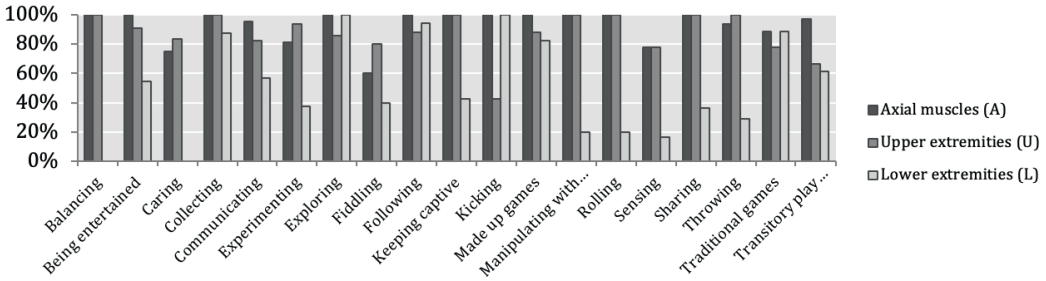


Figure 12 With Fizzy children used their axial muscles (A) and upper extremities (U) frequently, while using their lower extremities (L) more variably.

ticular in the form of locomotion and kicking. High exertion use of the upper and lower extremities mainly occurred in the form of projecting Fizzy (i.e. kicking and throwing), and occasionally running.
When playing with Stickz, children were almost constantly using their full body. All play activities involved axial, upper and lower muscles in at least 80% of the occurrences (see Figure 13). In particular 'playing in and around' and 'transporting' stand out in this respect. The first mainly involved walking around and crawling underneath built structures; the second involved the dragging or carrying of Stickz. Axial muscles were mainly used in a standing or walking position, and sometimes while sitting or crawling underneath a structure. The upper extremities were used mostly for picking up, holding, carrying, and placing Stickz, but also in the form of throwing, swinging and crawling. Lower extremities were mainly used in the form of locomotion, which typically involved walking and sometimes crawling. High exertion use of the upper extremities mainly occurred in the form of playfighting (i.e. using a large Stick to poke and swing with); high exertion use of the lower extremities occurred sporadically in the form of running.

Fizzy and Stickz stimulated bodily play in the hospital in very different ways. Fizzy was a single object that invited bodily play through its role as a ball and a creature, and through its interactivity in general. These characteristics invited the use of upper extremities, as reflected in the majority of activities (e.g. in the form of picking up, holding, carrying, throwing, rolling, crawling, etc.). The use of the lower extremities (e.g. crawling, walking, kicking) was more variable, possibly due the fact that several activities were enjoyable without having to move. Stickz formed a collection of loose elements, which in many cases were used for construction. Almost every play activity involved the use of axial muscles

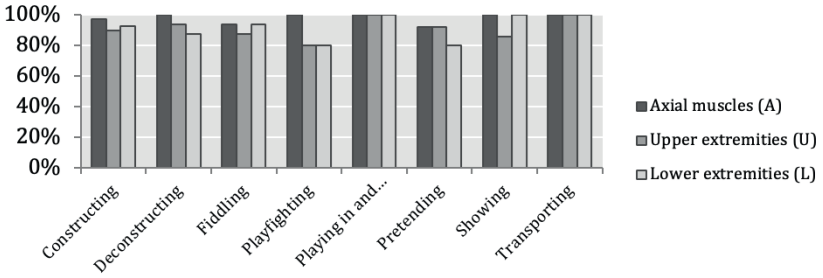


Figure 13 In the play activities with Stickz, children frequently used their full body; axial muscles (A) and upper- and lower extremities (U, L) were all used in at least 80% of the occurrences of each activity.

and the upper and lower extremities. Carrying Stickz around required the use of the full body and was involved in most activities. Another way in which children used their full body, was by playing in and around structures of Stickz. Passive play did not occur, which can be explained by the fact that Stickz are static, bulky, and not engaging when interacted with in a sitting or lying position. In both design cases, high exertion in of the upper and lower extremities occurred relatively little. Both the space available, as well as the vitality of the participants, may have played a role in this.

Dispersed play

For analyzing dispersed play, we used a pre-determined coding scheme, focusing on how dispersed play activities were, ranging from no dispersion (D0) to dispersion throughout the entire room (D3). In our analysis we only included play activities that occurred five times or more. In general, children occupied a large area of the patient room in their play with Fizzy. In Figure 14 we see that activities that tended to be most dispersed were traditional games (i.e. playing tag or hide and seek), exploration (i.e. interactions during first encounter with Fizzy) and following (i.e. seeing where Fizzy would go or chasing and catching Fizzy). In some cases, Fizzy invited the child to leave the room. One boy returned to the hallway several times, throwing Fizzy into the hallway to see if it would return to him when calling it. In most cases, however, Fizzy rolled out of the room itself; this created some excitement, and was often followed by the child bringing Fizzy back to the room. In one case, a child explicitly shut the door so Fizzy couldn't escape anymore. Another reason for leaving the room was the wish to go to a shared area called 'the living room'.

Dispersed play with Stickz occurred mainly in the form of transporting and pretending (see Figure 15). Transporting often happened in short bouts, followed by longer periods of play in the form of constructing. Pretending was dispersed in particular in cases where Stickz were used as play guns. There were several instances in which play moved beyond the waiting area. For example, two children, who were building a tent for a particular nurse, came to the idea to use bed sheets to cover the construction. Together with the nurse in question, the children left the play area to collect these additional materials. In two other instances, Stickz were brought along into the hallway of the clinic and returned later on. Other reasons to leave the waiting area were to collect parents, for example, in order to show what had been built.

Stickz and Fizzy invited dispersed play in distinct ways. Fizzy proactively invited children to follow throughout the room through its rolling-away behavior. Its maneuverability and small size allowed it cover almost the entire floor, resulting in play throughout the entire patient room. Also traditional games emerged, such as tag and hide and seek, in which the entire room was used. The ability of the researcher to allow Fizzy to play an intelligent role in these games was crucial for this purpose. Stickz, on the other hand, had a more passive way of inviting children to move around, and this usually occurred in a relatively short time frame. In the activity of constructing, children tended to first collect Stickz, which often occupied the entire room, and then started constructing, which generally occupied a quarter of the room. Stickz afforded such play by being transportable and connectable. The dispersion of activities depended on the position of the Stickz in relation to the place where the family was seated at that moment. In pretend play, Stickz were sometimes used in a way that involved dispersion; their ability to represent weapons or a vacuum cleaner, invited play narratives that were dispersed. The ability for Stickz to be 'brought along' resulted in some dispersed play beyond the waiting area.

4.5 Design strategies

Our findings and interim discussions show that Fizzy and Stickz contribute to free, bodily, and dispersed play in distinct ways. In Table 2 we draw from these particular design cases, and articulate design strategies for each of the three play qualities. To illustrate the design strategies, they are accompanied with examples of observations in the field.
The strategies in Table 2 are derived from the observed interactions

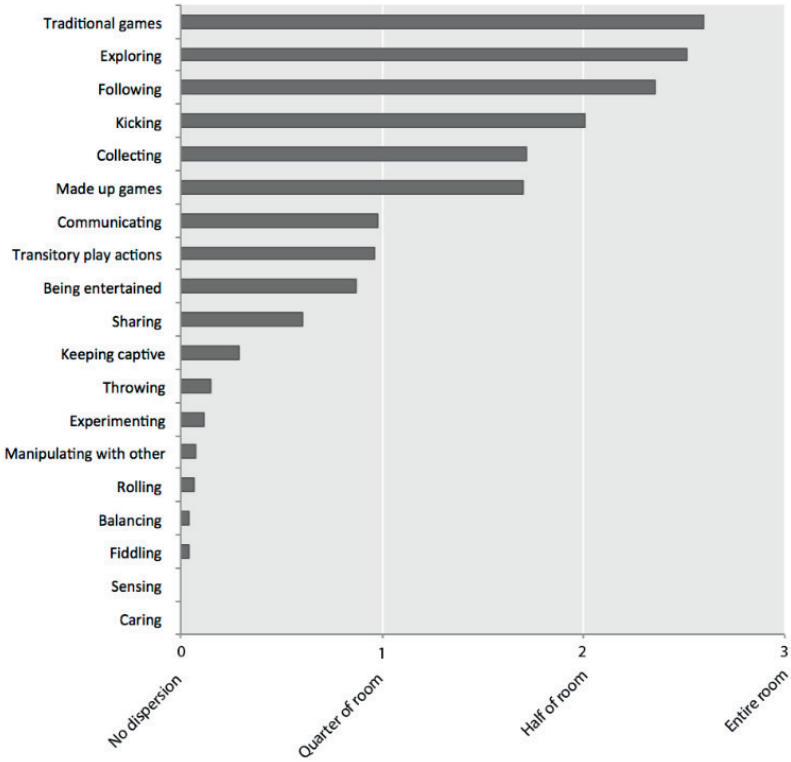


Figure 14 Dispersed play with Fizzy occurred mainly in the form of traditional games, exploring and following Fizzy around. In these activities, children generally occupied more than half of the patient room.

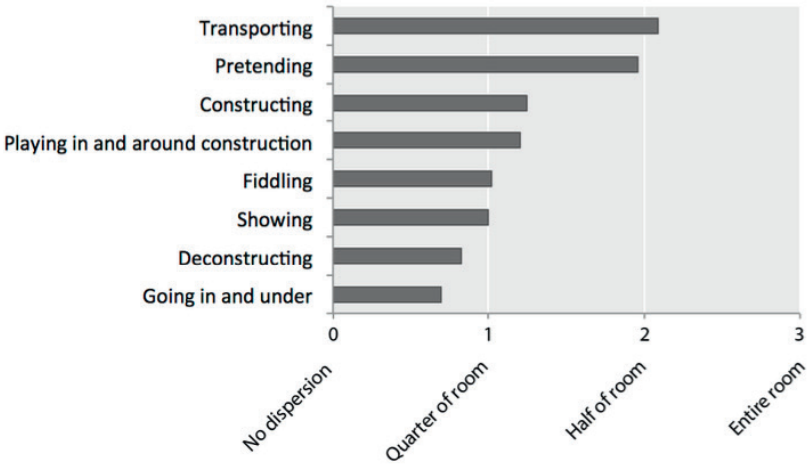


Figure 15 Dispersed play with Stickz occurred mainly in the form of transporting and pretending (i.e. using Stickz as pretend objects). In these activities, children generally occupied around half of the waiting area.

with Fizzy & Stickz, and abstracted to the extent that they are applicable in different contexts. They can help designers in creating design solutions for young children's physical activity and play by offering them particular ways to achieve bodily, dispersed or free play. The design strategies should not be seen as stand-alone solutions but rather as parts of an integral effort to design stimulating playthings or environments. A Playscape design, as illustrated by Fizzy and Stickz, is likely to require multiple design strategies in order to elicit each of the three play qualities.

We suggest that Playscapes and the strategies formulated in this paper provide a valuable contribution to the field of designing for children's physical activity and play. The strategies are attuned to young children's natural way of engaging in physical activity in an unstructured and spontaneous way. In this way, this paper offers concrete alternatives to the strategies and tools provided in scholarly work on exergames, which is more oriented towards children that are capable of playing according to a set of rules. As anticipated, the design strategies for free play show some overlap with work on open-ended play. For example, the quality of adaptability (Back et al., 2016) plays an important role in rearranging of and constructing with Stickz, perhaps best captured in the strategy 'Building elements'. The strategies of 'Ambiguous shape' and 'Ambiguous behavior' can be seen as concrete means to "embrace a level of ambiguity" when designing for open-ended play (de Valk et al., 2014, p. 127).

4.6 General discussion

In this paper, our aim was to make Playscapes better actionable to designers. We first showed how interactions reflected the play qualities and identified various roles that the prototypes played in contributing to these qualities. Fizzy stimulated free play by having a dual role – that of a ball and a creature – and by showing behavior that is multi-interpretable and unpredictable. Stickz facilitated free play by allowing children to creatively build constructions and by having a multi-interpretable shape. Bodily play with Fizzy occurred mainly in the form of ball play and following behavior, while with Stickz used their full body while constructing or maneuvering through built structures and loose lying elements. Dispersed play with Fizzy occurred mainly in the form of following behavior and traditional games, while with Stickz it took place in the form transportation and pretend play. These findings illustrate different ways in which playthings can stimulate play that is free, bodily and dispersed.

Table 2 Design strategies for Playscapes and examples from the fieldwork, categorized according to the qualities of free, bodily and dispersed play.

	Design strategies	*Examples from fieldwork*
Free play	***Building elements***: Offer a collection of loose elements that are stack-able and / or (dis)connect-able, allowing children to use their creativity in constructive play.	Children that were building with Stickz were making different structures, described, for example, as art, an apple tree, a tent, or a hut.
	Ambiguous shape: Make the shape of a plaything multi-interpretable in terms of purpose or function, allowing children to appropriate them in pretend play.	Children used Stickz as pretend objects, using them as vacuum cleaner, giant spider, water gun or walking stick.
	Hybrid character: Embed intelligence / agency into a familiar plaything, opening up two play directions between which children can alternate.	Fizzy was interpreted as a ball and as a creature, which resulted in two entirely different sets of play activities.
	Ambiguous behavior: When developing a smart plaything, program its behavior to be multi-interpretable, allowing children to project different intentions or expressions onto it.	Fizzy's behaviors were interpreted in different ways. For example, rolling away was interpreted as wanting to be followed or trying to escape.
	Pro-active and unpredictable behavior: When designing a smart plaything, make it pro-active and unpredictable, thereby eliciting children's improvisation.	With Fizzy, children often had to improvise, for example, when it suddenly moved towards them or away from them.
Bodily play	***Project-able embodiment***: Make it possible for a child to throw, kick, or roll the plaything, through its shape, robustness and soft embodiment.	Fizzy's spherical shape and robust and soft embodiment invited ball play; it was rolled, thrown and kicked.
	Large and heavy elements: Offer a collection of loose elements that are relatively large and / or heavy, so that play activities (e.g. collecting, constructing, play fighting) require use of the full body.	Most Stickz were large and relatively heavy, requiring children to use their full body to transport them and use them for building constructions.
	Large obstacles: Offer large (stable) elements that can be stepped on, off or over, jumped on, off or over, crawled under, balanced on, walked around, etc.	As Stickz were lying around and were turned into constructions, this formed a landscape full of obstacles to move through (in, under, around, over).
	Follow-able agent: Make your plaything ambulatory and move away from children, thereby inviting different forms of locomotion (also see Dispersed).	Fizzy rolled away when it was approached, inviting children to crawl, shuffle, walk or run after it.
Dispersed play	***Carry-able loose elements***: Offer a significant number of loose elements that can be transported from one place to another.	With Fizzy, children started playing hide and seek and tag, which occupied the entire patient room.
	Dispersed traditional games: Consider how a plaything can play a role in traditional games that are dispersed.	Stickz were spread across the floor through play and gathered again when children started building something.
	Dispersed pretend play: Consider how playthings as pretend objects can be led to dispersed play narratives.	Stickz were used as play guns, which involved running around the room and hiding behind different objects.
	Follow-able agent: Make your plaything ambulatory and able to find its way, inviting children to follow it throughout or beyond a particular room (also see Bodily).	Fizzy invited children to follow it throughout the patient room and sometimes into the hallway.

By articulating design strategies based on these findings (see Section 4.5), we give designers concrete directions for achieving the three play qualities.

Besides the concrete findings and strategies that we generated in this study, we also advanced our general understanding of what it means to take a Playscapes perspective. First, we experienced that the perspective is applicable in *multi-purpose environments*. Our design cases were situated in patient rooms and a waiting area in the hospital. We found that such environments can serve as 'landscapes for play' while fulfilling other purposes as well, such as resting, receiving medical care, or having a meal. Second, taking a Playscapes perspective requires taking into account the *social dynamics* of play; the different actors around the child can have important roles in children's physical activity and play. In particular parents were continuously present during the observations and were involved in various ways. Some played along, whereas others instructed, educated or corrected the child. In the case of Fizzy, parents often actively interpreted and narrated Fizzy's behavior, thereby directing the child's play (see Rozendaal et al., 2019 for a more elaborate account of the social dynamics in interactions with Fizzy). Third, a 'landscape for play' consists of more than just the elements introduced by the designer; there are various *situational affordances* that may play an important role as well. In our observations, the physical setting often enriched children's play. Examples are using bed sheets to make a tent with Stickz, or placing Fizzy on the bed while it is shaking, making it bounce. This 'meshing' of affordances (Glenberg & Kaschak, 2002) offers a unique contribution to children's play and it is, we expect, possible to anticipate and integrate in the design process to some extent.

There were several constraints to our research approach in terms of scope and validity. The first is that our findings and design strategies derive from two particular design cases in two specific environments. Some of our findings might have depended on particular characteristics of the designs or environments that are not brought to the surface in this paper. It also means that the overview of strategies in Table 2 is not exhaustive. For this we need a broader range of design cases to draw from. Including new cases will allow us to formulate additional strategies, to eventually reach a point of saturation. In our ongoing work with master students we see several strategies reappearing already, such as embedding moving-away behavior, multi-interpretable shapes, or having loose parts that get scattered.

Second, we analyzed relatively short-term interactions between families and playthings. This allowed us to get a rich understanding of how in-the-moment dynamics contributed to free, bodily and dispersed play. Such an understanding is key for getting a grasp on young children's physical activity and play, which is often very situated (de Valk, 2015). However, following our goal to stimulate physical activity, the long-term implications of Playscape designs are of interest as well. Future work should inquire into these long-term interactions of families with Stickz, Fizzy or other designs. It would allow us see whether the designs engage and activate the child in the long run. It would also bring a better understanding of how playthings are appropriated in the everyday lives of families and others, such as hospital staff. Furthermore, long-term studies may allow us to inquire into the developmental benefits of Playscape designs – does the fitness of children improve and do the designs offer affordances for children to develop their motor skills over longer periods of time?

A third limitation concerns our data analysis. We took several measures to increase the validity of our findings (see the 'Approach and methods' section). We could not make use of a previously validated approach, because our data analysis had to be specifically tailored to our research interests concerning Playscapes. This means that we cannot be entirely sure whether doing the same analysis over again will result in the exact same findings of our current study, in particular with respect to identifying and labeling play activities. However, with the measures we did take, we are confident that the findings of our inquiry consist of accurate descriptions that they form a reliable basis for the strategies that we formulated.

A final constraint concerns our WoZ set-up, which was key to our study with Fizzy. It took human intelligence to allow for some of the interactions to emerge. Unanticipated interactions could be responded to and new ways of triggering the child could be explored. Despite these benefits, it was quite demanding for the design researcher in the field. We found it to be a balancing act between acting according to the character of Fizzy, keeping the goal of physical activity in mind, while also improvising and responding to the emerging behavior of the child and family. We are aware that, as a result of our approach, some of our findings with Fizzy represent interactions not likely to be technically realizable in the near future. Therefore, we made sure that the strategies in Table 1 do not rely on an artificial intelligence that is as sophisticated as played out by the researcher.

Based on some of the above remarks, we have several recommendations for future research. First, it is important to better understand parents' mediating roles in children's physical activity and play, and how we can anticipate these roles better in the design process. Second, future research should inquire into the long-term effects of Playscape designs. Valuable insights can be gained with respect to physical activity levels, as well as how play dynamics change. We expect that the open-ended nature of Playscape designs allows children to continuously appropriate them in new ways, thus remaining engaging and activating for children over longer periods of times.

A final recommendation for future work is to further demarcate and explicate the solution space of Playscapes. We envision that formulating categories of ways to achieve the play qualities can be a way forward to guide this process. Based on the basic functionality that playthings can offer to children, we consider distinguishing between *landscape*, *loose*, and *animate* elements. To illustrate, Stickz provide structures to crawl under and obstacles to step or jump over (landscape elements), while also being transportable and used as building elements (loose elements). Fizzy is a ball that can be thrown, rolled and kicked (loose element), while also being a pro-active and lively agent that can followed and cared for (animate element). Together with the qualities of free, bodily and dispersed play, we expect that these elements can demarcate a clear solution space. In design practice, this solution space may support designers in coming up with their own design solutions and strategies, rather than depending solely on strategies generated in studies like the one in this paper. In research, the solution space may serve as a framework that can be further populated with design solutions and strategies, thereby expanding the body of knowledge to design for young children's physical activity and play.

4.7 Conclusion

In this paper we introduced and applied Playscapes – a design perspective on young children's physical activity and play. The perspective argues that stimulating young children's physical activity is a matter of creating opportunities for play that is free, bodily and dispersed. We analyzed how these play qualities surfaced in children's interactions with two Playscape designs, Fizzy and Stickz, from which we derived a set of concrete design strategies. These strategies make Playscapes actionable for designers, serving as concrete ways to achieve the three play quali-

ties. The design strategies form a valuable alternative to other existing approaches, enabling designers to direct interactions towards physical activity while leaving room for children's unstructured and spontaneous play. We are excited about

We hope this paper demonstrates that design can make an important difference with respect to stimulating young children's physical activity, even in environments that may initially not seem appropriate for such purposes. In an increasingly urbanized and densely populated world in which sedentary behavior is more prominent than ever, Playscapes may serve as a useful tool to create the necessary space for children's physical activity and play.

Chapter 5:

Towards tools and techniques

5.1 Introduction

In the previous two chapters, we introduced Playscapes as a design perspective on young children's physical activity play, and we implemented two of its instantiations, Stickz and Fizzy, in a pediatric oncology center. We showed that Playscapes can lead to appropriate design solutions for stimulating young children's physical activity. This chapter aims to take a step towards developing design tools and techniques that *other* designers can use, in order to take a Playscapes perspective and generate design solutions for young children's physical activity in hospital settings.

We conducted two studies. In the first study, we organized an ideation workshop in which design students applied the Playscapes perspective with the help of a preliminary set of tools and techniques (Section 5.2). We investigated whether the students were able to understand and use the three play qualities –free, bodily, and dispersed play– in their ideation. For the second study, we organized a design exhibition for healthcare professionals in the Princess Máxima Center for Pediatric Oncology, in which the design outcomes of the ideation workshop were presented (Section 5.3). Here, our question was whether the three qualities are reflected in the design outcomes and whether designers were able to generate appropriate design solutions according to the stakeholders.

Based on these two studies, this chapter aims to get a clear and well-founded picture of designers' ability to adopt a Playscapes perspective in generating design solutions. Based on this picture, we formulate recommendations for developing a set of Playscape tools and techniques.

5.2 STUDY 1: Ideation workshop with design students

In the ideation workshop, our aim was to understand whether designers are able to use and understand the three play qualities. For this, we hosted an ideation workshop with design students. The workshop was hosted as part of a master course at Delft University of Technology that offers workshops throughout the academic year with basic training for various design skills. In the workshop 28 design students participated. The workshop lasted approximately 6 hours, including a 1-hour break.

Workshop set-up and procedures

During the workshop the students were guided through five main phases (see Table 3). In each phase the students were briefed by means of presentation slides and additional oral instructions and suggestions by the researcher. In each phase, students were explicitly reminded of the goal to design for bodily, dispersed and free play. The students orally consented with the use of the video recordings for the purpose of analysis.

Table 3 Set-up of the ideation workshop

	Phase	*Duration*
1	Familiarizing with Playscapes	60 mins
2	Generating ideas	110 mins
3	Creating and rehearsing scenarios	90 mins
4	Presentations	20 mins
5	Joint reflection	10 mins

Familiarizing with Playscapes

The researcher first presented an overview of the steps in the workshop and what they could expect to learn. Using slides with visuals and texts, he then introduced the Playscapes perspective, its rationale and the key concepts that it consists of. Six groups of 4 to 5 students were formed. These groups worked together for the remainder of the workshop. Each group was provided with six definition cards of the key concepts (Figure 16). Besides cards containing definitions of the three play qualities (i.e., free, bodily and dispersed) we introduced several new concepts as part of our instruction, based on our recommendations of the previous chapter. These concepts were *loose*, *landscape*, and *animate* elements, which together are called 'Playscape elements'. The Playscape elements were presented to the students as possible means to achieve the three play qualities. Together, the three play qualities and the three Playscape elements *demarcate a particular solution space* in which we anticipate designers to come up with their own design solutions.

To allow the student groups to actively familiarize themselves with the key concepts, we let them use a simple 2-D mapping technique in which images of children's outdoor play were mapped on A1-sized canvasses. Two sets of the same images were provided and each was placed on one of two canvasses – one distinguishing the play qualities and one distinguishing the Playscape elements (see Figure 17 for an impression). The students were given about 40 minutes for this activity. To facilitate sense-making among the students, the researcher asked the students to be explicit in explaining to their team why they position a certain image on a certain place and to express hesitations.

Finally, all students placed their canvasses on the wall. The researcher asked whether the students had any questions about the concepts. The researcher made several observations about similarities and differences among the groups' canvasses and asked the students why certain images were placed at particular locations. He also asked whether students encountered difficulties in positioning the images, and whether the concepts were clear to them. For this step, no data was recorded.

Generating ideas

After the familiarization exercise, the researcher shared several slides to explain the situation of children with cancer, in particular when they hospitalized. Children's low levels of physical activity was emphasized. Students were then introduced to three distinct hospital environments: a patient room, waiting area, and a recreational area. Two groups were assigned to each type of environment, and each group was provided with a scale model of their assigned environment together with a short description of this environment and its daily functioning and use (Figure 18). The scale models represented actual hospital environments of the pediatric oncology center in which the second study was held. With the scale models we wanted to emphasize the importance of embedding design solutions in a real-world context.

The researcher explained that students could make use of the scale models and additional tinkering materials, but were free to use sketching materials as well. The students started ideating with the materials that were provided, and were given space to do this in their own way (see Figure 19). Towards the end of the workshop, students were asked to decide upon a design direction with high potential and work further in this direction. They were also reminded to prepare their 3-D mock-ups for the feedback sessions.

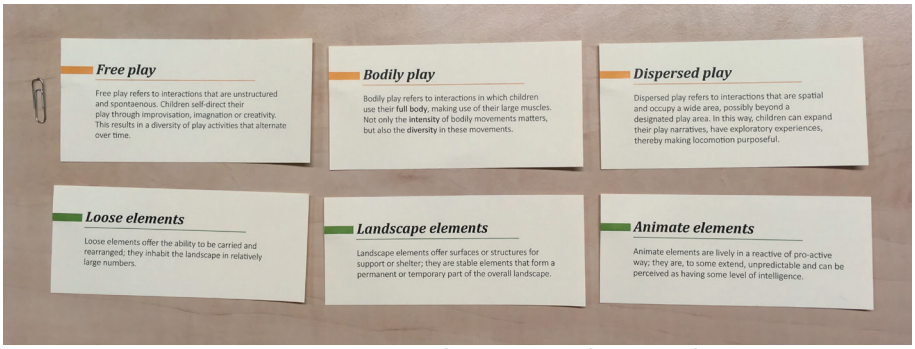


Figure 16 Students were provided with definition cards for each of the Playscape concepts

Figure 17 To familiarize students with Playscapes, they were provided with images of young children's outdoor play (left), which they mapped according to the key concepts of Playscapes (right)

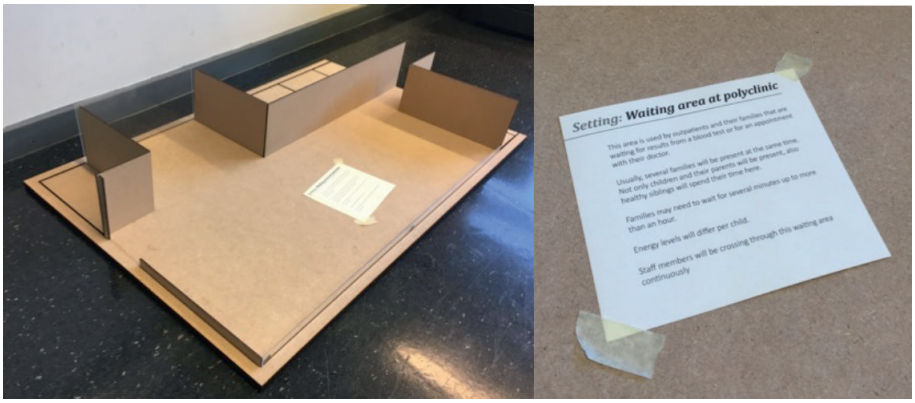


Figure 18 Students were provided with scale models of the environment they would be designing for (left), together with a short description of the users and purpose of the environment (right)

Feedback sessions
For the feedback sessions, the groups had two of their members visit the other group working on the same type of environment for giving feedback. Apart from reminding students of the three play qualities, this step was not guided. All feedback sessions were recorded on video and audio.

Creating scenarios
After a one-hour lunch break, the students proceeded with the workshop by building scenarios. The researcher explained how the scenarios would allow the students to think more carefully about the dynamics of play over time. The students were instructed to think of three different scenarios and to think about what kinds of play activities, interactions, and movements the children would be making with their design solutions. Having thought of scenarios, the groups rehearsed their scenarios by using Playmobil figurines in the scale model (Figure 20). The researcher instructed them to appoint *actors* and a *narrator.* The actors were to enact *what happens*, thereby showing how the children play. The narrator was to explain *why interactions happen*: What is triggering or motivating the child? How is the design contributing?

Presentations
For the final presentations and follow-up questions, the researcher and a research assistant ran two sessions in parallel in which three groups presented to one another, each having designed for a different environment. Each group played out three scenarios, followed by a round of questions by the students or researchers. The main question asked by the researcher was "Can you explain how your design is a Playscape design?", followed by questions for further clarification. This part of the workshop was audio- and video recorded.

Joint reflection
In the final phase, the students remained divided in two main groups. We conducted short interviews with the groups concerning Playscapes and the workshop. Questions that guided this were: How was it for you to apply the Playscapes perspective? Were the concepts clear to you? Were the concepts helpful? Also this part of the workshop was audio- and video recorded.

Coding and analysis
The video material of the feedback sessions, presentations, and joint reflection sessions were transcribed. The transcripts of the joint reflection were analyzed by summarizing students' answers to the questions

Figure 19 Impressions of how students started generating ideas early in the workshop. Some started out with post-its, others started building right away.

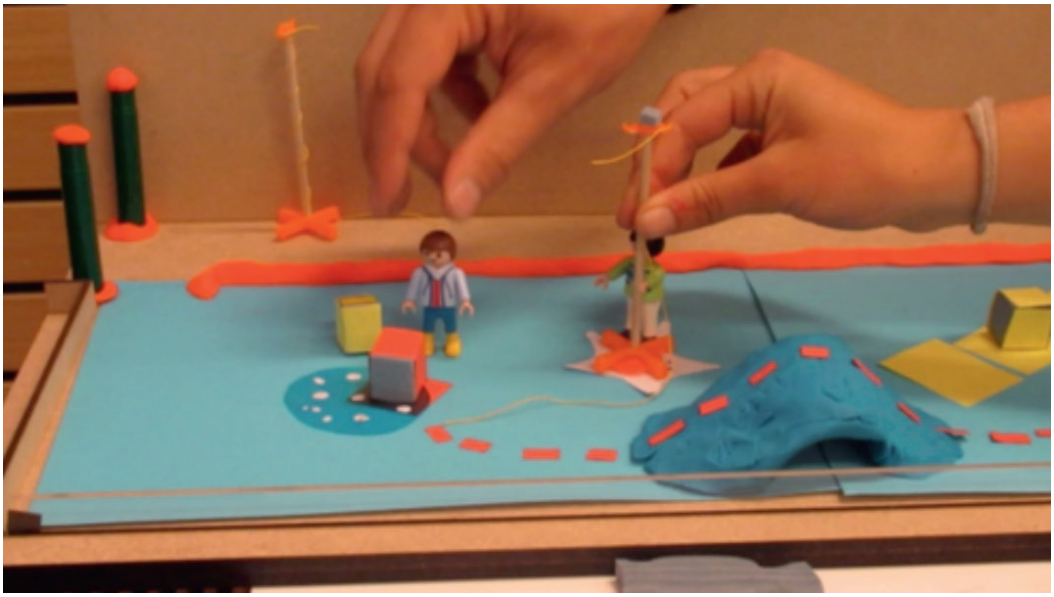


Figure 20 Students epxlained their design solutions by acting out different play scenarios, making use of Playmobil figurines.

posed. The transcripts of the feedback sessions and presentations were coded in Atlas.ti, using a predetermined coding scheme; we had 3 codes representing the play qualities (*free, bodily, dispersed*) and 1 code for other observations by the researcher (*other*). Segments that were coded consisted of single phrases, as well as more elaborate explanations by students. To the segments coded with 'other' we added comments to document what stood out in the segment to the researcher at the time of coding.

For the play qualities we counted code occurrences, allowing us to compare the qualities in terms how frequently they are expressed by students. Each of the play qualities was also analyzed qualitatively: the researcher made a printout of all the segments coded with a particular play quality and clustered them according to the ways in which students referred to the play quality when explaining their design solutions.

In the final part of the analysis, special attention was given to students' explicit reasoning in answering the questions after the presentations and the feedback they provided in the joint reflection. This was to obtain a general understanding of students' comprehension and opinion of the design perspective.

5.3 Workshop results

Design outcomes

All groups managed to come up with design solutions and made use of the scale models. Designs for the patient room are presented in Box 5.1, for the waiting area in Box 5.2, and for the recreational area Box 5.3 (boxes on the following pages). This overview can be used as a point of reference while reading the findings of both Study 1 and Study 2; in the findings we sometimes refer back to elements of the design solutions.

Transcript analysis: students' explanations of design solutions

A total of 197 segments were coded. Two segments were double coded (e.g. free play + other) leading up to a total of 199 codes. The coding was critically revisited twice, during the analysis and after sharing the findings with part of the research team. For the play qualities, *free play* was coded 89 times, *bodily play* 20 times, *dispersed play* 23 times. There were 67 segments coded as '*other*'.

Students talked about design solutions while making little explicit reference to the three play qualities. However, their explanations did reflect the qualities in various ways. As Figure 21 shows, students' explanations were more often related to free play than to bodily and dispersed play. All student groups showed this emphasis, with the exception of group 5. We identified several themes of how students talked about these play qualities (see Table 4). Free play was talked about in terms of *imagination*, *self-direction*, *adapting*, *creativity*, *exploration*, and *change*. Students talked about bodily play in terms of *bodily movements*, *capabilities*, and

physical activity. Dispersed play was talked about in terms of *directions or cues*, moving *throughout the room*, moving *beyond the room*, and *moving around*.

Students' explicit reasoning

After the presentations, when student groups were asked how their design was a Playscape design, the play qualities were often referred to implicitly. Student groups rarely explained their designs in terms of all the three play qualities, and three groups had a clear emphasis on free play (group 2, 4, 5). In general, most student groups were able to reason about their design solutions from a Playscapes perspective. In particular group 3, 4, and 5 could quite easily explain their design, either with implicit or explicit reference to the play qualities. The other groups appeared to have had more difficulties with applying Playscapes (group 1, 2 and 6). For example, Group 1 did not provide a clear explanation about how their design is a Playscape design. They started explaining details of their design that did not clearly relate to the Playscape concepts. When asked about bodily play, they referred to their 'sand blobs' and that they can be 'formed' and 'shaped'. How this involved children's use of their full body was not made explicit. Group 2 and 6 could talk about their designs from a Playscape perspective, but had several misunderstandings.

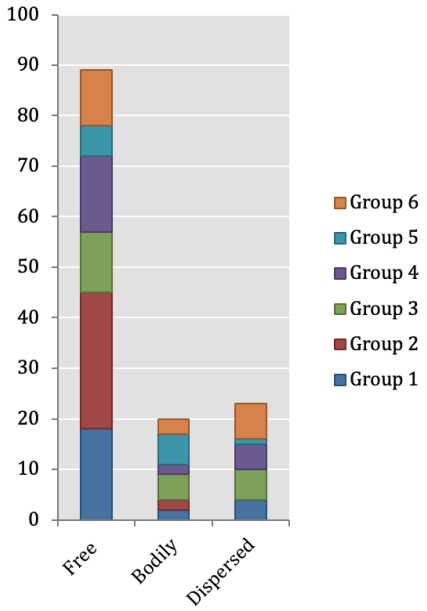
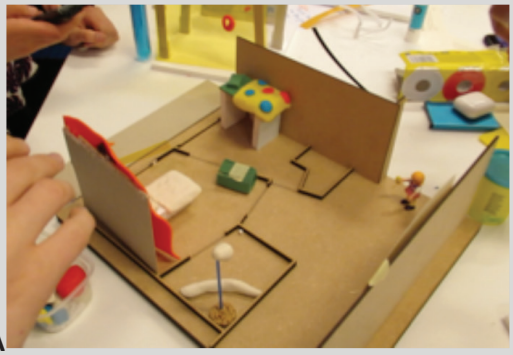


Figure 21 Students explained and reasoned about their design solutions mostly in terms relating to free play. All groups show this emphasis, except for group 5.

Box 5.1: Design outcomes for the patient room

Group 1: A treasure hunt throughout the room


A


B

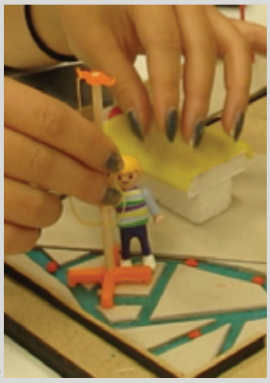

C


D

In the idea by Group 1 (Figure A), children receive a treasure map with which they can look for different kinds of treasures hidden throughout the patient room. One such treasure, for example, is hidden underneath the bed of the parents (Figure B). Another treasure is a chest containing 'magic sand blobs' (Figure C), of which children could change the shape and stick them on their IV pole or the windows of the room and balcony. By attaching different shapes on the window, the child can change the view that they have from their patient room on the outdoor environment (Figure D).

Group 6: Pushing boats through small canals in the floor


A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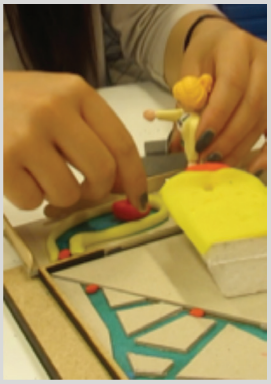
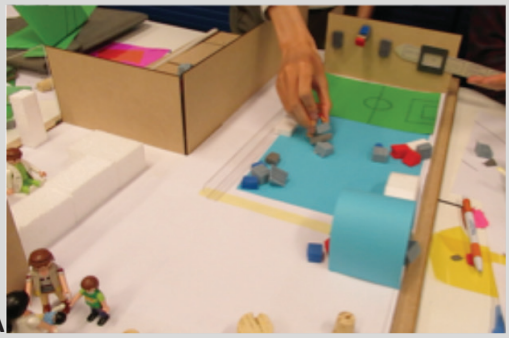

C

Group 6 proposed a system that was integrated in the floor, consisting of several small canals that are covered by transparent panels (Figure A). Through a magnetic element at the bottom of the child's IV pole, little boats can be pushed around through the canals (Figure B). The system extends to the balcony, where families can add new boats or toys (Figure C). For playing together, an additional tool with a magnetic element is available for visiting children to play with.

Box 5.2: Design outcomes for the waiting area

Group 2: A play area with floor projections of various themes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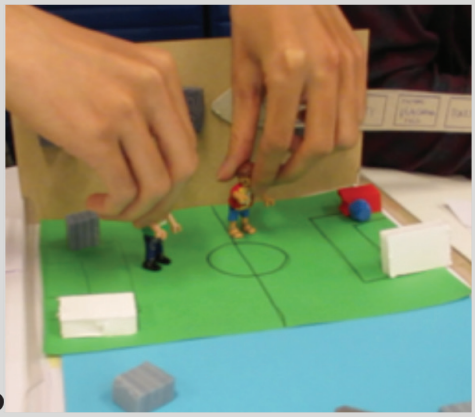
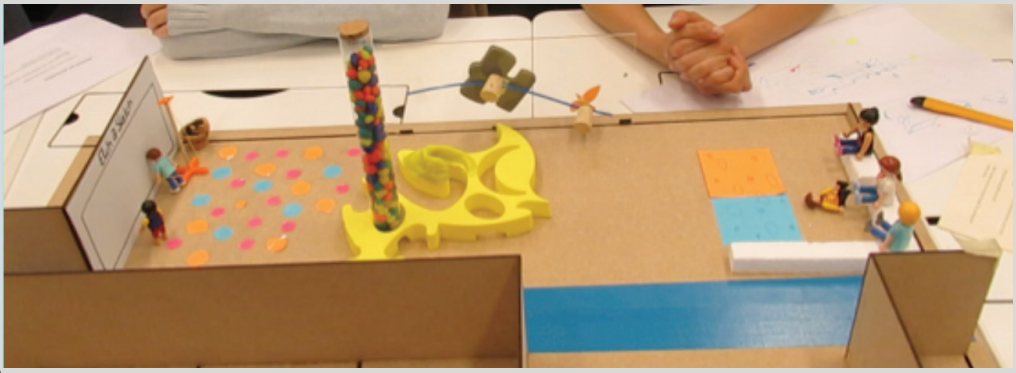

D

Group 2 combined a collection of blocks of different shapes and sizes with a theme (e.g. forest, road, planet mars, ocean) projected on the floor (Figure A). With a simple interface on the wall, children can select a theme. Children can use the blocks in imaginative ways, for example as a car or roadblock in the road theme (Figure B) or as a boat in the ocean theme (Figure C), or more functionally by using them to make goals for a game of football (Figure D).

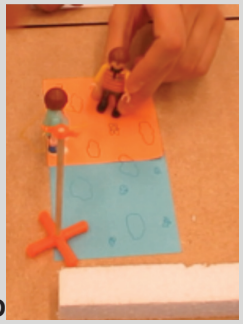
Group 5: Multiple areas for different play activities



A

B

C

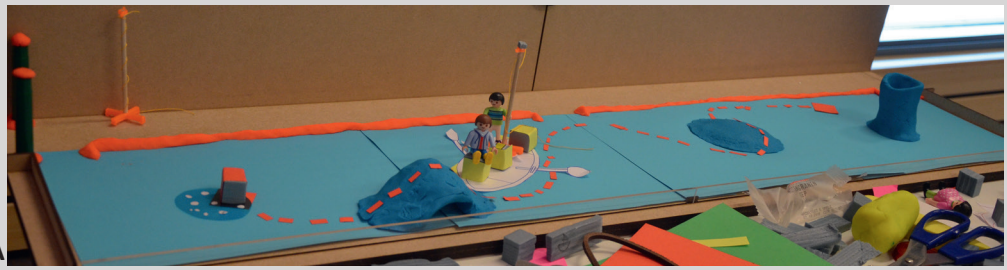


D

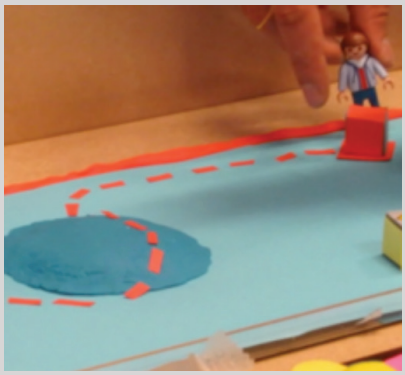
Group 5 presented an idea consisting of several different play areas and elements (Figure A). This included a large 'etch a sketch' on a wall (Figure B), a collection of dots on the floor, an exhibition of children's drawings on another wall, a 'labyrinth couch' (Figure C), an element on the window that could be moved on a particular trajectory, and an interactive game projected on the floor (Figure D). With the labyrinth couch children can play in all sorts of ways, while parents keep a close eye on them. The interactive game is sensitive to children with different capabilities, making games possible between patients and their healthy siblings.

Box 5.3: Design outcomes for the recreational area

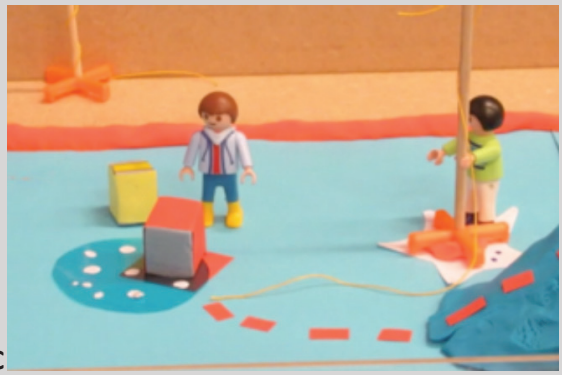
Group 3: A play area with interactive floor projections



A



B

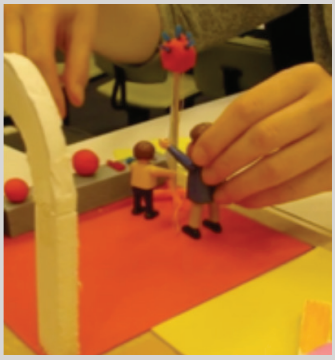


C

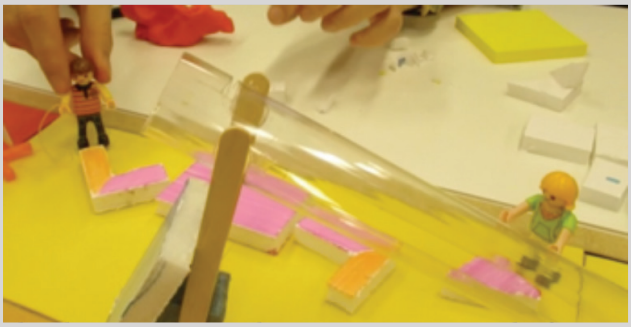
Group 3 made use of projections that cover almost the entire floor of the space (Figure A). The idea was presented with an ocean theme, but the theme would change over time to keep children interested during longer hospital stays. The projected theme is interactive, by being responsive to IV poles and different types of blocks. For example, by placing a block in a projected square of the same color, a path will appear that children can follow (Figure B). When placing another block at the end of the path, many bubbles appear (Figure C, left). When placing three blocks of the same kind at the right place, a boat appears (Figure A, center). Also below IV poles, shapes are projected (Figure C, right).

Group 4: A three-staged play activity

A



B



C

D

The design solution by group 4 consisted of an activity in which children would go through three main areas (Figure A). Each week there is a different theme (e.g. superheroes or Pokemon). The first area is a place in which children can "dress up" their IV pole with different loose elements (Figure B). In this way the IV pole can serve as an imaginary friend. The second area that children move through contains large blocks that light up when shifted together (Figure C). After having gone through the area with the blocks, children can collect a sticker in the third area (Figure D). The sticker can serve as a memory of the play experience when children would go back to their patient rooms.

For example, one group describes the possibility for children "to make their own boat or make their own car or make their own games" as an example of animate, whereas it actually strongly relates to free play. Later, also dispersed and free play are confused: a student suggests that their design "is kind of dispersed" because children "can have their own imagination and do everything they want". Another group explained how their design is a Playscapes design is that it stimulated the use of "precise motor skills […] instead of pushing something big around". Here, bodily play, and the intention to stimulate *gross* motor skills, is misunderstood or overlooked.

Students' feedback in the joint reflection

During the joint reflection, students gave feedback to the researchers in particular with respect to the Playscape concepts and the workshop materials provided (i.e. scale models and tinkering material). Students also raised several questions.

Playscape concepts
Students' accounts of the use of the Playscape concepts differed, with respect to *consciously* applying them, their *usefulness*, and the *difficulties* in applying them.

One student from group 5 indicated that they didn't use the play qualities *consciously*: "I think we didn't take them into account […]. But they really served as inspiration that we didn't notice." Group 3 indicated that they "tried to take into account all three things", referring to the play qualities. Other groups did not mention explicit or implicit use.

Several students indicated that Playscapes was *useful* by encouriging them to design for children's free play. A student from group 5 explained that "it's nice that we have to think of some environment where children can do things they want on their own. Like they have to use their imagination and not [play] a fixed game. […] So it was helpful to think of that." Similarly, a student from the group 6 explained how Playscapes was "pretty useful", allowing them to think about "how you can play with one thing in different ways." A student from group 3 agrees: "I think mostly the free part, like you said, […] that you can do multiple things with it. That […] it's still their own creation, and not a fixed game, is very much the free part." A contrasting view came from other students that pointed out that designing for free play or bodily play came quite naturally, and

that Playscapes for that reason might not be of much added value. One student explained how he expects that if you replace first 2D-mapping exercise with only the showing of some pictures of children's outdoor play, the design outcomes will be similar: "Because it's, I think, a concept that you can really relate to". A student from group 5 makes a similar remark with respect to free and bodily play: "I think, for free and bodily play, that everyone already knows it".

Students also shared some *difficulties* they had in using the Playscape concepts. A student from group 4 explained how it is counterintuitive to design for free play: "The thing is that as a designer you look for the rules [to] set boundaries for your project, so that it makes sense to *you*. But probably those rules don't make sense for the kid." Group 1 explained that applying the Playscapes perspective in a patient room was more difficult than in the other rooms, as "you don't have a lot of space and you have to take into account a lot of things, like the beds". Students showed most difficulties with designing for dispersed play. Students from two groups indicate that it is hard because "it's still one room and you can't really move it out of that particular room." Dispersed play was also described by one student as "the most vague" concept, "so that's why probably it's the hardest."

Workshop materials

Besides the Playscape concepts, students also commented on other materials provided to them. Students indicated that the scale models were limiting as well as facilitating. It was limiting according to one student, as it didn't offer the perspective that you would get in a real-life setting. Another student responded to this by pointing out that the scale model was helpful. She argued that when you design for an environment is helpful to *make* the environment. Things like floor plans, according to this student, would be less helpful in this respect. Another merit of the scale models that students perceived was that they were "sketchy and open", like a "clean canvas", inviting the students to fill it and "do [their] own thing". Another student said that it also gave an impression of "what has to be there".

The tinkering materials were perceived by one student as "super inspiring" and by another as an easier way to come up with ideas than sketching. Several students agreed with this latter observation. One group explained how they used the materials to diverge and fill up their scale model with ideas and to narrow it down by removing elements.

Table 4 Students explained their ideas in terms of the play qualities in various ways.

	Theme and occurrence (X)	*Examples from workshop*
Free play	Imagination (24)	Group 2 explained how their design allows children to find "cozy places" where children can have "imaginary thoughts". Other students explained that with their design children could "make their own story" (Group 6), "really imagine everything being anything" (Group 5), or "escape reality" (group 4).
	Self-direction (20)	Students talked about how children can "do whatever they want" (group 5), "have whatever they like" (group 3), or "interact with the landscape in whichever way they feel best" (group 2). Group 4 said: "It's really up to the kid, what he wants to do or not." Group 3 explained that their design "should be [free for children] to explore, and not like with a lot of rules and uh… explanation."
	Adaptation (19)	Group 4 explains how "really simple things can be arranged and attached to the pole to make it nicer". Another group explained how their design makes use of a projector, and that children can "select a scenery" (group 2). Group 1 in particular, had a focus on allowing children to adapt their environment; in their design, children can "change the landscape", "personalize their room", and "customize it".
	Creativity (8)	Group 4 explained how their idea is about "creativity and making things". In their design, "the creative part" is the area in which children can customize their IV pole. Group 6 explained that with their design "you can use your creativity to make a game out of it." Group 2 said that they really wanted "to stimulate kids to use really ordinary things, like random blocks, to build their own things" – they can "make their own boat or make their own car or make their own games".
	Exploration (8)	Group 1 designed a treasure map helped children explore the patient room and discover all kinds of hidden elements. For example, in one scenario a girl "discovers this nice hidden [hatch in the] wall, which she can open, and there are treasures in there with which she can play". Another group talked about an element of their design and how a child can "explore what it does" (group 6) in response to children's actions.
	Change (10)	Group 3 explained how their idea is "an interactive area where the projections […] can create a theme. The theme can change and as soon as they do something [referring to children playing with blocks] the area changes [e.g. a pathway appears]. So it [stays] interesting." Similarly, group 2 says: "whenever the kids are maybe fed up with the current scenery, [it] can maybe transform slowly into something new."

Bodily play	Bodily movements (10)	Students described “cubes that you can turn around” (group 3) or “canals” that give the opportunity to “jump over” it (group 6). Group 4 explains: “we try to give smaller things, so they could carry them.” Group 2 describes how children “can just climb on those blocks.” Group 5 explains what movements children can perform in interaction with their ‘labyrinth couch’: “they can walk on it, climb on it… crawl under it, if they want.”
	Capabilities (5)	Group 5 explained: “there’s different levels of physicality over the play areas, so that if you’re not very physical you can play the smaller games” while also taking into account children that “are capable of doing something that is more active.” They also describe a game that “reacts to the speed of the kids that are playing” so that it’s “the perfect […] intensity for her capabilities at the moment.” Group 3 acts out a scenario in which carrying a block is “maybe a little bit heavy” for the patient, and where a sibling starts helping.
	Physical activity (5)	One group explained that with their design “you have to keep moving” (group 3). Another group plays out their scenario, describing how a boy “moves around” (group 6). Another group says, “they.. they build.. they… they move” (group 2).
Dispersed play	Directions & cues (7)	Group 5 described an element that could move across a large window, which “motivates kids over here [pointing at one side of the room], to go all the way over there [pointing at the other side of the room]” (group 5). Group 3 described an idea in which children position a red block in a projected red square, making a path appear: “And they can move the block around the path […] and bring it all the way to the end of the area.” Group 1 uses a “treasure map” which gives directions to different hidden places in the patient’s and parents’ room that children can go to.
	Throughout the room (6)	Group 3 explained how children that carry an IV pole have a fish projected below it on the floor, which “they can take throughout the area”. The same group explained that children can play “throughout the scenery” with different kinds of blocks by collecting them. Group 6 explains how a boy can just play around “in the entire environment”; “it’s an interactive play through the entire patient room”.
	Beyond the room (7)	Group 2 came up with a floor system that extended to the balcony, inviting children and parents to go outside. The design of group 1 offered various hidden places across different rooms (patient room, parent room and balcony). A student explained this idea further: “it’s to give the child more space than only his room.”
	Moving around (3)	One group came up with a sea star projected underneath the IV pole as “something nice that [children] can walk around with” (group 3). Group 4, had a similar idea for the IV pole “that [children] have to carry it around to do something with it.”

Questions and comments by students
During the joint reflection and also after the workshop had ended, some students asked questions for further clarification and understanding. One student reflected on how children can play with "basically nothing", referring to images from the 2D-mapping exercise, and asked how you can understand or predict what they appreciate or not. Another student asked how Playscape designs actually work out in the real world; what do children do with such designs? Both these questions indicate that students had difficulties to get a feel for how children play, in general or with Playscape designs. When the researcher gave a response to these questions with examples from his fieldwork, students suggested it would have been valuable to hear more about this during the workshop.

Discussion of workshop findings

In explaining their design solutions, students showed a clear emphasis on free play. Furthermore, in students' explicit reasoning, three groups emphasized free play. We also saw a rich vocabulary emerge with respect to this quality; students seemed to have had a more in-depth conception of free play than of the other two qualities. We have several possible explanations for this.

It might be that students are more open to or familiar with free play or play more generally; this, in turn, makes it easier to reason from this perspective. Imagination and creativity, for example, are familiar terms to designers. Contrastingly, thinking about bodily movement and dispersion might come less naturally. For dispersed play we have clear indications for this, as it was experienced as vague and difficult to achieve. A more general explanation for the imbalance in the use of the play qualities could be that it was too complicated for the students to learn to apply them integrally over the course of a one-day workshop. While the students are trained to think in an integral manner, to do so with a new set of concepts could have been too demanding in the short time they had. The fact that some groups probably have not applied the concepts consciously, can also have contributed to unequal use.

The selected tools might also have had an influence. Bodily play, for example, may have been underemphasized due to the scale models and Playmobil figurines; the inflexibility of the figurines might have inhibited students in expressing full body movements in their designs. Full-scale interactions might have facilitated the exploring of bodily movements

better. Students also indicated that dispersed play was hard to design for, due to being limited to a single room; here the scale model of a single room seems to have played a role in inhibiting students to think about play *beyond* this room. Free play might have been emphasized through the task of making and rehearsing 'play scenarios', facilitating students to think more about how children play, rather than think about the bodily movements and the level of dispersion that such play involved.

During and after the joint reflection, students asked several questions about how Playscape designs would work out in real life and how to take the child's perspective, thereby indicating that they had not yet obtained a feel for the subject matter. In contrast, other students said that designing for children's free and bodily play came quite naturally; i.e., they indicate they *do* have a feel for the subject matter. While the students that asked for further clarification clearly indicate a lack of understanding, we suggest the second group's understanding could also be limited; these students rely on their personal experiences, potentially failing to grasp some the nuances that actually come into play when applying Playscapes.

A final observation concerns the use of the scale models. Several groups mentioned that the tinkering materials and scale models were useful and inspiring. The initial idea behind the scale models was to make the context comprehendible; they played this role by showing the space available and giving a general idea of what the environment was for. However, we also noticed that the scale models served as a clean canvas, as expressed by students. Students designed *entire environments* from scratch. This approach is different from designing *single playthings* to be embedded in existing hospital environments (such as Fizzy and Stickz in Chapter 3 & 4). What this implies is that Playscapes can be applied in different ways, and that care should be taken in selecting tools appropriate to the object of design. The scale models seem suitable for designing larger play environments and interiors, but may be less likely to result in interventions such as Stickz and Fizzy, which are objects designed to embed in an existing environment.

5.4 STUDY 2: Design exhibition

The design outcomes of the ideation workshop were evaluated in a design exhibition in the Princess Máxima Center for Pediatric Oncology in Utrecht, the Netherlands. Our main goal was to see whether the ideation

workshop had led to outcomes that reflected the play qualities of Playscapes as evaluated by healthcare professionals. The professionals were asked to give feedback on the designs from a Playscapes perspective, and were given the opportunity to provide other feedback as well.

Exhibition preparations

The six ideas resulting from the ideation workshop were taken as a starting point for the exhibition. Each of the scale models was given a makeover, bringing attention to aspects of the design that contributed to the three play qualities, while leaving other aspects in the background. We did this by spray-painting large parts of the mock-ups in white (e.g. floors, walls), while leaving important elements used in the scenarios in their original color (e.g. projections or blocks).

For each design we selected three interactions or scenarios that had been played out by the students during the workshop. Together with a professional illustrator, we created simple illustrated scenarios for each design. In making the illustrations, we made sure to represent the elements from the mock-ups clearly. While the scenarios showed how children could play with the design, the mock-ups allowed stakeholders to make spatial sense out of the design solution, showing how interactions would occur in the hospital environment in question.

Exhibition format

For the exhibition we used presentation panels carried by easels. We used two panels to inform potential participants about the exhibition and its purpose, and another panel for participants to leave a post-it about their background (Figure 22). The panels with illustrated scenarios were positioned above the scale models (Figure 23). For each hospital environment we presented the two ideas next to one another.

Participants and data collection

We actively recruited participants by inviting passersby and by informing people in several public areas of the hospital. Hospital personnel acquainted with the researcher also invited participants. Participants consisted mainly of medical doctors, psychologists, PhD students (MD's), and nurses. Because of the open set-up, no exact record of the number

Figure 22 At the entrance of the exhibition, participants were provided with information (right panel), instructions (middle panel) and were asked to leave information about their background (left panel)

Figure 23 The design solutions were presented with scale models and interaction scenarios on panels. This figure shows two design solutions for a recreational area.

of participants was made. 22 out of an estimated 30 participants left a post-it about their background.

The participants were asked to give their feedback on the designs by means of colored post-its positioned on a clipboard (Figure 24). Each color resembled a particular category of feedback: blue for bodily play, orange for free play, pink for dispersed play, and yellow for other comments. Participants were asked to give feedback for each of these categories.

We initially asked participants to choose which of the two designs per hospital environment was best in terms of each play quality and to explain their choice by writing on the post-its. We noticed, however, that this instruction raised confusion among participants, and that some participants started to give feedback for all designs. Therefore, halfway the exhibition we decided to change towards this simpler format that the participants already initiated.

Data processing and analysis

All post-it text was entered manually into an Excel table, recording for each post-it the number of the student group, the category of feedback, the written content on the post-it, and additional notes during data processing. Feedback that did not fit the category was repositioned to the correct category. For the 'bodily', 'dispersed', and 'free' categories, each post-it record was marked as either positive or negative feedback. We scored each of the designs for each category by subtracting negative comments from positive comments. This allowed us to compare how ideas were appreciated from a Playscapes perspective. For the 'other' category, we printed the post-it records and manually clustered the feedback into themes according the concerns expressed by stakeholders.

5.5 Exhibition results

A total of 185 post-its with comments were collected. Each design received between 25 and 36 comments. The distribution of the feedback per category was as follows: 41 comments on *free play*, 37 on *bodily play*, 25 on *dispersed play*, and 82 *other* comments. The results below show how stakeholders evaluated the various designs with respect to their ability to stimulate free, bodily, and dispersed play, and the concerns they have about implementing these Playscape designs in a hospital setting.

Figure 24 Participants provided their feedback for each category with colored post-its

Evaluation according the play qualities

Stakeholders mainly gave their feedback through appreciative statements. Only in some cases, stakeholders critiqued a design. For example, group 1 had two positive and two negative remarks on bodily play. Group 6 received one positive and two negative remarks on free play, resulting in a negative score (see Figure 25). The figure also shows how most critical remarks with respect to the play qualities were given to the designs for the patient room.

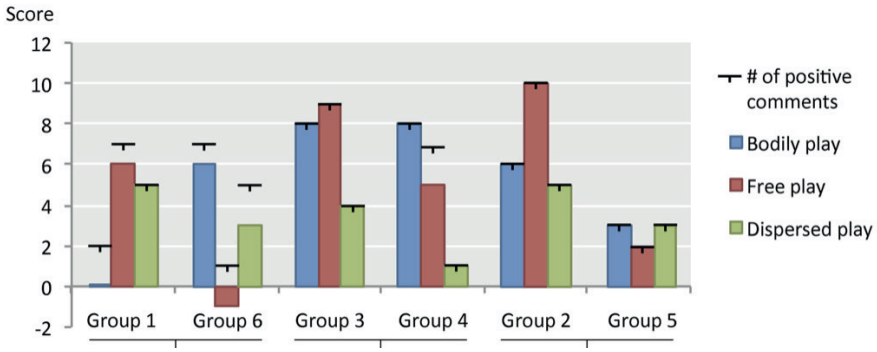


Figure 25 Two groups scored relatively high on all three qualities (group 2 and 3), whereas the other groups score low on one or more qualities. The designs for the patient room received most critical comments.

Free play – In particular the design solutions by group 2 and 3 scored high on free play. Both were appreciated for stimulating children's imagination, for example: "the different themes stimulate children's imagination a lot". Furthermore, for group 2 it was appreciated that few rules are involved in the design, and that children can choose their own theme. The ideas by group 5 and 6 were not really appreciated, and in particular group 6 received critiques. The idea, consisting of the floor system with little boats, was criticized for offering "few opportunities", and being "limited by rules and supporting only few ways of playing".

Bodily play – In particular group 3 and 4 scored high on bodily play. Stakeholders had various comments on the idea of group 3, for example concerning "rewards in the form of shapes that appear" which contributed to "great conditioning" of physical activity behavior. Other comments referred to the blocks, for example: "the carrying of blocks is a good way to stay physically active". The idea of group 4 was also appreciated for carrying and shifting large blocks. The idea by group 1 was received critically, with two positive and two negative remarks, the latter two stating that the design barely invites physical activity.

Dispersed play – With respect to dispersed play none of the ideas stood out. The ideas by group 1 and 2 were best received. The first idea was seen as dispersed for its use of multiple spaces that can be explored (i.e. patient room, parents' room, balcony). The idea by group 2 was appreciated for children's use of the entire floor. The idea by group 6 received two critical comments, one focusing on limited use of the space, the other on the fact that only a single room was used. The idea by group 4 received the least appreciation, but no explicit critiques.

Other comments

Stakeholders gave a relatively high number of comments in the *other* category, which reflected a variety of concerns (Table 5). A first set of concerns were about the embedding of Playscape designs in hospital environments; Playscape designs should ensure the *safety* of children, avoid cluttering or *messiness* that gets in the way of everyday hospital practices, and encourage *social interaction* among children. A second set of concerns was more centered on the needs of patients and their families: Playscape designs should offer a *positive experience*, be *appropriate for children of different ages*, be *inclusive* for children with, for example, IV poles or wheel chairs, and take into account the role of *parents*.

Discussion of exhibition findings

Overall, stakeholders evaluated the design outcomes from the ideation workshop positively with respect to the play qualities. Two designs scored high on all three qualities. The other designs scored low on one quality, and in one case on more of the qualities. The latter designs are in line with the findings from the workshop, namely that students had difficulties applying Playscapes in an integral way.

We see similarities as well as differences between the extent to which particular groups talked about their designs in terms of the play qualities, and how these designs were scored in the second study. We see similarities, for example, in how group 1, 2 and 3 talked about their designs mostly in terms of free play and how the stakeholders give the designs the highest score in this dimension as well. There are also clear differences. Group 2, for example, did not talk about dispersed play at all, yet scored relatively high on this quality in the second study. This might indicate that intuitively the students understood dispersed play, but that they had difficulties explaining their idea in these terms, or simply forgot to do so. Another example is how Group 6 explained their idea mostly in terms relating to free play, while their design received a negative score by stakeholders on this dimension. Thus, while students find it easier to explain their ideas in terms relating to free play (study 1), this is not necessarily an indication that their design outcome actually reflects this quality (study 2).

Besides our primary goal of evaluating the design outcomes from a Playscapes perspective, we also identified several concerns of stakeholders. Although our overview is preliminary, we suggest it brings value by pointing at relevant areas to take into account when applying Playscapes in pediatric hospital settings. Some themes are particularly interesting, in that they expose challenges inherent to Playscapes that are not easily circumvented. A challenge, for example, is that stakeholders' concerns with messiness were mostly in response to designs with loose elements. As loose elements form an important ingredient for children's physical activity and play, how can hospitals somehow manage or contain them as not to obstruct hospital practices? Other themes, such as safety and inclusion, also pose challenges inherent to Playscapes, in particular with respect to free play. Designing for free play means allowing children to self-direct their play; for designers it will be difficult to account for whether or not children will do this safely or whether they will include others.

Table 5 The feedback by stakeholders in the 'other' category reflected a variety of concerns.

	Concern	*Examples of stakeholder feedback*
Embedding in hospital environment	Safety	Several aspects of designs were deemed "not feasible" or "not convenient", such as situations that involve balls (group 2) or open water (group 6). One stakeholder pointed out that pushing around boats in canals with your IV pole would be dangerous (group 6). Another idea of manipulable large wires behind the bed (group 1) was perceived as scary for the child and not feasible.
	Messiness	The idea of group 1 was perceived by two stakeholders as "crowding up" the room with all its loose elements and resulting in "junk lying around". The idea of stickers on IV poles (group 4) was criticized twice, as it would result in stickers being attached everywhere in the hospital. Two others commented on large blocks (group 4) that might block pathways, asking who is going to manage the correct placing of the blocks.
	Social interaction	There were several appreciative comments about the possibility for children to play together or socially interact (group 2,5,6). For example, "Playing together is fun! It is stimulating!" (group 6) or, "Great way to bring children in contact with one another" (group 5).
Patient and family needs	Positive experience	Several stakeholders questioned whether the designs would be enjoyable for children. For example, one comment was that particular scenarios were probably "not exciting anymore after several hospital admissions" (group 1). Two comments point out that particular ideas are positively challenging (group 3,4).
	Age-appropriate-ness	There were five comments on how certain ideas were particularly oriented towards young children, thereby not being attractive to older children (group 2, 4, 5). Another comment suggested that the choosing of themes would not be very suitable for very young children (group 2). Others asked: "is it clear enough what you should or can do?", or stated that an idea would be "difficult to execute and a complex activity for children" (group 3).
	Inclusion	Three stakeholders commented on aspects of designs that would not allow children with an IV pole or a wheel chair to participate, such as the carrying of blocks (group 3) or the climbing and hiding in the 'labyrinth couch' of group 5. Two other ideas, according to stakeholders, did allow children with a handicap or wheel chair to play (group 4,5).
	Parents	Three stakeholders appreciated that parents were taken into account, by giving them a place to sit and allowing them to keep an eye on the children (group 5).

5.6 General discussion: key findings and recommendations

In this section we discuss the results of the two studies in light of the development of a set of Playscape tools and techniques for design practitioners.

A first set of recommendations concerns the integral use of the three play qualities. From both studies we learn that student groups had difficulties to apply the qualities in an integral manner. In the first study, we observed this in students' explanations and reasoning; here students showed a clear emphasis on free play. In the second study we observe this in the design outcomes of the workshop, where only 2 out of 6 designs scored high on all three qualities. To allow designers to express the play qualities in more equal terms, we suggest a set of tools and techniques should provide a clear *vocabulary* for each of the qualities. The results in Table 4 may inform this vocabulary, as well as some of the results in the previous chapters. Furthermore, tools or techniques should be included that encourage the conscious and integral use of the qualities. In particular, they need to afford designers to explore and design for bodily and dispersed play (e.g. for bodily play, 1:1 tinkering materials that allow designers to act out bodily movements).

A second set of recommendations is about supporting designers in *getting a feel* for the phenomenon of young children's physical activity and play. From Study 1, we learned that some students had difficulties in this respect. At the same time, other students expressed that thinking about free play came naturally. These students indicate already having an intuitive feel for the subject matter, based on childhood memories, but this does not necessarily entail a *nuanced* understanding of children's physical activity and play or how to design for it.

In response to both these issues, we suggest a Playscapes toolkit should advice designers to gain real world experience with children's play and physical activity, to witness its spontaneous and unstructured nature first hand. Furthermore, in order to give designers concrete pointers for *how* to design for physical activity and play, the sharing of design examples would be an effective way. While we consciously decided not to include Fizzy and Stickz as design examples in the ideation workshop in order to avoid fixation, offering a wider range of design examples may avoid or alleviate this issue by pointing in a wider range of design directions. Annotating this set of design examples in terms of the Playscape concepts might be a way forward (e.g. see Gaver & Bowers, 2012), or the Playscape concepts could be communicated in a similar way to the 'pat-

tern language' proposed by Alexander (1977). The Playscape elements (loose, landscape and animate), largely unaddressed in this chapter, could also be illustrated in formats such as the above.

Another finding from the first study is that the workshop resulted in design solutions that were quite different from Fizzy and Stickz described in Chapter 3 and 4. In the discussion of the first study, we suggested to distinguish between designing single *playthings* and entire *play environments*. Both these objects of design can be designed from a Playscapes perspective, but would benefit from different tools and techniques. For example, this study shows that open and empty scale models invite designers to design an *entire* environment, but this might be less useful when designing single playthings. Designing playthings to be embedded in already existing environments may require different tools. Also good to point out is that design projects may involve the designing of both a play environment and playthings. Here it may make sense to first develop master plan for the environment and subsequently shifting the focus to the different playthings that will be part of the environment. For example, in a graduation project by Donna Stam (D. Stam, 2017; D. Stam & Boon, 2018), the focus was first on an overall design for a pediatric physical therapy room and then shifted towards developing further two particular playthings.

Finally, in the second study we identified some of the concerns that stakeholders expressed concerning the embedding of Playscape designs in the hospital and their assumed appropriateness to children and their families. Although still a preliminary overview, we suggest it can offer designers focal areas for when doing contextual research in the early stages of the design process.

5.7 Conclusion

This chapter examined whether and how design students use the play qualities – free, bodily, and dispersed play – in ideation, and how their design outcomes reflect the play qualities as perceived by stakeholders in a pediatric hospital. One of the main findings is that students had difficulties applying the three qualities in an integral way. We provided several commendations to address this issue that can help taking steps toward developing Playscapes into a concrete set of tools and techniques. In the next chapter incorporate some of the recommendations in this chapter by illustrating the key Playscape concepts with concrete design examples in the form of a brochure.

Chapter 6:

The solution space of Playscapes

6.1 Introduction

In Chapter 3 we developed and positioned Playscapes making use of two design examples, Fizzy and Stickz. These two examples instantiate Playscapes – i.e. they are instances of Playscapes that show what this design perspective is all about. Fizzy and Stickz show that Playscapes leads to novel solutions for stimulating children's physical activity that are different from the solutions that would result from a more exercise-oriented perspective. In other words, Fizzy and Stickz helped express how Playscapes opens up a particular solution space for stimulating young children's physical activity.

In this chapter, we explore this solution space further and populate it with additional design examples and strategies. This wider range of design examples shows that Playscapes allows designers to create a variety of design solutions that are appropriate for different healthcare contexts. The collection can serve as a catalogue of inspiration for designers that are developing their own solutions for stimulating young children's physical activity and play.

The design examples that we include were all developed in interaction with the researcher. Some examples, like Fizzy and Stickz, were central to the research presented in this thesis. One of the designs was designed to see the merits of Playscapes in home environments, while others were designed as part of project with a client, in which Playscapes played an informing role.

6.2 A brochure format

This chapter presents the solutions pace of Playscapes in the form of a highly visual brochure, which shows and explain Playscapes and its key concepts. Its phrasing is less hedged and more suggestive than in academic texts, as it is directed at an audience of design practitioners. Often, these forms of guidance toward the profession are delivered as annexes or separate leaflets. Here, the brochure is included in the thesis as it is part of the knowledge dissemination, conveying actionable insights. The brochure lives in the space of intermediate-level knowledge next to other forms such as annotated portfolios, patterns and guidelines (Höök & Löwgren, 2012; Löwgren, 2013; Stappers & Giaccardi, 2017). These formats play an important role in RtD in between the 'ultimate particular' (Stolterman, 2008) of the single prototype (i.e. concrete, but difficult to generalize) and formal theory (i.e. general, but difficult to apply).

Taking a Playscapes perspective

A solution space for stimulating young children's physcial activity and play

Introducing Playscapes

Playscapes is a design perspective on young children's physical activity and play. It is inspired by children's outdoor play and proposes three play qualities – free play, bodily play, and dispersed play – to be central in young children's physical activity. It also proposes three broad categories of means to achieve the play qualities: loose elements, landscape elements and animate elements. These are the potential ingredients designers can use to turn children's environments into rich 'landscapes for play'.

Play qualities

When taking a Playscapes perspective, the three play qualities are the primary goals to pursue in an integral manner (see Figure 6.1). Leave one out, and a design solution is less likely to be attuned to young children's natural physical activity patterns.

Free play

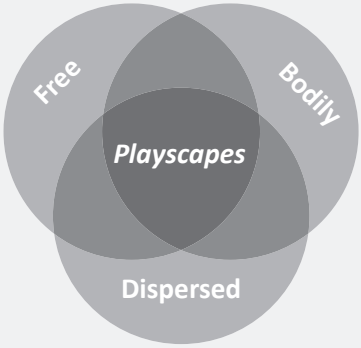
Free play is play that is spontaneous, unstructured and self-directed. When young children play outdoors, they act on the possibilities for play in their proximity, often in creative, improvisational and imaginative ways. The quality of free play brings meaning to children's physical activity.

Bodily play

Bodily play is play that involves the use of a variety of gross motor skills. When young children play outdoors, they use their full body moving through and manipulating their environment. The quality of bodily play supports children in building their physical competence.

Dispersed play

Dispersed play is play that covers a wide area. When young children play outdoors, they are drawn into their environment, often going beyond a demarcated play area. In this way, the quality of dispersed play discloses new opportunities for play.



To design from a Playscapes perspective, is to integrally design for play that is free, bodily and dispersed

Playscape elements

The Playsape elements are categories of basic means for achieving the play qualities. These elements are omnipresent in outdoor environments and offer distinct affordances to children.

Landscape

Loose

Animate

Landscape, loose and animate elements are different ways in which to evoke free, bodily and dispersed play.

Loose elements

Loose elements offer the ability to be transported and rearranged; they form the stuff that is lying around in the landscape. Examples in outdoor play are sticks for building, logs to push over, leaves to throw in the air, stones to stack, and pinecones or shells to collect.

Landscape elements

Landscape elements are surfaces and structures that provide support or cover; together they form the stable elements in the landscape. Examples are hills to role of, a bush to hide behind, trees to climb in, stepping stones to jump on, and hideouts to retreat in.

Animate elements

Animate elements are elements that move in reactive, pro-active, expressive and / or unpredictable ways; they act in the landscape. Examples in outdoor play are butterflies to follow, birds to feed, or ocean waves to jump over or dive under.

Playscape designs

In this brochure we use five design examples of playthings to explain the solution space of Playscapes. Below we provide descriptions of the basic functionality of the playthings. Project partners in these design projects were the Princess Máxima Center for Pediatric Oncology, Utrecht, The Netherlands, and the Child Development & Exercise Center, Wilhemina Children's Hospital, Utrecht, The Netherlands.

Fizzy

Fizzy is a robotic ball that stimulates young children's physical activity in the patient room. Fizzy wiggles to grasp your attention, rolls away when it is approached, shakes when somebody gets hold of him, and gently vibrates when stroked. Children can actively play with Fizzy as a ball (i.e. throwing, rolling, kicking) and as a creature (e.g. following, catching it)

Designer: Boudewijn Boon
(PhD candidate)

Stickz

Stickz are branch-shaped objects that stimulate young children's physical activity in waiting areas or play areas in the hospital. Just like sticks in a park or forest, children can drag them around, use them as building materials for building huts and other constructions, or as props for imaginative play (e.g. a Stick as sword or as a gigantic spider).

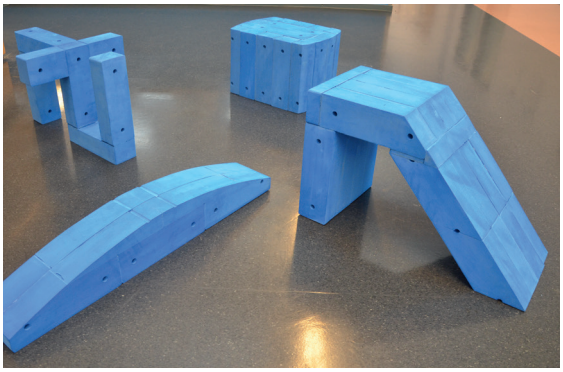
Designer: Boudewijn Boon
(PhD candidate)

Hobble

Hobble offers home-based physical therapy for young children with cancer. It is an expressive little robot that consists of a base with a motorized wheel axis, and a set of differently shaped wheels that can be attached. Each wheel set changes Hobble's expression as it propels itself throughout the room. By playing with Hobble, children are invited to engage in locomotion and use their trunk muscles.

Designer: Chiwei Luu
(master graduation student)

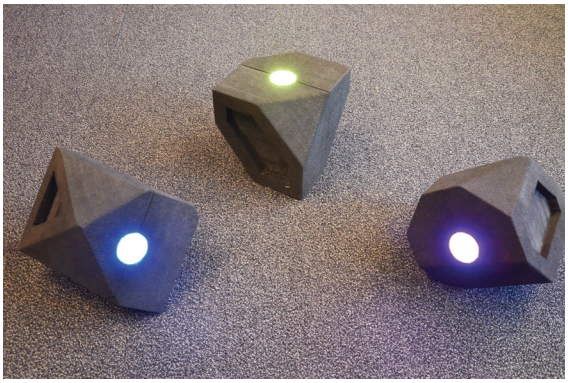
Track Me



Track Me was designed as part of a pediatric physical therapy room for children of different ages and with different chronic diseases. It consists of four differently shaped foam blocks that facilitate children's physical activity and play, thereby allowing therapists to observe, diagnose and train the children.

Designer: Donna Stam
(master graduation student)

Chase Me



Chase Me was also designed as part of a pediatric physical therapy room for children of different ages and with different chronic diseases. It consists of multiple interactive foam blocks that use light and audio signals in a therapy mode (functioning as countdown targets) and free play mode (changing the orientation of a block, changes the LED colour).

Designer: Donna Stam
(master graduation student)

The solution space of Playscapes

Below, the solution space of Playscapes is visualized by organizing the play qualities and Playscape elements on two different axes. Nine different focal areas emerge, which show that the Playscape elements can contribute to the play qualities in distinct ways. The content of the solution space is derived from the concrete design examples described in the following pages.

	Free play
Landscape elements	Landscape elements can contribute to free play by ... - demarcating 'special places' - being unstable - offering multiple functionalities
Loose elements	Loose elements can contribute to free play by... - being rearrangable - allowing their form to be multi-interpretable - offering multiple functionalities
Animate elements	Animate elements can contribute to free play by ... - by giving a plaything a hybrid character - allowing their behaviour to be multi-interpretable - displaying a variety of expressive behaviors

Bodily play	*Dispersed play*
Landscape elements can contribute to bodily play by ...	Landscape elements can contribute to dispersed play by ...
- being an obstacle (climbing over, crawling under, jumping over, etc.) - being a target (throwing at, hitting, etc.) - being a platform (jumping on and off, balancing on, stepping on and off)	- serving as destinations to go to - serving as pathways to follow
Loose elements can contribute to bodily play by ...	Loose elements can contribute to dispersed play by ...
- being transportable (carrying, dragging, pushing) - being projectable (kicking, throwing, rolling) - being combinable (positioning, stacking, connecting)	- being transportable - being scatter-able & collectable - being hide-able
Animate elements can contribute to bodily play by ...	Animate elements can contribute to dispersed play by ...
- being followable (walking, crawling, running) - being dodgeable and catch-able (running, jumping, grabbing, side-stepping) - being communicate-with-able (clapping, waving, imitating)	- being ambulatory and thus followable - making a plaything respond differently in different places

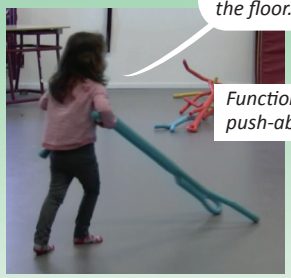
Free play

Creating room for children's unstructured and self-directed play

Loose elements

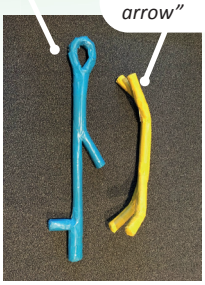
Offer multiple functionalities

Stickz offer different functionalities, affording different play activities (e.g. imaginative play and constructive play)



Make shape multi-interpretable

The different shapes of Stickz trigger different associations (e.g. vacuum cleaner or airplane), resulting in a variety of play narratives.



Landscape elements

Allow children to make 'special places'

With the Track Me blocks, children can make an enclosure that serves as a special places (e.g. a secret cave)

Make things unstable

Due to the loose connection points and irregular shapes of Stickz, children often have to improvise in response to the instability of individual Stickz or constructions.

Make things rearrangable

With Track Me, children can continuously rearrange the blocks to form new 'tracks' or constructions to play with.

Animate elements

Make behaviour multi-interpretable

Fizzy's behaviour (e.g. shaking and rolling away) can be interpreted in various ways, eliciting different responses.

Offer variety in expressive behaviour

Hobble's different wheel sets result in a variety of expressive behaviors, affording a variety of interpretations.

Bodily play

Creating room for children to use their full body

Landscape elements

Create obstacles to overcome

The blocks of Track Me offer obstacles to crawl under, climb over, leapfrog over, and more. A therapist can use the blocks to make an obstacle course.

Offer heightened platforms

The blocks of Track Me offer platforms of different heights that can be balanced on, climbed on, jumped of, etc.

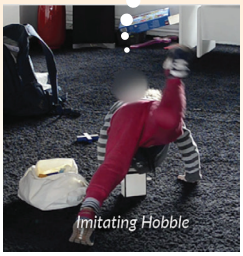
Animate elements

Make a plaything ambulatory

As Fizzy moves around children follow it, or they avoid it or try to catch it. Occasionally, children may end up on all fours.

Afford bodily communication

As Hobble moves around, children wave to encourage it to come over or imitate its expressive movement.



Create targets to aim for

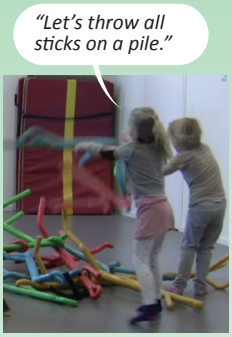
The Chase Me blocks serve as countdown targets that children run for to reach in time and hit it, or throw another object at it.

Loose elements

Make things projectable

Fizzy's spherical shape and soft embodiment, invite children to throw, kick, roll and receive it.

When Stickz are collected, they're often thrown on a pile.



Make things combinable

With Stickz, children can continuously build new structures.

With Hobble, children can make different combinations of wheels.

The Chase Me blocks can be stacked into towers.

Dispersed play

Creating room for children to expand their play area

Loose elements

Make things transportable

Stickz are continuously dragged and carried around, for example to collect Stickz or when playing swords with them. Occasionally, a child might bring a Stick to the patient room.

Fizzy can be easily picked up and brought a long to different areas of the hospital.

Animate elements

Make a plaything ambulatory

Hobble moves in different directions, depending on the attached wheel set. In this way, children follow it into different corners of the room.

Fizzy's rolling-away behaviour makes children follow it throughout the room, or into the hallway if it manages to break out.

Make things scatter-able and collectable

As children play with Stickz, they continuously get scattered over the floor and collected again, e.g. for constructive play.

Landscape elements

Create destinations

Particular places can serve as destinations to go to. A structure of Stickz that is under construction is a destination for bringing more Stickz that lay around the room.

An enclosure made out of Track Me blocks may serve as a destination for collecting other toys available throughout the space.

Chapter 7:

General discussion

This chapter reflects on the research project as a whole. First, the research questions and goals are revisited. Next follows a discussion of the contributions of the project to society, and a reflection on the research approach, with a focus on the role that design activities played in it. Limitations and recommendations for future work are integrated in each of these steps.

7.1 Stimulating young children's physical activity and play

Below we address the research questions introduced in Chapter 1. RQ1 was a question in the service of RQ2, and is addressed first, followed by more elaborate responses to RQ2 and RQ3.

RQ1: *What stimulates young children to be physically active?*

The literature indicates that young children are most active when playing outdoors, and that the physical environment plays an important role in this (Chapter 3, 4). Children perceive outdoor environments as being full of opportunities for play (Fjørtoft, 2004; Heft, 1988) and by acting on these opportunities, children engage in physical activity in an unstructured and spontaneous way. The literature suggests that environments with natural elements are particularly stimulating for young children's physical activity and imagination.

Based on the literature and our early explorations in hospital contexts, we identified a promising new direction for understanding and promoting children's physical activity, focused on playthings and environments with an open-ended character. Within this direction, this thesis developed a design perspective that we call 'Playscapes', with which we argue that stimulating young children's physical activity is a matter of bringing opportunities for *free*, *bodily* and *dispersed* play within children's proximity (Chapter 3, 4). In addressing RQ2, we built empirical evidence for this argument (see next paragraph). The design perspective is a novel contribution in interaction design research: it builds on existing work on 'open-ended play' and offers a needed alternative to exergames and other game-oriented approaches, as it is specifically attuned to the spontaneous and unstructured way in which young children tend to be physically active. Playscapes aims to *direct* young children's interactions towards physical activity (like 'exergames'), while *creating space* for children's self-directed play (as in the case of 'open-ended play').

RQ2: *What stimulates young children with cancer to be physically active during hospitalization?*

Taking a Playscapes perspective, we hypothesized that bringing opportunities for free, bodily and dispersed play within the proximity of children with cancer (e.g. in the patient room or waiting area) will stimulate their physical activity. Through the development of Fizzy and Stickz – two playthings that instantiate the Playscapes perspective (Chapter 3) – and their implementation in a pediatric oncology center (Chapter 4), we built first evidence for this. Fizzy and Stickz demonstrate that hospital environments can be turned into locations that enable free, bodily and dispersed play and that this stimulates young children with cancer to be physically active (Chapter 4). Furthermore, the fieldwork with Fizzy and Stickz shows that playthings can contribute to the qualities of free, bodily and dispersed play in very distinct ways (Chapter 4). On a more general level, the fieldwork showed that young children with cancer, despite their predicament, have an inherent drive to act on the opportunities for play that are available in their proximity and that they can be physically active while doing so.

What stood out in our observations of young children's physical activity in the field (Chapter 4) was the role of parents. Some parents played along or facilitated play by following the child while holding the IV pole, while others instructed or educated their child. When aiming to stimulate young children's physical activity, these mediating roles of parents needs to be taking into account. While Playscapes focuses on the role of playthings and environments in stimulating the children's physical activity, the important role of parents suggests a fruitful direction for future research that is more family-centered. By understanding parents' mediating roles better, this could not only inform designers, but also healthcare practitioners who are increasingly collaborating with parents to optimize care for the child.

Although the research presented in this thesis gives a rich understanding of young children's physical activity and play in hospital environments, it was limited in both space and time. With respect to time, our conclusions are limited to interactions within a relatively short time frame (several minutes up to 1 hour). We suggest future work should study interactions over a longer period of time, focusing on whether and how children remain engaged with Playscape designs and how this affects children's level of physical activity. We hypothesize that the

open-ended character of Playscape designs, and the social settings in which they are used, allows for children to re-appropriate the designs through recurring encounters in the hospital, keeping children engaged and physically active during hospitalization over longer periods of time. With respect to space, our research is limited in particular in terms of understanding dispersed play. While our study clearly showed how play occurred throughout a particular room, our set-up did not allow us to observe interactions *throughout the hospital*. Inquiring into play as it occurs on this higher level of dispersion would be valuable in particular in the context of long-term play dynamics and physical activity patterns. For example, it is conceivable that bringing a Stick along from a play area to the patient room, may later serve as a motivator to return to that same play area; the movement between these locations brings about physical activity.

RQ3: *Does Playscapes support designers in generating appropriate design solutions for stimulating young children's physical activity?*

My own designs (Chapter 3, 4) and those of design students (Chapter 6) demonstrate that the concept of Playscapes leads to appropriate design solutions for stimulating young children's physical activity and play. The solutions are 'appropriate' particularly with respect to how well the designs are attuned to the way in which young children naturally engage in physical activity and play. To support making Playscape designs appropriate for particular healthcare contexts, this thesis points at several stakeholder concerns that can serve as focal points for initial contextual inquiry in design projects (Chapter 5).

This thesis also shows that applying Playscapes comes with particular challenges. Design students had difficulties to design for play that is free, bodily and dispersed in an integral manner and indicated that they found it hard to get a feel for young children's physical activity and play and how playthings play a stimulating role in hospital environments (Chapter 5). Chapter 6 presents a *Playscapes brochure* that addresses these issues. First, it is explicit about the need to integrally pursue the three play qualities and it offers a vocabulary that helps designers to reason and express themselves during the design process. Second, the brochure offers concrete design strategies, accompanied with descriptions of particular interactions between children and playthings, which supports designers in *taking action* according to the Playscapes perspective and getting *a feel* for young children's physical activity and play.

As it stands, the brochure represents the authors' best insights on how to guide designers to apply a Playscapes perspective in their design activities. The brochure does not convey contextual sensitivity to designers, so we advise designers to use it in combination with fieldwork in the context of application. To date, the brochure has not been evaluated formally in design settings. Doing so can lead to an improved understanding of the usefulness and usability of Playscapes for design practice.

7.2 Contributions to society

Playscapes makes a significant contribution to improving how we design for young children with cancer. It is more than an approach to stimulating physical activity; it focuses on the child rather than the disease, and it enables playful experiences not only for the individual child but also other children and family members. With Fizzy we saw a variety of play activities emerge between children and parents, which created shared moments of joy and laughter. With Stickz, children were often immersed in their building project and showed pride when viewing and sharing their final result. Sometimes other children joined the building activity, or suggested other ways of playing to the patient, creating moments of collaboration, negotiation and improvisation. Given the above, the contribution of Playscapes to 'development-based care' (Chapter 1) goes beyond promoting children's physical activity and development; it also supports children to develop socially and emotionally and can play an important role in improving the child's and family's hospital experience.

Based on our research, we suggest Playscapes can be applied on multiple levels of care, ranging from basic care to more targeted and specialized care. Stickz, for example, can be made available in semi-public areas to all hospitalized children, provided that children are ambulatory and able to leave the patient room. Fizzy, on the contrary, can be used in more targeted care by deploying it with children that are confined to their patient room due to risk for infection. Another possibility for using Playscapes for targeted healthcare is in therapy, as illustrated by Hobble, Track Me, and Chase Me (Chapter 6; Luu, 2018; D. Stam, 2017). In future work it would be interesting to explore further how particular Playscape elements can be used to elicit particular interactions, by having therapists organize them in particular ways or allowing them to adjust particular parameters (e.g. speed, height, weight, etc.).

The value of Playscapes, as outlined above, depends on the extent to which design and healthcare professionals will deploy it in practice. In this thesis several measures were taken to facilitate implementation. We aimed to make the insights that were generated actionable and finally compiled these insights in the format of a brochure (Chapter 6). The brochure is available online as well as in print (https://studiolab.ide.tudelft.nl/boon/playscapes).

Finally, we suggest that Playscapes' and the brochure's applicability and value extend beyond healthcare contexts to, for example, schoolyards, residential areas, playgrounds and home environments. A reason for this is that Playscapes addresses needs that are more generally shared among young children, whether they are healthy or ill – e.g., the need to play, to move, to explore or to learn. Accordingly, the future application of Playscapes may shift from curative to preventive healthcare, supporting designers in addressing conditions such as childhood obesity (e.g. see Høiseth & Van Mechelen, 2017).

7.3 Reflections on research through design

In this PhD project, design activities were central to the research process. Below we share our reflections with respect to how this approach was challenging as well as helpful in addressing the research goals and questions.

Knowledge on different levels of abstraction

This thesis developed knowledge contributions on multiple levels of abstraction (see Figure 26). These different levels fit the discourse on *intermediate-level knowledge* in design research, which discusses formats such as annotated portfolios, guidelines and strong concepts (B. Gaver & Bowers, 2012; Höök & Löwgren, 2012; Löwgren, 2013). These formats occupy the space between the 'ultimate particular' (Stolterman 2008) of the single prototype (i.e. concrete, but difficult to generalize) and formal theory (i.e. general, but difficult to apply in a particular situation). In this thesis, the Playscape concepts form the most abstract knowledge contribution, together opening up a solution space; the play qualities serve as central goals and the Playscape elements as generic design directions to achieve these goals (Chapter 3, 4). The design strategies offer more concrete and narrow design directions within this solution space, connecting to particular Playscape concepts (Chapter 4, 6). Finally, descriptions

of interactions with playthings, and of the playthings themselves, are the most concrete level of knowledge presented in this thesis (Chapter 6). While typically such descriptions are not seen as knowledge contributions, we argue that they are and that they play an important role by 'speaking the language of designers', allowing designers to obtain an intuitive understanding about what it means to promote young children's physical activity from a Playscapes perspective.

To support designers in creating appropriate solutions, it is useful to generate and disseminate knowledge contributions on multiple levels of abstraction. In the case of Playscapes, the more abstract Playscape concepts bring a general perspective and open up a solution space, while the more concrete design strategies and examples populate this solution space, thereby making Playscapes more accessible and better actionable for designers.

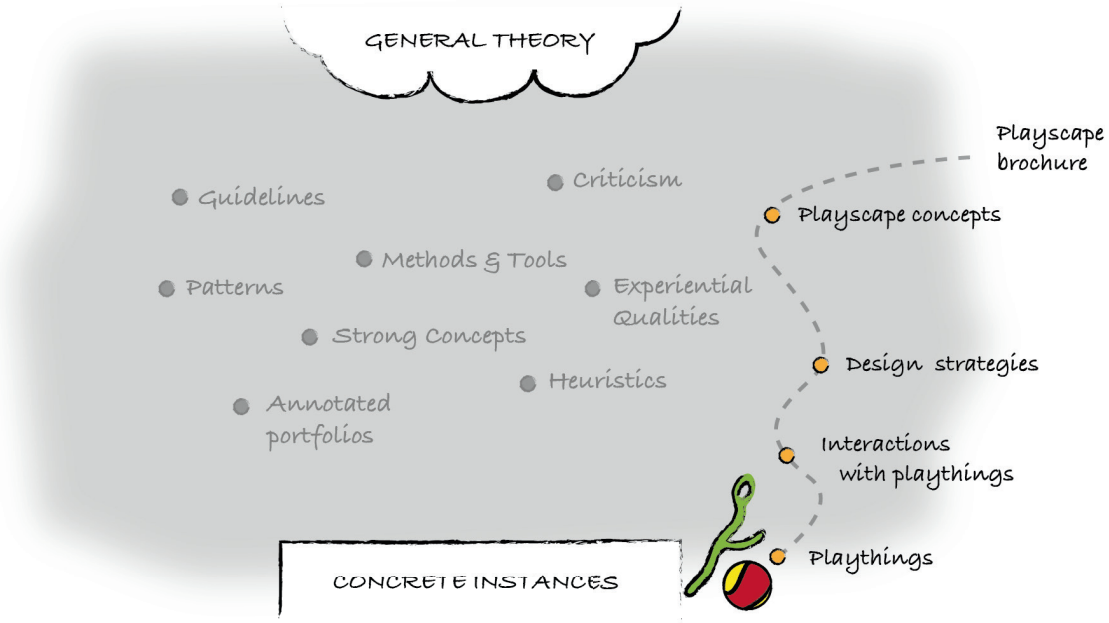


Figure 26 This thesis contributes knowledge on different layers of abstraction, which come together in the Playscapes brochure presented in Chapter 6. Figure adapted from Höök & Löwgren (2012)

Combining design and research activities

Research through design requires the integration of design and research activities in one process (Basballe & Halskov, 2012; Stappers & Giaccardi, 2017), which poses particular challenges. In this project, the development of Playscapes became the main thread of the thesis, offering an initial frame or foundation that structured the research (Chapter 2; Binder & Redström, 2006; Stappers et al., 2015). In the midst of doing research, however, it was experienced as difficult to pinpoint how the development of Playscapes, the design of playthings, and addressing research questions related to one another. Looking back, it is clear that these activities are alternately at the service of one another, and that in this way progress is made in achieving both design and research goals. For example, reading about what stimulates young children's physical activity in the literature (research activity) gave me input for the development of Playscapes (design activity as tool developer), which helped me to make decisions with respect to Fizzy and Stickz (design activity as product designer), which in turn allowed me to ground Playscapes empirically (design activity as tool developer), etc. Informing novice design researchers (e.g. first year PhD candidates) about the possible relations between research and design activities may support them to plan such activities more deliberately and perform them more confidently then they otherwise would have.

Research through design in healthcare

Healthcare environments are highly structured environments, governed by rules and protocols. This has implications for RtD on several levels, which I outline below.

Involving end-users – In the context of interaction design research, RtD projects typically require the involvement of end users for generative or evaluative purposes. In healthcare, however, involving end users can be challenging for design researchers (Groeneveld et al., 2018). Our close collaboration with the Princess Máxima Center was important for involving young children with cancer and their families. Pediatric oncologists opened the door to patient groups, and played a key role in selecting and approaching families for the study with Fizzy. During the fieldwork with Stickz, nurses informed families about the study as they entered the ward, and asked if they would be interested in participating. Such support is crucial in realizing RtD projects in healthcare that require the involvement of patients.

Preparing prototypes for fieldwork – In RtD, prototypes play a central role in generating knowledge (Stappers, 2014; Wensveen & Matthews, 2015) and in the context of interaction design they are typically used to realize the interaction under study (Stappers & Giaccardi, 2017). Studying patients' interactions in hospital environments poses certain requirements. For example, technologically advanced prototypes may interfere with existing infrastructure. In the case of Fizzy, for example, we could not make use of WiFi technology for remotely controlling the prototype, while Bluetooth was allowed. There are also requirements with respect to safety and hygiene, as children with cancer run high risks for infections. This urged us to pay extra attention to the cleanability of the prototypes, leading to particular material choices.

The frequency of design iterations – In some approaches to RtD, the iterative or cyclical nature of design plays an important role in the research (e.g. Bang & Eriksen, 2014). In the early stages of an RtD project, such iterations can be very short, consisting of the creating and sharing of initial ideas by making use of low fidelity prototypes. Involving patients in this early stage can be beneficial, for example, to see whether the ideas fit the needs of the users. Such initial and short design iterations, however, are difficult to perform in healthcare, as involving patients requires an often lengthy process of getting permission from a medical ethical review committee. Preparing a proposal and having it evaluated takes several weeks up to months, depending on whether the study is seen as medical or as subjecting people to actions or imposing rules of behavior. In this research project, we dealt with these limitations by testing early prototypes with healthy children, which helped us to get an initial understanding of how young children play and move, and by presenting early ideas to healthcare professions, which helped us to see whether the ideas fit the context of a pediatric oncological hospital.

Towards RtD 'styles', 'genres', and quality criteria

Above we shared several reflections about the benefits and challenges of doing design as part of doing research. These reflections are based on our specific project in which design activities were integrated in a particular way. Our project is very different, however, from projects based on critical practice (e.g. Mazé & Redström, 2008) or on experimental research (e.g. Wensveen, 2005), to give two examples. The plurality of approaches to RtD, together with a lack of established words, models and practices (Stappers & Giaccardi, 2017), make it difficult to evaluate the quality of RtD work.

In a recent series of discussions[1] hosted in the StudioLab, TU Delft, participating researchers came to the shared conclusion that it would be valuable to distinguish different 'styles' or 'genres' of RtD and to formulate quality criteria accordingly. We believe this will not only contribute to evaluating the quality of RtD work, but will also support design researchers in planning their work and performing it more competently and confidently.

7.4 To conclude ...

This dissertation generated new insights about what stimulates physical activity in young children with cancer, in particular in hospital environments. Through the development of Playscapes we made this knowledge accessible and actionable to other designers that pursue similar goals, whether in hospitals or other children's environments. Playscapes can support designers, and other professionals, to design and organize children's environments in a way creates space for young children's physical activity and play. By doing so, young children can gain, or *regain*, access to play experiences that foster their development and wellbeing.

1 The RtD-Labtalk series was organized by Abighyan Singh, Marco Rozendaal, and Boudewijn Boon. It involved around 30 researchers from the various departments of the Industrial Design Engineering faculty at TU Delft. In particular Elisa Giaccardi, Tomasz Jaskiewicz, and Alev Sönmez made valuable comments with respect to RtD 'styles', 'genres' and quality criteria that inform our discussion here.

Summary

Overview of the chapters

In early childhood, physical activity plays a pivotal role in children's wellbeing and their development towards becoming healthy and physically competent individuals. However, young children do not always have access to the right opportunities for physical activity. In Chapter 1, we describe the problem that drove this research, namely that children with cancer show low levels of physical activity compared to their healthy peers, in particular during periods of hospitalization. In the research project, we set the goals to promote physical activity of children with cancer during hospitalization, and to develop a form of design guidance for designers with similar intentions. Both goals were addressed in close collaboration with the Princess Máxima Center for Pediatric Oncology in Utrecht, the Netherlands. This medical center also served as a context for our fieldwork with hospitalized children and healthcare professionals.

In line with our goals, this dissertation addresses three research questions. First, we gained information and inspiration from children's physical activity more generally by asking:

> ***RQ1:*** *What stimulates young children to be physically active?*

The findings of the first question were at the service of hypothesizing an answer to the second research question, which was the central question of this thesis:

> ***RQ2:*** *What stimulates young children with cancer to be physically active during hospitalization?*

Throughout the PhD trajectory, answering the first two questions went parallel with the development of Playscapes – a design perspective on young children's physical activity and play (see below). The third research question centers on the generative value of Playscapes for designers:

> ***RQ3:*** *Does Playscapes support designers in generating appropriate design solutions for stimulating young children's physical activity?*

In Chapter 2 we describe our approach to address the research questions and pursue our design goals. This approach is characterized by the integral role of design actions in generating knowledge. Design actions are taken on two levels. At one level, the researcher is a product designer, generating design solutions to stimulate physical activity and implementing prototypes of these solutions in a real-world hospital context. At another level, the researcher is a tool developer, where design actions are used to develop guidance for other designers to use when aiming to stimulate young children's physical activity. In the project, the design solutions and the design guidance are developed in conjunction with each other. The design solutions come in the form of *playthings* – i.e. 'things to play with' with an open-ended and ambiguous character. The design guidance that is developed is a '*design perspective'* – i.e. a conceptual framework to support designers in understanding a phenomenon in a particular way, and to design solutions according to this understanding. It points in a certain direction, and thereby opens up a particular solution space. In this thesis we develop *Playscapes* – a design perspective on young children's physical activity and play.

Chapter 3 develops the initial idea of Playscapes and positions it in the field of interaction design research as a much-needed alternative to more exercise- and game-oriented approaches to stimulating children's physical activity. Playscapes is inspired and informed by literature on outdoor play and by the development of two playthings: Fizzy and Stickz. The design perspective orients designers towards creating playthings and environments for play that is *free*, *bodily*, and *dispersed*. Free play is play that is unstructured, spontaneous and self-directed; bodily play is play that involves the full body, making use of the large muscles; dispersed play is play that spans a wide area, potentially moving beyond the boundaries of a dedicated play area or other demarcated space. These play qualities can help designers to generate design solutions that stimulate young children's physical activity. The three qualities were central in the development of Fizzy and Stickz, two playthings specifically designed for children with cancer in the hospital. Fizzy is a pro-active and self-propelled ball with a cheeky character, designed to invite young children in the patient room to engage with it and play in a physical way. Stickz are a collection of large and soft, yet sturdy, branch-shaped objects, designed to enable young children in waiting areas to play imaginative and constructive play. By comparing these Playscape designs with two exercise-based interventions, we point out the merits of Playscapes.

Chapter 4 empirically grounds Playscapes, based on two field studies in which prototypes of Fizzy and Stickz are implemented in a pediatric oncology center. Stickz were positioned in a semi-public waiting area; Fizzy was introduced to patient rooms. We made video recordings of the interactions between children and the two Playscape designs. Free play was analyzed according to the diversity of play activities, bodily play according to the diversity of muscle groups used, and dispersed play according to the floor area covered in play. Fizzy and Stickz differed significantly in how they stimulated physical play. From our findings we abstract a set of design strategies that can be applied in different contexts where the aim is to stimulate children's physical play. With this set of strategies, Playscapes offers a concrete alternative to existing approaches in that it supports designers in directing interactions towards physical activity while leaving room for children's unstructured and spontaneous play.

Chapter 5 takes a step towards developing concrete developing tools and techniques to facilitate designers in applying Playscapes. We report on two successive studies: i) an ideation workshop with design students and ii) a design exhibition with stakeholders in a pediatric hospital, in which the workshop outcomes were presented. In the two studies we examine whether and how design students use the play qualities (i.e. free, bodily, and dispersed play) in generating design solutions; the first study looks at how design students explain their ideas and how this reflects the play qualities, and the second study looks at how stakeholders evaluate the design outcomes of the workshop according to the play qualities. An important finding is that design students had difficulties in applying the three play qualities in an integral way. Furthermore, they indicated having a lack of concrete examples of children's interactions with playthings or play environments in hospital environments. Based on the findings from the two studies we give recommendations on how to further develop Playscapes into a set of design tools and techniques.

Chapter 6 explores and explains the solution space of Playscapes, by populating it with additional design examples and strategies. The design examples used were all designed from a Playscapes perspective. This wider range of design examples and strategies shows that Playscapes allows designers to create a variety of design solutions that are appropriate for different healthcare contexts, as well as other contexts. We present the design examples and strategies in the format of a visual brochure. The brochure can serve as a catalogue of inspiration for designers that are developing their own solutions for stimulating young children's physical activity and play.

Finally, Chapter 7 looks back at the PhD project as a whole. The chapter describes our responses to the research questions, the societal contributions of the thesis and discussion of the research approach, in which design actions played a central role. Below we address each of these points.

Addressing the research questions

In response to RQ1, the literature indicates that healthy young children are most active when playing outdoors, and that the physical environment plays an important role in this. Children perceive outdoor environments as being full of opportunities for play and by acting on these opportunities, children engage in physical activity in an unstructured and spontaneous way. The literature suggests that environments with natural elements are particularly stimulating for young children's physical activity and imagination. Within this scope, this dissertation developed the Playscapes perspective, which proposes that stimulating young children's physical activity is a matter of bringing opportunities for free, bodily and dispersed play within children's proximity.

In response to RQ2, this thesis demonstrates that hospital environments can be turned into locations for play that is free, bodily and dispersed, and that this stimulates young children with cancer to be physically active. This thesis also shows, on a more general level, that young children with cancer, despite their predicament, have an inherent drive to act on the opportunities for play that are available in their proximity and that they can be physically active while doing so. An additional finding of our fieldwork was the important role of parents in mediating children's play. When aiming to stimulate young children's physical activity, these mediating roles of parents need to be taken into account, in particular in the case of hospitalized children whose parents tend to be continuously present.

In response to RQ3, the designs presented in this thesis, designed by the lead researcher as well as design students, demonstrate that taking a Playscapes perspective leads to appropriate design solutions for stimulating young children's physical activity and play. Taking a Playscapes perspective, however, come with particular challenges. The workshop with design students (Chapter 5) showed that students found it hard to design for play that is free, bodily and dispersed in an integral manner.

They also had difficulties getting a feel for young children's physical activity and play and how playthings could play a stimulating role in hospital environments. Chapter 6 presents a brochure that addresses these issues. First, it is explicit about the need to integrally pursue the three play qualities and it offers a vocabulary that helps designers to reason and express themselves during the design process. Second, the brochure makes the subject matter accessible and actionable for designers, by offering images and descriptions of concrete interactions between children and playthings, in addition to the more abstract concepts such as the three play qualities.

Societal contributions

Playscapes is more than an approach to stimulating physical activity; it focuses on the child rather than the disease, and it enables playful experiences not only for the individual child but also other children and family members. We suggest Playscapes can be applied on multiple levels of care, ranging from basic care to more targeted and specialized care. To illustrate, while Fizzy was designed for hospitalized children's physical activity more generally, it could also be made suitable for particular uses physiotherapy. For example, by making Fizzy's speed and acceleration adjustable, physiotherapists can challenge children at the right level and potentially obtain a better picture of children's motor skills.

The value of Playscapes, as outlined above, depends on the extent to which design and healthcare professionals will deploy it in practice. For this reason, we compiled the insights generated in this thesis in the format of a brochure, which makes the insights concrete and actionable (Chapter 6). The brochure is accessible online (see: http://studiolab.ide.tudelft.nl/studiolab/boon/playscapes/). We suggest that the value and applicability of Playscapes and the brochure extend beyond healthcare contexts. Also schoolyards, residential areas, playgrounds and home environments, for example, can be considered as contexts where it would be valuable to create space for children's physical activity and play.

Research through design

This thesis shares several reflections and suggestions with respect to doing design as part of doing research. Based on our experiences, it describes what worked in terms of combining design and research activities and how to tackle particular challenges of doing research through design in a healthcare context. One of the main points that we outline, concerns the merit of generating knowledge of multiple levels of abstraction; we suggest that doing so increases the extent to which the knowledge is actionable for designers. In the case of Playscapes, the more abstract Playscape concepts offer designers a *perspective* on children's physical activity, opening up a particular solution space, while the more concrete knowledge contributions give designers resources for taking action according to this perspective.

A more general recommendation that we make for the field of design research is to distinguish different 'styles' or 'genres' of research through design and to specify quality criteria according to these categories. We believe this will contribute to evaluating RtD work, as well as support design researchers in planning and performing their work more competently and confidently.

Samenvatting

Overzicht van de hoofdstukken

In de jonge jaren speelt lichaamsbeweging een centrale rol in het welzijn van kinderen en in hun ontwikkeling naar gezonde en fysiek competente individueën. Helaas hebben kinderen niet altijd toegang tot de juiste mogelijkheden voor lichaamsbeweging. In Hoofdstuk 1 beschrijven we het probleem dat dit onderzoek heeft gedreven, namelijk dat kinderen met kanker weinig lichaamsbeweging vertonen vergeleken met hun gezonde leeftijdsgenoten, met name tijdens periodes van ziekenhuisopname. In het onderzoeksproject hebben we het doel geformuleerd om lichaamsbeweging bij kinderen met kanker in het ziekenhuis te bevorderen, en om richtlijnen te ontwikkelen voor ontwerpers met soortgelijke intenties. Beide doelen zijn aangepakt in nauwe samenwerking met het Prinses Máxima Centrum voor kinderoncologie in Utrecht. Dit centrum diende ook als context voor ons veldonderzoek met gehospitaliseerde kinderen en ziekenhuisstaf.

In lijn met onze doelen richt dit proefschrift zich op onderzoeksvragen. Eerst hebben we informatie en inspiratie opgedaan door te kijken naar lichaamsbeweging bij jonge kinderen in het algemeen, met de vraag:

RQ1: *Wat stimuleert jonge kinderen om lichamelijk actief te zijn?*

De bevindingen die volgden op de eerste onderzoeksvraag stonden ten dienste van het formuleren van een hypothetisch antwoord op de tweede onderzoeksvraag. Deze vraag staat centraal in dit proefschrift:

RQ2: *Wat stimuleert jonge kinderen met kanker om lichamelijk actief te zijn tijdens ziekenhuisopname?*

De eerste twee onderzoeksvragen zijn geadresseerd in parallel met het ontwikkelen van 'Playscapes' – een ontwerpperspectief op lichaamsbeweging en spel bij jonge kinderen (zie hieronder). De derde onderzoeksvraag richt zich op de generatieve waarde van Playscapes voor ontwerpers:

RQ3: *Ondersteunt Playscapes ontwerpers bij het genereren van passende ontwerpoplossingen voor het stimuleren van lichaamsbeweging bij jonge kinderen?*

In Hoofdstuk 2 beschrijven we onze aanpak om de onderzoeksvragen te beantwoorden en de ontwerpdoelen na te streven. Deze aanpak is gekarakteriseerd door de integrale rol die ontwerphandelingen spelen bij het genereren van kennis. Ontwerphandelingen zijn uigevoerd op twee niveaus. Op het eerste niveau werkt de uitvoerend onderzoeker als productontwerper, waarbij hij ontwerpoplossingen genereert om lichaamsbeweging te stimuleren en hij prototypes implementeert in een ziekenhuisomgeving. Op een ander niveau werkt de onderzoeker als ontwerper van ontwerptools, waarbij ontwerphandelingen gericht zijn op richtlijnen voor andere ontwerpers die lichaamsbeweging bij jonge kinderen willen stimuleren. In het project worden de ontwerpoplossingen en richtlijnen ontwikkeld in onderlinge samenhang. De ontwerpoplossingen nemen de vorm aan van speelobjecten (in het Engels 'playthings') – met ander woorden, 'dingen om mee te spelen' met een open en ambigu karakter. De richtlijnen worden ontwikkelt in de vorm van een 'ontwerpperspectief' – een conceptueel raamwerk dat ontwerpers helpt een fenomeen op een bepaalde manier te begrijpen, en te ontwerpen volgens dit begrip. Een ontwerpperspectief geeft een richting aan voor ontwerpers en opent daarbij een specifieke oplossingsruimte. In dit proefschrift ontwikkelen we *Playscapes* – een ontwerpperspectief op spel en beweging bij jonge kinderen.

In Hoofdstuk 3 ontwikkelen we het oorspronkelijke idee van Playscapes en positioneren we het in het gebied van 'interaction design research', als een alternatief voor meer trainings- en game-geörienteerde aanpakken voor het stimuleren van lichaamsbeweging. Playscapes is geïnspireerd en gebaseerd op literatuur over lichaamsbeweging en buiten spelen bij jonge kinderen, en het ontwikkelen van twee speelobjecten: Fizzy en Stickz. Het ontwerpperspectief moedigt ontwerpers aan om speelobjecten en omgevingen te ontwerpen voor spel dat *vrij*, *lichamelijk* en *verspreid* is. Vrij spel is spel dat ongestructureerd, spontaan en zelfgestuurd is; lichamelijk spel is spel waarin het hele lichaam wordt gebruikt, met name de grote spieren; verspreid spel is spel dat een wijds gebied bestrijkt en wat mogelijk de grenzen overschrijd van een toegewijde speelruimte of een andere afgebakende ruimte. Deze drie kwaliteiten in spel kunnen ontwerpers helpen bij het genereren van oplossingen voor het stimuleren van lichaamsbeweging bij jonge kinderen. De drie kwaliteiten stonden centraal in de ontwikkeling van Fizzy en Stickz, twee speelobjecten specifiek ontworpen voor kinderen met kanker tijdens ziekenhuisopname. Fizzy is een proactief zelfaangedreven balletje met een brutaal karakter, ontworpen om kinderen in de patientenkamer

uit te nodigen te improviseren en om het als bal te gebruiken (gooien, rollen, schoppen). Stickz zijn een collectie van grote, zachte, maar toch robuuste, takvormige objecten, ontworpen voor constructief en fantasierijk spel in de wachtkamer. Door deze twee Playscape ontwerpen te vergelijken met twee op training gebaseerde interventies, wijzen we op de verdiensten van Playscapes.

Hoofdstuk 4 onderbouwt Playscapes empirisch, gebaseerd op twee veldstudies met prototypes van Fizzy en Stickz in een kinderoncologisch centrum. *Stickz* zijn geplaatst in een semi-publieke wachtruimte en *Fizzy* is geïntroduceerd in patiëntenkamers. Er zijn video opnames gemaakt van de interacties tussen kinderen en de ontwerpen. Vrij spel is geanalyseerd door te kijken naar de diversiteit aan spelactiviteiten, lichamelijk spel door te kijken naar welke spiergroepen kinderen gebruikten, en verspreid spel door te kijken naar de hoeveelheid vloeroppervlak dat het spel innam. Fizzy en Stickz stimuleerde fysiek spel op zeer verschillende manieren. Op basis van onze bevindingen hebben we een set van ontwerpstrategieën geformuleerd die in verschillende contexten toegepast kunnen worden waar het doel is om lichaamsbeweging bij kinderen te stimuleren. Met deze set van strategieën biedt Playscapes een concrete alternatief voor bestaande ontwerpaanpakken door interacties te sturen in de richting van lichaamsbeweging, terwijl er ook ruimte blijft voor kinderen om ongestructureerd en spontaan te spelen.

Hoofdstuk 5 neemt stappen in de richting van het ontwikkelen van ontwerptools en technieken om ontwerpers te ondersteunen in het toepassen van Playscapes. We beschrijven twee opeenvolgende studies: i) een ideegeneratie workshop met ontwerpstudenten en ii) een expositie met stakeholders in een kinderoncologisch centrum, waar de uitkomsten van de workshop gepresenteerd zijn. In de twee studies onderzoeken we hoe de ontwerpstudenten de drie kwaliteiten in spel (vrij, lichamelijk en verspreid spel) gebruiken in het genereren van ideeën. De eerste studie kijkt naar hoe studenten hun ideeën en ontwerpuitkomsten toelichten en hoe dit de drie spelkwaliteiten weerspiegelt. In de tweede studie kijken we naar hoe stakeholders de ontwerpuitkomsten evalueren met de spelkwaliteiten als uitangspunt. Een belangrijke bevinding is dat ontwerpstudenten het lasting vonden om de drie spelkwaliteiten integraal toe te passen. Daarnaast gaven ze aan dat ze concrete voorbeelden misten van interacties tussen kinderen en speelobjecten in ziekenhuisomgevingen. Op basis van deze bevindingen doen we aanbevelingen over hoe Playscapes verder te ontwikkelen tot een set van ontwerptools en technieken.

Hoofdstuk 6 verkent de oplossingsruimte van Playscapes, door deze eerste de definiëren en vervolgens in te vullen met ontwerpvoorbeelden en strategieën. De gebruikte ontwerpvoorbeelden zijn allemaal ontworpen vanuit een Playscapes perspectief. Deze bredere reeks voorbeelden en strategieën laten zien dat Playscapes ontwerpers de ruimte geven om een variëteit aan ontwerpoplossingen te creëren die passend zijn voor verschillende zorgcontexten, evenals andere contexten. We presenteren de ontwerpvoorbeelden en strategieën in de vorm van een visuele brochure. De brochure kan dienen als een inspirerende catalogus voor ontwerpers die hun eigen oplossingen willen ontwikkelen voor het stimuleren van spel en beweging in jonge kinderen.

Tenslotte kijken we in Hoofdstuk 7 terug op het PhD project als geheel. Het hoofdstuk beschrijft onze antwoorden op de onderzoeksvragen, de maatschappelijke bijdragen van het onderzoek en reflecties over de onderzoeksaanpak, waarin ontwerphandelingen een centrale rol speelden. Hieronder behandelen we elk van deze punten.

Antwoorden op de onderzoeksvragen

Met betrekking tot de eerste onderzoeksvraag (RQ1) geeft de literatuur aan dat gezonde jonge kinderen het meest actief zijn wanneer ze buiten spelen en dat de fysieke omgeving hier een belangrijke rol in speelt. Kinderen zien buitenomgevingen als zijnde vol met mogelijkheden voor spel en door deze mogelijkheden te benutten zijn ze lichamelijk actief op een ongestructureerde en spontane manier. De literatuur suggereert dat omgevingen met natuurlijke elementen vooral stimulerend zijn voor de beweging en verbeeldingskracht van jonge kinderen. Vanuit dit kader ontwikkelt dit proefschrift het Playscapes perspectief, waarin wordt voorgesteld dat het stimuleren van beweging bij jonge kinderen een kwestie is van het creëren van mogelijkheden voor vrij, lichamelijk en verspreid spel en deze aan te bieden in de nabijheid van kinderen.

In reactie op RQ2 laat dit onderzoek zien dat ziekenhuisomgevingen omgezet kunnen worden in locaties voor vrij, lichamelijk en verspreid spel, en dat dit beweging stimuleert in kinderen met kanker. Op een algemener niveau laat dit onderzoek ook zien dat kinderen met kanker, ondanks hun situatie, een inherente neiging hebben om mogelijkheden voor spel in hun nabije omgeving te benutten en dat ze hierbij lichamelijk actief kunnen zijn. Een extra bevinding is dat ouders een belangrijke

rol speelden in het spel van de kinderen. Wanneer het doel is om lichaamsbeweging te stimuleren bij jonge kinderen, is het belangrijk rekening met deze rol, vooral bij gehospitaliseerde kinderen waarbij ouders continu aanwezig zijn.

In reactie op RQ3, presenteert dit proefschrift ontwerpoplossingen die door de uitvoerend onderzoeker en ontwerpstudenten ontworpen zijn. Deze uitkomsten demonstreren dat het toepassen van Playscapes kan leiden tot passende ontwerpoplossingen voor het stimuleren van lichaamsbeweging en spel bij jonge kinderen. Het toepassen van Playscapes komt echter ook met uitdagingen. Bij de ideegeneratie workshop (Hoofdstuk 5) bleek dat de meeste studenten de kwaliteiten van vrij, lichamelijk en verspreid spel niet op een integrale manier gebruikten. Ook gaven ze aan dat het lastig was om een gevoel te krijgen voor spel en beweging bij jonge kinderen en hoe speelobjecten hier een stimulerende rol in kunnen spelen in ziekenhuisomgevingen. Hoofdstuk 6 presenteert een brochure dat inspeelt op deze kwesties. Ten eerste is de brochure expliciet over de noodzaak om de drie kwaliteiten integraal na te streven, en daarbij biedt het een vocabulaire aan dat ontwerpers ondersteunt in het redeneren en het uiten van hun ideeën in het ontwerpproces. Ten tweede maakt de brochure het onderwerp toegankelijk en werkbaar voor ontwerpers, door naast de abstractere concepten van het ontwerpperspectief ook concretere vormen van kennis aan te bieden, zoals afbeeldingen en beschrijvingen van concrete interacties tussen kinderen en speelobjecten.

Maatschappelijke bijdragen

Playscapes is meer dan een aanpak voor het stimuleren van lichaamsbeweging; het richt zich op het kind in plaats van op de ziekte, en het maakt speelse ervaringen niet alleen mogelijk voor het individuele kind, maar ook voor andere kinderen en familieleden. Playscapes kan toegepast worden in meerdere lagen van de zorg, variërend van basiszorg tot meer gerichte en gespecialiseerde zorg. Ter illustratie: al is Fizzy ontworpen voor het stimuleren van lichaamsbeweging bij gehospitaliseerde kinderen in het algemeen, het gedrag kan ook geprogrammeerd worden voor specifieke toepassingen in fysiotherapie. Door bijvoorbeeld Fizzy's snelheid en acceleratie aanpasbaar te maken, kunnen fysiotherapeuten kinderen gerichter uitdagen en mogelijk een nauwkeuriger beeld krijgen van de motorische vaardigheden van kinderen.

De waarde van Playscapes, zoals hierboven beschreven, hangt af van de mate waarin ontwerp- en zorg professionals het zullen toepassen in de praktijk. In dit proefschrift hebben we de gegenereerde inzichten werkbaar gemaakt en deze verzameld in de vorm van een brochure (Chapter 6). Deze brochure is ook online beschikbaar gesteld.
(zie: http://studiolab.ide.tudelft.nl/studiolab/boon/playscapes/).
We stellen voor dat de waarde en toepasbaarheid van Playscapes en de brochure verder reikt dan alleen in zorg contexten. Denk bijvoorbeeld aan schoolpleinen, residentiële omgevingen, speeltuinen en thuisomgevingen, waar het creëren van ruimte voor spel en beweging van kinderen een meerwaarde heeft.

Research through design

Dit proefschrift bevat meerdere reflecties en suggesties rondom 'ontwerpend handelen' als centraal onderdeel van onderzoek doen, of wat ook wel 'research through design' (RtD) wordt genoemd. We hebben beschreven wat werkt wat betreft het combineren van ontwerp- en onderzoeksactiviteiten en hoe specifieke uitdagingen aan te pakken omtrent RtD in een zorgcontext. Een van de belangrijkste punten betreft de verdienste van kennis genereren op meerdere abstractieniveaus; door dit te doen, zo stellen wij, verhoog je de werkbaarheid van de kennis voor ontwerpers. In het geval van Playscapes bieden de abstractere concepten ontwerpers een *perspectief* op lichaamsbeweging bij jonge kinderen, waardoor een bepaalde oplossingsruimte wordt geöpend. Met de meer concrete kennisbijdragen kunnen ontwerpers gemakkelijk over te gaan op handelen in lijn met dit perspectief.

Een algemenere aanbeveling die we maken op het gebied van ontwerponderzoek is om onderscheid te maken tussen verschillende 'stijlen' en 'genres' van RtD en om kwaliteitscriteria volgens deze categorieën te specificeren. We verwachten dat dit zal bijdragen aan het evalueren van research through design werk, en ook ontwerponderzoekers zal ondersteunen in het plannen en uitvoeren van hun werk op een competente en zelfverzekerde wijze.

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Appendices

Appendix I: Different forms of play with Fizzy

Play type	Play activity	Description of activity
Creature play *Activities in which Fizzy was interacted with as a creature.*	Keeping captive	Enclosing Fizzy with legs or keeping it on the bed, not letting it escape
	Following	Following Fizzy around, following and catching it, and wondering where Fizzy wants to go
	Communicating	Luring Fizzy, giving orders to Fizzy or talking to it in a conversational way
	Collecting	Picking up Fizzy to bring him to a desirable place, or getting Fizzy from under the bed.
	Caring	Stroking Fizzy, gently rocking it, or holding it quietly and close to the body
Ball play *Activities that involve using Fizzy as a ball*	Throwing	Throwing Fizzy towards one another, or throwing the ball up in the air or against something.
	Rolling	Rolling Fizzy towards one another
	Kicking	Kicking the ball towards one another, or kicking it around
	Ball play (mix)	Ball play in which throwing, rolling and kicking alternate in quick succession
Exploration *Activities that involve using Fizzy as an unfamiliar or technical object*	Exploring	Initial interactions with Fizzy, exploring what it is and does
	Experimenting	Trying out various things to get responses and trying to understand how Fizzy works
	Examining	Weighing Fizzy (particular case)
Games *Activities that involve using Fizzy as a tool for the game or as player*	Traditional games	Playing tag or hide and seek
	Made up games	Playing games made up by the child or emerging from interactions, such as ‘take away ball’ or ‘to whom will Fizzy come?’
Transitory play actions *Short actions that fall in between play activities*	Transitory play actions	Various actions that form transitions between other play activities.
	Observing	Moments in between play activities in which child holds back and observes Fizzy.
Sensory play *Activities that involve using as a sensory stimulus*	Sensing	Attentively sensing Fizzy while it is purring, trying to move around or shaking
	Massaging	Using Fizzy as a massage tool while it is shaking
Functional play *Activities in which Fizzy is played with*	Balancing	Balancing Fizzy on one hand while it is shaking
	Fiddling	Playing around with Fizzy in the hands
	Lifting	Lifting Fizzy with legs to the bed
Manipulative play *Activities in which the objects around Fizzy are manipulated*	Enclosing	Surrounding Fizzy with other objects
	Manipulating environment	Preparing or manipulating the environment for playing with Fizzy
	Manipulating with objects	Attaching or placing other objects on
Dramatic play *Activities in which Fizzy is used as pretend object*	Being entertained	Watching parent acting silly in response to Fizzy’s shaking
	Pretending	Pretending Fizzy is another object
Sharing *Activities in which Fizzy was handed over to others*	Sharing	Handing over Fizzy to other
Rough-and-tumble *Activities in which Fizzy is used as tool for playfighting*	Hitting another person	Using Fizzy as a ball to hit one another

Appendix I: Different forms of play with Fizzy

Play types	Play activity	Description of activity
Constructive play *Activities that involve using Stickz as building materials or modifiable structure*	Constructing	Constructing with or without a clear goal, often including actions of collecting Stickz
	Deconstructing	Disassembling or destructing a structure of Stickz
	Maintaining	Keeping a structure of Stickz from falling over
	Manipulating	Adjusting structure of Stickz or placing an object on it
	Stacking	Placing Stickz on top of each other in a horizontal orientation
Dramatic play *Activities that involve using Stickz as pretend object or objects*	Pretending	Pretending a Stick is a water gun, vacuum cleaner, etc..
	Storytelling	Telling a story about Stickz
Landscape play *Activities in which Stickz form a landscape to move through*	Going around	Moving around constructions with skelter
	Going underneath	Sitting in a structure of Stickz, crawling in and out
	Overcoming	Jumping over or climbing a pile or construction of Stickz
	Playing in and around	Various actions in and around a structure of Stickz
Loose play *Activities in which Stickz are played with as loose elements*	Fiddling	Playing around with single Stick in the hands
	Sorting	Organizing Stickz in separate piles or naming them according to color
	Transporting	Dragging or carrying Stickz or a collection of Stickz, often in order to collect them
Rough-and-tumble *Activities in which Stickz are used as tool for playfighting.*	Playfighting	Poking or swinging Stickz at each other
Sharing *Activities in which Stickz are shared with or shown to others*	Sharing	Sharing Stickz with another child or dividing them
	Showing	Demonstrating Stickz or showing construction

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About the author

Boudewijn Boon was born in Zwaanshoek, the Netherlands. He started his PhD in 2014 at Delft University of Technology, at the department of Industrial Design. Currently he works as a postdoctoral design researcher in the Food & Eating Design Lab. Boudewijn's research centers on promoting healthy and sustainable ways of living through designerly interventions, while simultaneously enabling people's positive experiences and self-direction. He is actively engaged with 'research through design', in his own research practice, as well as by facilitating discussions and workshops among design researchers and practitioners.

Prior to his PhD research, Boudewijn worked as a research assistant on the topic of designing for mood regulation with Professor Pieter Desmet. Earlier he obtained his master degree in Industrial Ecology (MSc) – a joint master program by Delft University of Technology and Leiden University that is often referred to as 'the toolbox for sustainable development'. Towards the end of this interdisciplinary program, Boudewijn's attention turned towards designing for sustainable ways of living. He obtained his bachelor degree in product design (BEng) at The Hague University of Applied Sciences, with a specialization in human-product interaction.

List of publications

Under review

Boon, B., Baha, E., Singh, A., Wegener, F. E., Rozendaal, M. C., & Stappers, P. J. (under review for conference publication). Grappling with Diversity: Towards 'Styles' and 'Genres' of Research Through Design.

Boon, B., Rozendaal, M. C., van den Heuvel-Eibrink, M. M., van der Net, J., van Grotel, M., & Stappers, P. J. (under review for journal publication). Designing for Young Children's Physical Play: Applying Playscapes in a Pediatric Oncology Center.

Published

Rozendaal, M. C., **Boon, B.**, & Kaptelinin, V. (2019). Objects with Intent: Designing Everyday Things As Collaborative Partners. *ACM Trans. Comput.-Hum. Interact.*, *26*(4), 26:1--26:33. https://doi.org/10.1145/3325277

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