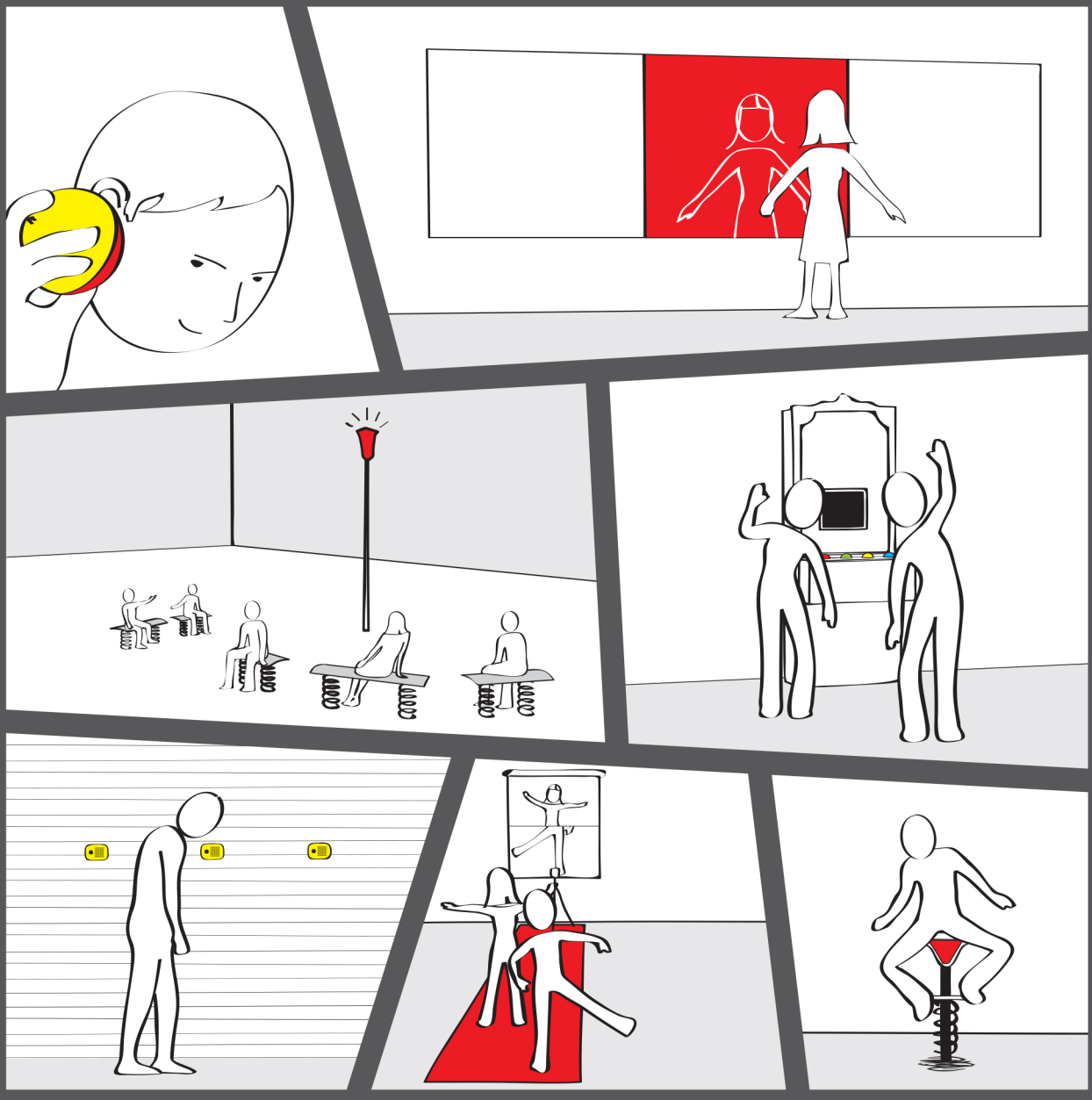
Activating play : a design research study on how to elicit playful interaction from teenagers

ROB TIEBEN

ACTIVATING PLAY

A DESIGN RESEARCH STUDY ON HOW TO ELICIT PLAYFUL INTERACTION FROM TEENAGERS



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a design research study on how to elicit playful interaction from teenagers

Doctoral dissertation by Rob Tieben

Activating Play - a design research study on how to elicit playful interaction from teenagers, by Rob Tieben.

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door

Rob Tieben

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Gallery of playful moments

Chapter 1

Introduction

Playing is beneficial to people of all ages (Huizinga, 1950; Polaine, 2010): through playful activities, people can e.g. develop skills (Piaget, 1962; Vygotsky, 1980), engage in physical activity (Goldstein, 2012), or improve cooperation and social interaction (De Kort & IJsselsteijn, 2008). The valuable qualities of play are often inherent to the playful activity; for example, children playing with a ball will run around while playing, they will compete, create and negotiate rules, and of course have a good time. They are enjoying themselves, while (inherently) developing skills and being physically and socially active (Goldstein, 2012).

This thesis is about play, more specifically about eliciting playful activities with inherent benefits. It is about designing for play with physically and socially active players, in public spaces. It is about activating play, one playful moment at a time.

The design research project described in this thesis focused on play, teenagers and public spaces. Many teenagers have a sedentary lifestyle (Marshall, Biddle, Sallis, McKenzie & Conway, 2002; Tremblay, Colley, Saunders, Healy & Owen, 2010): they sit down in the bus, during class, in their lunch break, and at home while gaming or using social media (Sikkema, 2009; CBS, 2010). Stimulating teenagers to engage in moments of physically and socially active play throughout the day can have many benefits: it can decrease sedentary behaviour while increasing social interaction, creativity and autonomy (Tremblay, Colley, Saunders, Healy & Owen, 2010).

The main goal of this design research project was *activating play: learning and showing how we can stimulate physical and social play for teenagers using interactive technology in public spaces.* Or, in other words, our goal was to motivate teenagers to get out of their chair and change their daily rhythm, by seducing them to do something which they actually like, and which is beneficial to them - playing!

This PhD project was part of the PlayFit project (2010-2014). In this four-year design research project, a consortium of universities, SMEs and government partners designed and studied playful physical activity interventions for teenagers at high schools. Most of the activities described in this thesis were performed as part of the PlayFit project.

In this introduction chapter, we will first describe the design research approach and process that we have used in this project (Sect. 1.1). The design research space is discussed next (Sect. 1.2), our focus is on motivating physical and social play for teenagers using interactive technology in public spaces. We conclude this chapter with the objectives, design research questions and contributions for this project, and an outline of the four design research cycles that are presented in this thesis (Sect. 1.3).

1.1 Design research to elicit social and active play

In this project, a design research approach was used to study how to elicit playful activity. Design research is an approach that is widely used, in our Industrial Design department of Eindhoven University of Technology and in other universities (examples are given in Zimmerman, Forlizzi and Evenson, 2007; Hoven et al., 2007; Koskinen, Zimmerman, Binder, Redström and Wensveen, 2011).

This section begins by elaborating on the design research approach and its focus areas. It continues with a brief discussion of typical outcomes of design research, in the form of intermediary knowledge: knowledge that resides between abstract theory and design practice (Dalsgaard & Dindler, 2014).

1.1.1 Design research approach

Design research is a research activity that is related to design: it is exploratory, and is both a way of inquiring and a way of producing new knowledge (Frankel & Racine, 2010). In the last decades, many analyses, discussions and frameworks have been published that describe the field of design research (e.g. Archer, 1995; Fallman, 2003; Zimmerman, Forlizzi and Evenson, 2007; Hoven et al., 2007; Koskinen, Zimmerman, Binder, Redström and Wensveen, 2011).

One commonly-used taxonomy distinguishes research for design, research through design and research about design (Frayling, 1993 in Frankel and Racine, 2010), as shown in Fig. 1.1.

Research for design is research to enable design (Downton, 2003); it provides information and insights that designers can use in specific design projects, in order to achieve a better end-result. Approaches such as Action Research (Archer, 1995) or design-oriented research (Fallman, 2003) fit in this category. Usability testing and user research are examples of research for design (Frankel & Racine, 2010).

Research through design is about creating knowledge through action-reflection in a design process (Jonas, 2007); the goal is to provide an explanation or theory within a broader context, that can be used in future general projects (Frankel & Racine, 2010). Jonas's (2007) action-reflection, Schön's (1984) reflection in action and research-through-design by Zimmerman, Forlizzi and Evenson (2007) fall in this category. The process followed in participatory design and experience design are examples of research through design (Frankel & Racine, 2010).

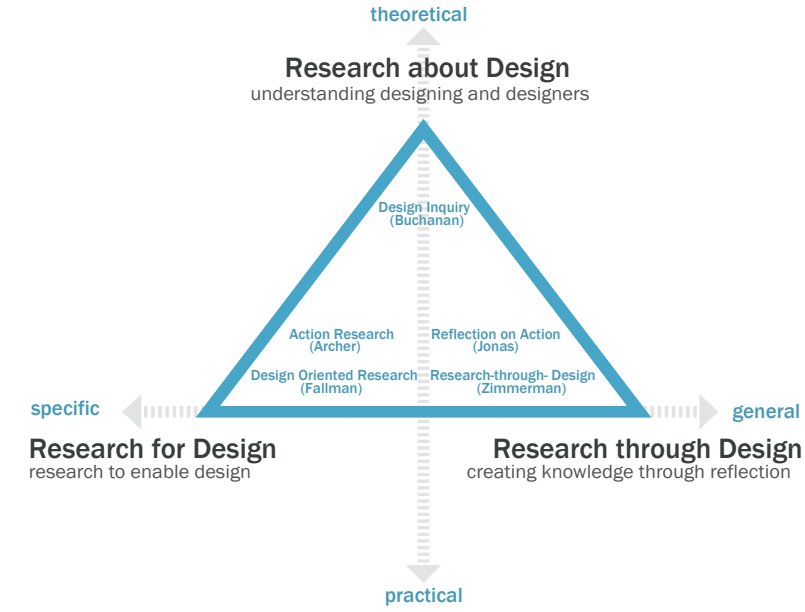

Figure 1.1: ***Research For Design, Research through Design, and Research about Design (inspired by / adapted from Frankel and Racine, 2010).***

Research about design seeks to understand the process of design and the way designers work (Buchanan, 2007). It focuses on design thinking, processes and methods. Design inquiry (Buchanan, 2007) is an example of research about design. Dorst's (2008) analysis of design research is a typical outcome of research about design (Frankel & Racine, 2010).

The three categories overlap in origin, process and intent; it is hard to differentiate between various methods, as they have a lot of in common. Our process of conducting design research bears elements of all three categories.

Our main focus is on research for design and through design: helping future designers, including ourselves, to improve their work. This is achieved through reflection in action and on action (Schön, 1984; Jonas, 2007): by analysing our designs, specific and generalisable knowledge is created. Simultaneously, our way of designing is studied, and compared to others', to understand why certain designs and methods are successful while others are not.

1.1.2 Holistic evaluations

In design research, prototypes are iteratively designed, developed and evaluated, which leads to rich, qualitative and situational insights; in this process, theory, designs and evaluations together drive and inform the knowledge generation (Hoven et al., 2007).

Design research often tries to study how to design for complex situations. User behaviour in these complex situations (in our case playful behaviour in public spaces) is caused and influenced by many factors, which makes it meaningless to look at one design variable in isolation; only the combination of the design in its specific context and situation creates the experience for the user (Sein, Henfridsson, Purao, Rossi & Lindgren, 2011).

Our prototypes are therefore studied in an *holistic* way, and evaluated as a whole. Holistic means "characterised by the belief that the parts of something are intimately interconnected and explicable only by reference to the whole" ('holistic', 2015). When evaluating or analysing, we do not consider individual design variables, but look at the combination of the whole design, the situation and the context.

Insights from prototypes and evaluations are used to inform new iterations, designs and research questions; by looking holistically at a series of prototypes and evaluations, more general conclusions such as frameworks or design recommendations are formulated (Sein, Henfridsson, Purao, Rossi & Lindgren, 2011).

1.1.3 Intermediary knowledge

Design research often results in designs, frameworks and theory. Zimmerman, Forlizzi and Evenson (2007) discuss the relation between these outcomes.

Designs and prototypes are most of the time the first step, they precede frameworks and theory. These designs are important and contain valuable scientific insights; they contain implicit theories from a philosophical, functional, social and aesthetic perspective (Gaver, 2012). Designs both reveal the issues that designers think are important, and the beliefs about the right way to address these issues. Designs are, as both Gaver (2012) and Stolterman (2008, p. 59) suggest, the 'ultimate particular', that (should) have "the same dignity and importance as truth in science".

Frameworks are reflections on designs, implemented theories, debates and the design process; they are generalised from the designs and prototypes. Frameworks are a form of *intermediary knowledge*: the knowledge resides between abstract theory and design practice (Dalsgaard & Dindler, 2014). Zimmerman, Forlizzi and Evenson (2007) add that this is where most design researchers place their effort, and where the largest contribution to human knowledge is made.

Theories are more abstract, they create consistency behind designs and frameworks; theory helps to explain why design works, but as Zimmerman, Forlizzi and Evenson (2007) stress, it does not tell how to create good designs.

The focus in this project was on developing designs and frameworks; our main goal was to explore how we can stimulate physical and social play for teenagers using interactive

technology in public spaces, and to illustrate this design knowledge through proofs-of-concept.

Our findings were synthesised in preliminary frameworks, in which we reflected on the designs, rationale, and process (see Sect. 3.2.4 and 4.4). These frameworks were used in follow-up design cycles, and can be used for inspiration and guidance by design researchers in related fields. Eventually, the insights and design knowledge from this design research project were presented in a framework of layers and types of free play (see Sect. 5.5).

The term framework covers a whole range of intermediary forms of knowledge between theory and designs. Examples are strong concepts (Höök & Löwgren, 2012), framing constructs (Zimmerman, 2009), annotated portfolios (Gaver & Bowers, 2012), design patterns (Gamma, Helm, Johnson and Vlissides, 1994 in Höök and Löwgren, 2012), and many other types which are often used in the HCI community (see Fig. 1.2). These forms differ in origin and intent (Dalsgaard & Dindler, 2014); some generate their knowledge by operationalising theory through concepts, others by abstracting concepts from practice. Some forms are intended to help theoretical advancements, while others inform design practice (Dalsgaard & Dindler, 2014).

We based the final framework in this thesis on bridging concepts. Bridging concepts are a type of intermediary knowledge, inspired by design examples as well as theory, and facilitate an exchange between theory and practice (Dalsgaard & Dindler, 2014). The results of our design research are also based on a combination of theory and design examples, and intend to improve design practice with insights from theory, while simultaneously providing proofs-of-concept about the used theories. For this reason, the final framework in this thesis is presented in a format that is an adapted version of bridging concepts.

1.2 Design research space

Several decisions were made at the start of this project, in order to focus and constrain the design research.

This project is part of the field of Human-Computer Interaction (HCI): a research area that studies the interaction between humans and interactive technology. Interactive technology was used for reasons explained below. The focus areas in this design research space correspond to research fields within HCI.

The positioning and relation to these fields, and the knowledge gained from literature and related work, will be discussed in the main chapters of this thesis. This thesis attempts to contribute to the HCI literature with design knowledge, experiences and examples.

This design research project focused on motivating (1) physical and social play, (2) for teenagers, (3) using interactive technology, (4) in public spaces.

physical and social play As mentioned before, this design research project focused on motivating physical and social play. Play is beneficial to people of all ages (Huizinga, 1950; Polaine, 2010): through playful activities, people can e.g. develop skills (Piaget, 1962; Vy-

	Primary origins	Primary intent
Annotated Portfolio (Gaver & Bowers, 2012)	design cases	abstracting knowledge to create intermediary level knowledge
Bridging Concepts (Dalsgaard & Dindler, 2014)	design cases and theory	facilitating exchange between theory and practice
Conceptual Constructs (Stolterman & Wiberg, 2010)	theory	theoretical advancements
Design Patterns (Gamma, Helm, Johnson & Vlissides, 1994)	theory	theoretical advancements
Framing Constructs (Zimmerman, 2009)	recurring elements and theory	applying theory in design processes
Strong Concepts (Höök & Löwgren, 2012)	design cases	informing design practice

Figure 1.2: ***Comparison of origins and intents for different types of intermediary forms of knowledge (based on Dalsgaard and Dindler, 2014).***

gotsky, 1980), engage in physical activity (Goldstein, 2012), or improve cooperation and social interaction (De Kort & IJsselsteijn, 2008).

With physical and social play we refer to activities where players perform physical movements and use their body to play (e.g. balancing on a curb, jumping from tile to tile or showing off dance moves); in addition, they perform this physical play in a social context (e.g. competing or cooperating, discussing and negotiating rules, and other types of social interaction).

One main benefit of motivating physical and social play is that it can reduce sedentary behaviour, if the playful moments replace sedentary moments. Sedentary behaviour is behaviour with little physical movement and low energy expenditure (Tremblay, Colley, Saunders, Healy & Owen, 2010). Studies such as Marshall, Biddle, Sallis, McKenzie and Conway (2002), Reilly and McDowell (2003) and Tremblay, Colley, Saunders, Healy and Owen (2010) all give an extensive overview of literature about the negative effects of sedentary behaviour, including increased risk of physical, mental and developmental problems (e.g. self-esteem, depression, bone health, obesity, cancer). Motivating moments of social and active play that reduce sedentary behaviour is therefore another benefit of play, and another reason for us to focus on stimulating play.

Play has been studied extensively, in a variety of expertise fields and focus areas, such as HCI, psychology, child development and in play and game design. In Chapter 2, we discuss theory and related work about play, and position our design research in relation to those fields.

We will also discuss our focus on free play, a type of play that is different than e.g. competitive or game play, and for example occurs when children play outside with a stick ("It's a wand! No, a pistol!"). Existing literature about free play mostly focuses on children and its benefits for child development (e.g. Smith and Pellegrini, 2008; Bekker, Sturm and Eggen, 2010; Goldstein, 2012; Moreno, Delden, Poppe and Reidsma, 2013). Free play for other target groups, and free play over a period of time, requires more study in the HCI community, as was also requested by Morrison, Viller and Mitchell (2011).

This thesis explores and shows how we can conduct design research about free play, and aims to contribute to the existing design knowledge about free play. This topic is covered in full detail in Chapter 2, as the focus on free play was the result of our explorations and findings during the first design research cycle.

This thesis is not about games, but the way in which games are designed and motivate people overlaps with our focus on designing for free play. Theory about motivation, play and game design has been a source of inspiration for our work and design vision (e.g. Salen and Zimmerman, 2003; Yee, 2006; Montola, Stenros and Waern, 2009; Polaine, 2010; Goldstein, 2012; Deen, 2015). In Chapter 2 we discuss motivation, and specifically how (serious) games try to motivate specific behaviour and how that relates to our work. In that same chapter we position our focus and define free play, and discuss the relation to play and games.

for teenagers Teenagers (12-16 years old) were the target group for this project. First of all, because sedentary and inactive behaviour increases at the start of high school (around the age of 12) (Sikkema, 2009; CBS, 2010), and habits are easily formed during puberty and adolescence (Verplanken & Wood, 2006; Yang et al., 2006). Therefore, encouraging teenagers to be more playful, social, and less sedentary can have a positive influence on the rest of teenagers' life.

In addition, teenagers are an under-studied user group in the HCI community, as also stated by Fitton, Read and Horton (2013). Extensive literature can be found about designing for and evaluating with specific target groups such as children and elderly (e.g. conferences and journals such as Interaction Design for Children and Gerontechnology). Teenagers, however, have largely been ignored; only recently there has been an increased discourse at conferences (e.g. workshops at BHCI'11, IDC2013, CHI'13, CHI'14). This project tried to contribute to this field by exploring how we can perform design research with and for teenagers. In Chapter 2 we discuss theory, related work and user research about the target group teenagers in more detail.

using interactive technology Motivating teenagers day after day can be a challenge: their interests change, hypes come and go, their social situation and conditions are different every day, and there are many other reasons. The field of persuasive technology (Fogg, 2002; Oinas-Kukkonen & Harjumaa, 2008), and many interactive (art) installations have shown that interactive technology can be used to change people's behaviour in these complex, every-changing environments. Therefore, interactive technology was used in this project as a tool to stimulate social and active play.

In Chapter 2 we discuss the relation of our work to persuasive technology in more detail, and show what our project has in common, and how it differs from persuasive technology.

in public spaces In order to stimulate daily physical and social play, locations are required where teenagers are frequently present, preferably in groups, and have the possibility to play. Schools and other (semi-)public spaces are well-suited for this: teenagers spend a lot of time in public spaces, often together with peers. In addition, such places are often visited several times per day, resulting in multiple encounters spread out over the day.

Designing for such a public context offers many opportunities for encounters that persuade passers-by to play; on top of that, the presence of peers in these areas allows designing for social curiosity, social interaction and peer conformity, which can all be valuable principles for persuasion (Cialdini, 2006). Therefore, this project focused on stimulating playful activities in (semi-)public spaces; especially in and around high schools. In Chapter 3, we analyse related work and theory about designing for public spaces, to learn how others have designed for, and used interactive technology in these settings.

Designing for public spaces also brings challenges on a design and research level, such as safety, feasibility, privacy and ethical issues. In this project, best practices and methods

for design research in public spaces were explored, in order to contribute to the existing knowledge in this field.

Designing interactive systems in public spaces has become an increasingly popular topic in the HCI community: researchers have studied the design of such installations, evaluation methods, and best practices for conducting design research in public spaces (e.g. Brignull and Rogers, 2003; Finke, Tang, Leung and Blackstock, 2008; Montola, Stenros and Waern, 2009; Fischer and Hornecker, 2012; Müller, Walter, Bailly, Nischt and Alt, 2012; Akpan, Marshall, Bird and Harrison, 2013). However, many of these studies focused on interactive displays in city environments; in addition, the focus was often on first-time users. Our project focused on recurrent encounters with public installations in school environments.

play, teenagers and public contexts In summary, this thesis attempts to contribute to the existing design knowledge about teenagers, free play and public spaces - and especially to the combination of these three fields. In recent years, others have studied these fields, but with different focuses. Polaine (2010) studied play and interactivity in public spaces such as shopping centers; Hobye (2014) studied designing for curiosity and exploration in public spaces such as art festivals; and both Costello (2009) and Morrison (2010) studied the design of playful interfaces and free play respectively, in the context of interactive art environments.

Their findings have been sources of inspiration for this thesis; however, they all focused on single visits, first-time users and a general target group. This thesis differs from previous work by the focus on teenagers and recurrent encounters with the playful installations.

1.3 Iterative design research in four cycles

This last section of this introduction chapter sketches the global process followed in this design research project: the objectives, design research questions and planned contributions at the start, and the resulting four design research cycles with their individual and cumulative outcomes.

1.3.1 Objectives, questions and contributions

The main goal of this design research project was to learn and show how we can motivate teenagers in public spaces to engage in physical and social play, using interactive technology. The first challenge was to discover *what* type of social and active play is enjoyable for teenagers in daily life, followed by *how* we can recurrently elicit that type of play. Parallel to this was the challenge of how we can conduct *design research* in this design research space of free play, teenagers and public spaces.

This project had three main design research questions:

1. What type of social and active play is enjoyable for teenagers in daily life?
2. How can we recurrently elicit this type of playful activities through interactive installations in public spaces?
3. How can we conduct design research about such playful activities for teenagers in public spaces?

Contributions The focus of this design research project was on designs and frameworks (see Section 1.1.3); designs to show that and how it is possible to design for this objective (proofs-of-concept), and frameworks to reflect on the designs, rationale and process. These designs and frameworks can be used as example or initial guidance by design researchers in related fields, but also by other stakeholders such as school managers, policy makers or event organisers. This thesis delivered three types of contributions: conceptual, applied and methodological contributions (inspired by Ljungblad (2008)).

As *conceptual contributions*, this work shows why designing for free play is useful or even necessary, and what type of mindset can be used when designing for teenagers, free play and public spaces. A design vision and resulting frameworks show the important insights from literature, explorations and evaluations; presented as design examples, bridging concepts and other forms of intermediary knowledge.

This work also resulted in many prototypes throughout all phases of the design research process. These *applied contributions* show how the knowledge in the frameworks can be applied; prototypes transform the values, vision and design ideas into concrete and functional systems that were evaluated and consequently informed new iterations. A single

prototype can serve as an example for a range of designs that are based on similar principles: a design is a nexus for all the (implicit) theories and decisions that have been made by a designer. Furthermore, the evaluation of a prototype can serve as proof-of-concept for these principles.

Finally, *methodological contributions* can support both designers and researchers that face similar challenges, or want to apply these insights to related design goals, users or contexts. These contributions explain how a design process has to be adapted, when designing for teenagers, free play and public spaces.

1.3.2 Structure of this thesis

Design research is an iterative process, in which prototypes are designed, developed and evaluated, and results from one iteration drive future iterations (see Fig. 1.3). In every iteration in this project, a combination of different activities was performed, such as design (explorations, prototypes), analysis (literature, user research, evaluations), and synthesis of designing knowledge (design recommendations, best practices, frameworks).

In this project, four main design research iterations have been executed with separate and cumulative outcomes (see Fig. 1.4). Every cycle built upon the results of the previous cycle(s); the goal of every cycle was to further improve the design knowledge about free play, teenagers and public spaces.

The three design research questions were answered iteratively throughout the four design research cycles. In every cycle, we improved (our understanding of) the answers, going from explorations and informal user evaluations in the first cycle, to longitudinal in-depth user studies in the fourth cycle. The four cycles together provide the answers to the design research questions, as presented in the conclusion and discussion chapter.

The prototypes and evaluations in these cycles shifted from a large number of low-fidelity prototypes to a few high-fidelity installations, and from rapid user confrontations to more formal longitudinal user evaluations with a large number of players (see Fig. 1.3).

This thesis consists of this introduction chapter, four chapters that each describe a design research cycle, and a conclusion and discussion chapter. In Fig. 1.4 an overview of the goal, activities and outcomes of every design research cycle is given. Fig. 1.5 presents these same outcomes and their relation to the design research questions, sorted in conceptual, applied and methodological contributions.

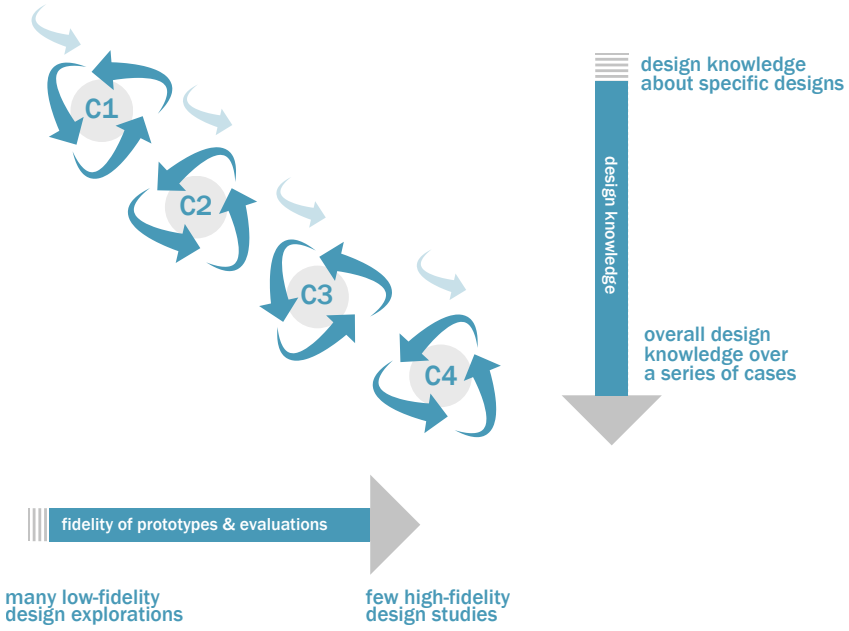

Figure 1.3: *Four design research cycles were performed in this project, each consisting of iterations of design, evaluation and analysis, and each improving the design knowledge from previous cycles.*

Goal		Activities	Design knowledge
C1	What type of social and active play is enjoyable for teenagers in daily life?	Literature & related work: motivation, persuasion, play, teenagers User research: observations, focus groups Design explorations: Sway It, Dancing Shoes, Dynamic Clothes Analysis & Synthesis	Free play vision Teenager interest areas Qualities for motivating teenagers Design explorations Answer des res question 1
C2	How can we activate play in public contexts?	Literature & related work: curiosity, public contexts Design explorations: dotMirror, Light Scribe, Bomb It Design studies: Curious Action Speakers, Magic Mirror Analysis & Synthesis	Curiosity principles Curious-action framework Insights designing for public spaces Design explorations Proofs-of-concept Answer des res question 1 Answer des res question 2
C3	How can we design for free play in public contexts?	Design explorations: Photo Drop, Treasure Race, Waterdraw, Teaseat, Whisperballs Design study: Photo Vault Analysis & Synthesis	Framework design values: Elicit & Seduce, Emergent play, Resonate Design explorations Proofs-of-concept Answer des res question 2 Answer des res question 3
C4	How can we design for and study recurrent free play in public contexts?	Literature & related work: recurrent experiences, daily play Design studies: Wiggle the Eye, Walk of Fame Analysis & Synthesis	Proofs-of-concept Bridging concepts framework: layers & types of free play design recommendations Answer des res question 2 Answer des res question 3
Conclusions & Discussion		Reflection on design research and process Strategies for design research with teenagers Strategies for design research in public spaces Strategies for design research about free play	Conceptual, applied and methodological design knowledge

Figure 1.4: ***Goal, activities and design knowledge of the four design research cycles (Chapter 2, 3, 4, and 5).***

	Conceptual contributions	Applied contributions	Methodological contributions
C1	Free play vision Teenager interest areas Qualities for motivating teenagers	Design explorations Proofs-of-concept	
C2	Curiosity principles Curious-action framework Insights designing for public spaces	Design explorations Proofs-of-concept Curious-action speakers Magic Mirror	Curious-action framework
C3	Framework design values: Invite & Elicit Emergent Play Resonate	Design explorations Proofs-of-concept Photo Vault	Framework design values: Invite & Elicit Emergent Play Resonate
C4	Bridging concepts framework: types & layers of free play, design recommendations	Wiggle the Eye Walk of Fame	Bridging concepts framework: types & layers of free play, design recommendations
C&D	Conceptual design knowledge	Applied design knowledge	Methodological design knowledge Reflection on design research process Strategies for design research about teenagers, public spaces and free play
	Answer des res question 1 Answer des res question 2	Answer des res question 1 Answer des res question 2	Answer des res question 2 Answer des res question 3

Figure 1.5: ***Contributions of this thesis, sorted by conceptual, applied and methodological contributions.***

Chapter 2

Design research cycle 1: Motivation and playful activities for teenagers

Parts of this chapter have been published as:

> *Tieben, R., Bekker, M.M., Sturm, J. and Schouten, B.A.M. (2011). 'Eliciting casual activity through playful exploration, communication, personalisation and expression'. In: Proceedings of CHI-Sparks 2011.*

2.1 Introduction

The main goal of this design research project was to learn and show how we can motivate teenagers to engage in physical and social play in public spaces, using interactive technology (see Chapter 1); a design research approach was followed to achieve this goal (see Section 1.1.1).

The design research space was constrained by four focus areas: physical and social play, for teenagers, using interactive technology, in public spaces (see Section 1.2).

The project focused on three main design research questions:

1. What type of social and active play is enjoyable for teenagers in daily life?
2. How can we recurrently elicit this type of playful activities through interactive installations in public spaces?
3. How can we conduct design research about such playful activities for teenagers in public spaces?

Four design research cycles have been executed in this project, each building on the results of the previous cycles. Together, these cycles answered the main design research questions.

2.1.1 Focus of design research cycle 1

This cycle was the first cycle in this design research project; as such, it had an explorative nature, aiming to broaden our understanding of the design research space and the solution space of the design research questions.

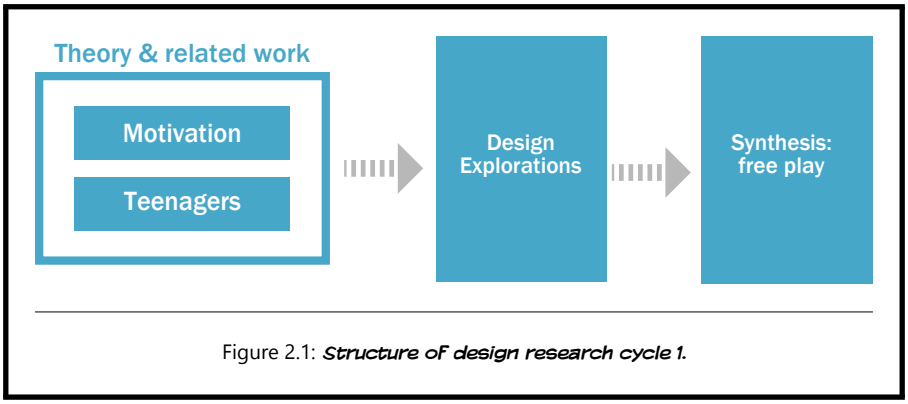

Figure 2.1: *Structure of design research cycle 1.*

This cycle mainly focused on question one: *what type of social and active play is enjoyable for teenagers in daily life?* In this cycle, motivation and playful activities for teenagers were explored, through literature review, user research, related work and design explorations.

Small iterations of design exploration applied insights from literature and user research; each iteration studied (a combination of) motivation, playful activities and teenagers from a different perspective.

This chapter starts with a discussion of selected related work and literature about motivation (2.2) and teenagers (2.3). The insights were applied in a series of design explorations (2.4) that embody our vision, and were eventually synthesised in an interpretation of social and active play that is enjoyable for teenagers (our design vision, Sect. 2.5). This chapter concludes with a reflection and a preliminary answer to the design research question of this cycle.

2.2 Motivation through technology

Motivation and behaviour are extensively studied in psychology, sociology, management, marketing, design and related fields. There are many models that describe motivation and changing behaviour from different perspectives, as covered in literature reviews such as Reilly and McDowell (2003), Jackson (2005) and Biddle and Mutrie (2007).

In this section, we present a selection of work about motivation that strongly inspired and informed us, eventually leading to our design vision (Sect. 2.5). We start with the Self-Determination Theory (SDT), a widely accepted theory of motivation (Ryan & Deci, 2000).

SDT is a need theory model of human behaviour; it suggests that particular needs can motivate a person to act. We decided to use SDT over other models because it is especially suited for our design research space: SDT has been used to understand motivational aspects in gaming and education for various target groups, including children and teenagers (Ryan, Rigby & Przybylski, 2006; Przybylski, Rigby & Ryan, 2010; Deen, 2015).

We briefly discuss the elements of SDT that are most relevant for our case of designing for enjoyable social and active play for teenagers. Then, we discuss related work and theory from three inspiring application fields that use interactive technology to motivate people: persuasive technology, exergames and mobile health tracking. We conclude with a discussion about playful interactions, a field that combines insights from several knowledge areas.

2.2.1 Self-Determination Theory

The Self-Determination Theory (SDT) (Ryan & Deci, 2000) is a theory of human motivation and personality. It defines intrinsic and varied extrinsic sources of motivation. Intrinsic motivation refers to doing an activity for the inherent satisfaction of the activity itself; motivated from within, by interests or curiosity, for the enjoyment of doing the activity. Extrinsic motivation refers to the performing of an activity in order to attain some separable outcome; motivated by external factors such as rewards, scores and grades (Ryan & Deci, 2000).

External regulations such as rewards seem useful in the short run to control and steer behaviour. However, over time external regulations become less effective and can even have negative effects (Kohn, 1999; Deen, 2015). Studies show that students who feel externally regulated show less interest, value and effort towards achievement (Ryan & Connell, 1989), and tend to disown responsibility for negative outcomes (Ryan & Deci, 2000). In addition, intrinsic motivation has many benefits throughout life (Csikszentmihalyi, 1975; Ryan & Deci, 2000; Przybylski, Rigby & Ryan, 2010). Ryan and Deci (2000, p. 70) state for example: *"(Intrinsic motivation) describes this natural inclination toward assimilation, mastery, spontaneous interest, and exploration that is so essential to cognitive and social development and that represents a principal source of enjoyment and vitality throughout life"*.

Ryan and Deci (2000) further explain that activities foster greater intrinsic motivation when they satisfy three fundamental human needs: the need for *competence*, *autonomy* and *relatedness*. Skill development, completing challenges, and receiving positive feedback are examples that fulfil the user's need for competence. Freedom of choice, different paths of progression and individual experiences can motivate autonomy. Cooperation, social bonds and social interaction are contributors to the need of relatedness (Przybylski, Rigby & Ryan, 2010).

Intrinsic motivation is an initial answer to this cycle's design research question: it is important to focus on stimulating intrinsic motivation when designing for playful activities in the daily life of teenagers. Eliciting values such as curiosity, creativity and passion can lead to sustained enjoyment, while also benefiting people in other aspects.

The *how* question is more difficult: how can we design activities for teenagers that satisfy the needs for competence, autonomy and relatedness - and how can we motivate teenagers to participate in these activities? These questions are the core of this project, and return in every design research cycle.

a. Health Month

b. Withings Wireless Scale

Figure 2.2: ***Two examples of persuasive technology.***
Health Month (2014) is an online game that motivates people to achieve their goals during a month, using a combination of persuasion strategies (image from health-month.com).
Withings Wireless scale (2014) is a scale with WiFi connectivity that automatically uploads user's weight to a series of online services, stimulating weight control (image from withings.com)

Intrinsic motivation and a theory such as SDT, can help to answer the how question by creating a frame of reference for the answer. Activities such as skill development, freedom of choice and social interaction motivate people; enabling designers to understand why such activities motivate, through the needs, is a first step for informing the design process. Translating these insights from motivation psychology to design knowledge is a second step, for example by providing inspiration and examples grounded in design-relevant knowledge. This way, theory can aid designers throughout the entire design process.

2.2.2 Persuasive technology

In this section, we discuss several application and research fields that use interactive technology to influence behaviour.

Persuasive technology is "*technology that is designed to change, reinforce or shape attitudes or behaviors of users through persuasion and social influence, but not through coercion or deception*" (Fogg, 2002; Oinas-Kukkonen and Harjumaa, 2008). Many interventions for changing behaviour are developed and studied in this expertise area, resulting in products, services, principles, theories and best practices (Fogg, 2002; Oinas-Kukkonen and Harju-

maa, 2008). Fogg (2002) presents three ways in which persuasive technology can function: as tools, by making the target behaviour easier or by restructuring it; as media, by using elements such as rewards, reminders, interactivity and narratives to guide the user; or as social actors, by leveraging social influence, such as normative influence or social comparison.

As tools, media and social actors, persuasive technology elicits or persuades people to perform a certain action; a combination of intrinsic and extrinsic sources of motivation are used to guide the user. This inherent persuasion is required in our design research space as well: to motivate teenagers to recurrently play in a social and active way, we need to invite, elicit and convince them to start and continue playing.

Motivation, ability and triggers are all required for persuasive technology to be effective in a situation. People need motivation for performing a certain action; they have to be able to perform it; and they need to be triggered at the right moment to actually start the action (Fogg, 2002). This presents a challenge in designing for public spaces: users need to be able, motivated, and triggered to start playing, right at the moment when they first encounter one of our designs.

This is where our case of designing for play in public contexts differs from typical persuasive technology applications: users are not motivated or even aware beforehand. In cases such as Health Month (2014) or Withings (2014) (see Fig. 2.2), users are motivated from the start; they care about their health or the responses from friends. In our case, users do not know that they can and (possibly) want to play: they have to be motivated and triggered to start playing - by, and at, the encounter with our designs.

2.2.3 Exergames

Serious games are games that have an explicit and carefully thought-through additional purpose, where entertainment is used to achieve goals such as training, education or health (Abt, 1987; Michael and Chen, 2006). Exergames or exertion games are a type of serious games with input mechanisms that use physical exertion, where the outcome of the game is determined by physical activity (Mueller, Gibbs & Vetere, 2008).

Exergames motivate players to perform physical activity while playing a game. However, many existing exergames do this in a limited or even flawed way. For instance, they create a mismatch between the physical action and the game representation. The required physical action is just a tedious way to press a button; this action has to be performed before progress can be made in the game. The physical activity itself is, and remains, tedious. On Exerbikes (2014) for example, players can play all sort of Xbox games by cycling and using a controller. Peddling results in a forward movement of the game characters.

Other exergames such as Wii Fit (2014) and Pokéwalker (2014) focus on the result of physical activity: they reward physical activity with high scores, badges, or level progress. They motivate players extrinsically to perform the physical activity (and to earn the reward). The motivation is reinforced by external factors such as the score, and not by the players' willingness to engage; as a result, these exergames do not make the activity itself more enjoyable.

Figure 2.3: *Two examples of exergames.*
Dance Dance Revolution (2014) is a video game series in which players step on areas of a dance pad controller in a specific rhythm and order (image from wikipedia.org). Just Dance (2014) is a video games series in which players have to mirror on-screen dance choreographies accompanied by social playful moments (image from gamespot.com).

To remedy these issues, exergames could create a natural connection between action and representation. Through this, the physical activity itself can become more enjoyable, and not just the result. Two examples can clarify this: Dance Dance Revolution (2014) (see Fig. 2.3a) is a game that both creates a mismatch between action and representation, and focuses on extrinsic motivation. The game shows a list of arrows, and players have to physically step on corresponding buttons in a specific order and rhythm. The game is enjoyable to many players: the competition, speed and rewards create an intense play experience. However, the game focuses on the result of physical activity. and the activity itself remains tedious.

Just Dance 3 (2014) (see Fig. 2.3b) in contrast invites players to dance in a personalised and expressive way; players can mimic dance moves from models. Besides giving a score for correct actions, the game focuses on making dancing enjoyable. Players improve their dance skills (competence); they are invited to express themselves in creative ways while dancing (autonomy); and social interaction is a strong and hilarious aspect of the multiplayer mode (relatedness). The movements in the song Somethin' Stupid (2014) for example are a caricature of a romantic affair, where players have to kneel and propose, and play with their masculinity and/or femininity. This results in a highly enjoyable activity. In addition, many player-created videos ('Just Dance YouTube movies', 2014) show that the game is enjoyable with large groups of players, even though the system only tracks four players: players are playing, dancing and physically active, without receiving points, badges or feedback. They dance for the enjoyment of the activity.

Figure 2.4: ***Two examples of mobile health tracking.***
Fitbit (2014) is a wearable activity tracker that tracks and communicates users' activity, motivating a more active lifestyle (image from Fitbit.com).
Moves (2014) is an activity diary app that tracks physical activity and motivates a more active lifestyle (image from moves-app.com).

For our case of motivating social and active play, two valuable lessons can be learned from exergames: first of all, the importance of a natural connection between physical action and game representation. This is required for the second lesson: focusing on intrinsic motivation and making the physical activity itself enjoyable, instead of merely rewarding the activity.

2.2.4 Mobile health tracking

Mobile health tracking (2014), and the quantified self movement (2014), use apps and tools to track a person's daily input or performance such as food and physical activity. Systems such as Fitbit (2014) or Moves (2014) measure and visualise a user's activity, show the progress towards certain goals and allow comparison or competition with others. A combination of intrinsic and extrinsic drives are used to coach and remind people to change their behaviour - but of course, users of these systems are already motivated to change their behaviour, they 'just' need to be triggered.

These systems are ambient and mobile: they can trigger the user at various moments throughout the day, independent of location or time. Creating many opportunities for persuasion throughout the day is also applicable to our case of persuading teenagers to engage in social and active play: our installations should create moments of playful activity throughout the day. Simultaneously, our case shares a challenge with mobile health tracking apps: how do we make sure that every interaction or encounter is motivating for the users? How do we activate and trigger the users time after time? This once again con-

firms the importance of designing for intrinsic motivation, as making the users intrinsically motivated to interact has the best chance of success for recurrent moments of persuasion.

2.2.5 Playful Interactions

Playful interactions is a design vision of products, systems and services that are designed for interaction in a playful way, in order to elicit explorative, social and enjoyable behaviour (Bekker, Sturm & Eggen, 2010). This field is studied in our design research group ('User Centered Engineering', 2014), and is closely related to work in other design research groups (e.g. 'Mobile Life Centre', 2014; 'Child Computer Interaction Group', 2014).

Playful interactions are open-ended and emergent: the playful (inter)action has no fixed rules or goals; both the actions of the players, and the interaction between players and the design, determine the play that emerges (Valk et al., 2012).

Playful interactions that elicit relevant behaviour can be found in the design, research and art world, and increasingly in the commercial world as well. There are many examples from our University of Technology (e.g. Bekker and Sturm (2009); Valk et al. (2013); SmartGoals (2015)). Four examples from others that invite playful interaction are Figure Running, Piano Stairs, WeatherWorlds and Indoor Weather Stations.

Figure Running (2014) and Piano Stairs (2014) (see Fig. 2.5a and 2.5b, respectively) both stimulate people to be more physically active in a playful way. WeatherWorlds (2014) invites children to start playing in a bodily way, allowing them to control the weather (see Fig. 2.5c). Indoor Weather Stations (Gaver et al., 2013) promote environmental awareness in a playful (ludic) way (see Fig. 2.5d).

Related to playful interactions are pervasive games, games that have "one or more salient features that expand the contractual magic circle of play spatially, temporally, or socially" (Montola, Stenros & Waern, 2009, p. 12). Pervasive games are often played in public areas such as office buildings, schools or whole cities. Pervasive gamers inhabit a game world that is present within the ordinary world and they can play wherever they go. These games use the environment and context as part of the game, and invite open, emergent and creative play from players and passers-by (Montola, Stenros & Waern, 2009).

In pervasive games, designers often try to stimulate certain playful behaviour in public spaces, using the social conditions and context to full effect. In Montola, Stenros and Waern (2009) and Stenros, Waern and Montola (2011) scholars share their experiences and best practices in the design and evaluation of pervasive games. Such insights are a good source of reference for our situation, as pervasive games have many elements in common with our case, such as the social interactions, public environments and expanded magic circle.

Playful persuasion specifically focuses on persuading people to perform certain behaviour in a playful way, using engaging elements from play and games (Romero, Sturm, Bekker & Valk, 2010; Tieben, Sturm, Bekker & Schouten, 2014a). The before-mentioned Figure Running and Piano Stairs exemplify how playful persuasion can be used to change

Figure 2.5: *Four examples of playful interactions.*
Figure Running (2014) is an app that allows players to make art while running, by using GPS to turn the runner into a pencil on the map (image from Figurerunning.com).
Piano Stairs (2014) are stairs transformed into a big piano, to motivate people to take the stairs instead of the escalator (image from KJ Vogelius, Flickr).
WeatherWorlds (2014) is an interactive museum installation that allows children to control weather superpowers by using their bodies (image from design-io.com).
Indoor Weather Stations (2013) are devices that communicate environmental data about living spaces in a ludic way (image from research.gold.ac.uk).

behaviour for the better.

Literature and examples in the fields of playful interactions and persuasion confirm our vision of fostering play that has positive side effects. However, a still understudied aspect in these examples is the long-term effect: how will people behave if they encounter playful installations every day? Most likely, the curiosity will disappear, and people fall back into their normal behaviour. How can we design an interactive installation that invites people to play in a social and active way - on recurrent encounters? This sketches one of the main challenges for this project, and the focus of the upcoming design research cycles.

2.2.6 Motivating through interactive technology

In this section, we have discussed our exploration of literature and related work about motivating through technology.

Motivation theory shows that intrinsically motivating activities are enjoyable for people. These activities should satisfy the needs for competence, autonomy and relatedness. Skill development, freedom of choice and social interaction are examples of qualities that contribute to these needs.

Persuasive technology attempts to motivate people intrinsically or extrinsically through technology. Users need to be able, motivated and triggered to start interacting with our designs, right at the start of the first encounter. A challenge is to do this while the users have no knowledge about the existence of an installation until they encounter it.

Our review of exergames shows the importance of a natural connection between physical action and game representation. To let users enjoy physical actions, we should make the physical activity intrinsically motivating, instead of merely rewarding it.

The related work about mobile health tracking and playful interactions that we discussed shows the richness of opportunities in designing for social and active play: throughout the day, there are many opportune moments where we can persuade users to start playing.

The discussion and insights about motivation confirm and strengthen our initial vision of enjoyable playful activities with inherent benefits. It shows that we should not design a 'chocolate-covered broccoli' that makes physical actions more fun (Habgood, 2007). Instead, we should design an enjoyable activity that requires or incorporates physical actions. We should focus on satisfying needs such as competence, autonomy and relatedness.

These insights served as starting point, benchmark and assessment for the design decisions throughout this design research process. The importance of designing for intrinsically motivating playful activities was a constant focus point in our design decisions and when coaching students.

User research	Details
Literature	Hoyng, Roques and Stegeman (2004), Berk (2006), Haan and Hof (2006), YoungMentality (2006), Dorsselaer, Zeijl, Eeckhout, Bogt and Vollebergh (2007), Duimel and Haan (2007), Foundation (2007), Valkenburg (2007), Utrecht (2009), CBS (2009), Sikkema (2009), Haan and Pijpers (2010), Nelis and Sark (2010)
Observations	Observing leisure activities and social interaction; 2x full day at two different high schools
Focus groups	7 focus groups at two different high schools; 6-9 students per group (ages 12-15); 2 researchers per group, duration 50 minutes; focus on leisure time activities

Figure 2.6: ***Three types of user research used to study teenagers and their leisure activities.***

2.3 Teenager interests and activities

Teenagers are the target group of this design research project, and as such it is important to understand them in depth: their daily life, values, interests, emotions, activities and the contexts in which their lives take place. A combination of user research methods was employed to sensitise ourselves to the daily life of teenagers, and to create a foundation for future design research cycles.

An overview and summary was made of literature about teenagers, youth behaviour, lifespan development and leisure activities, specifically focused on Dutch secondary school youth (12-16 years old). Two full day observation sessions were executed at high schools, focusing on the social interactions and activities during the breaks. Finally, seven focus groups were held at two different high schools, discussing leisure time activities (see Fig. 2.6 for more details).

2.3.1 Focus groups with teenagers

A literature review about teenagers and their lifestyle provided us with qualitative and quantitative information about the target group teenagers, their daily life and their interests. To complement this relatively abstract information, a focus group study was setup to develop depth (stories behind the numbers), insight (better insight in the lifestyle of teenagers) and empathy (feeling and understanding for the target group).

In each focus group, we discussed a typical day in the life of the teenagers, focusing on the similarities and differences between them, and on the leisure activities.

Setup

Seven focus groups of one hour each were setup at two high schools in different social-economic neighbourhoods. Each focus group had 6-8 participants with mixed genders, age 12-15. Two researchers were present in all focus groups.
Setup of session:

1. Introduction and explanation focus groups
2. Opening discussion: who are you, and what is the first thing you do when you wake up?
3. Typical day: fill in a typical weekday on the entry form
4. Group discussion: discuss weekdays; focus on leisure time and hobbies. Laddering, why/who/with whom/etc
5. Group discussion: important elements in life of teenagers. Money, music, hobbys, sport, leisure activities, etc.
6. Self-description: let each participant describe him/herself in one sentence ("I am a real sporter because.."), plus his/her hobbies in one sentence ("I play soccer because..")
7. Thank you and end

Data collection:

1. Sound recordings of focus group
2. Notes researchers
3. Notes participants

Analysis

All recordings and notes were transcribed and annotated.

Four types of qualitative analysis were performed by the two researchers:

1. compare literature findings with focus group findings: did the teenagers confirm what literature indicated
2. reflection per focus group: surprising insights and differences, typical findings for a specific group/school, etc
3. comparison between groups: surprises and differences in answers between groups and schools.
4. general observations, remarks and conclusions.

The initial results were discussed with three other design researchers in a one hour session, in order to formulate the conclusions.

Summary conclusions

Below, we give a short summary of the most important thematic issues that surfaced in the analysis of the focus groups.

Similar around school, different in leisure time
Most participants behaved similar to each other in and around the school: they cycled to school, used the break to "relax a bit", spent their time with peers, etc. After school, leisure activities differed greatly between participants.

Attention to other gender
Attention towards people of the other gender differed greatly between teenagers of 12-13 and 14-15 years old.

The younger participants were not interested at all in the other gender: boys talked and played with boys, and girls with girls; in the focus groups, hardly any interaction took place between genders. For ages 13-14, this interaction increased: with every statement, participants looked at the others to see what they thought of it.

With the oldest participants, this gender interaction became even more prominent: the flirting, teasing and physical contact between boys and girls overruled all other interaction in the room, disrupting the focus group at times.

In daily life, peer groups, interests and social interaction revolved as well around mixed groups.

Puberty
Boys and girls behaved in a totally different way: girls were 'more grown-up', which resulted in large differences in social skills, behaviour and leisure activities between boys and girls.

Activities and individuality
The younger teenagers (12-13) spent the majority of their leisure time on one activity (playing outside, gaming, etc), while the older teenagers performed several activities simultaneously (relaxing a bit, while watching television and using social media).

In addition, the group compositions changed over time: younger teenagers often played (physically) alone, while the older ones wanted to be together with peers. Virtually, nobody was alone: they were always in contact with peers, day and night, through their mobile phones.

Identity and profiling
The forming of an identity during puberty resulted in differences between age groups. The younger teenagers were all relatively similar, while the older ones fit into one type of category (nerds, skaters, etc), and commented a lot on the identity of others. The oldest teenagers had developed their own identity, and ignored or respected those of others.

2.3.2 Teenager interest areas

The findings from the literature review, observations and focus groups were analysed. A summary was created, combining and describing the main insights about the target group teenagers.

In addition, a selection of literature and annotations from the observations and focus groups were analysed. Terms and descriptions of key elements in activities, interests and lifestyle of teenagers were identified and clustered. These clusters were discussed with fellow design researchers, in four informal sessions of one hour each. This eventually resulted in four interest and activity areas for teenagers.

Youth from 12-16 is in the middle of the adolescence, the transition between childhood and adulthood. In this period, the teenagers rapidly develop on a physical, cognitive, emotional and social level, initiated by the puberty (Berk, 2006).

The cognitive, emotional and social changes focus among others on exploration and development: self-reflection, identity development, self-concept and self-esteem are important topics, in addition to the need for autonomy, the forming of cliques and crowds, and the strong peer conformity and pressure. The teenagers explore, define and develop their own identity, and their relation with others (Berk, 2006).

In the life of teenagers, the school plays an important role: a large amount of time and (social) attention is spent here. Besides this, the average teen has six hours of leisure time per day, filled with activities such as internet, gaming, sport, television and movies, meeting friends and music (Sikkema, 2009; CBS, 2010; Tieben, Bekker, Sturm & Schouten, 2011). The cognitive, emotional and social focus is apparent here: exploration, development, identity, autonomy and peer influences are pivotal in all these leisure activities.

Four core interest and activity areas are (Tieben, Bekker, Sturm & Schouten, 2011):

- Exploration: trying novel experiences; exploring and developing one's relations, preferences and boundaries.
- Social Interaction: verbal, written, virtual and body communication; individual and group interaction.
- Personalisation: adapting and personalising one's items, environment, activities and actions, both individually and in peer groups.
- Self-Expression: broadcasting one's individual and group identity and opinion, through actions and appearances.

Present in most teenager activities is 'observing - being observed - broadcasting': many actions by teenagers are performed knowing that, or because of, peers are observing. Commenting on other's actions, or receiving feedback on one's own, occurs all the time, and is at the core of the experience. In addition, one's own actions and those of peers are directly broadcast to peers, via various social media. These areas offer design opportunities to connect to the teenagers' daily interests and activities.

2.3.3 Designing for teenagers

The summary and the core interest and activity areas provide an overview of the characteristics and drives of the target group teenagers. Connecting to these interest and activity areas offers design opportunities and can help to guide design decisions. By designing for activities that specifically target the drives of the teenagers, one can elicit playful behaviour that motivates teenagers, ideally time after time.

We used this understanding of the target group throughout the design research process: in idea generation and concept development, and also in the setup and methods of our evaluations. Designing for the four interest areas proved to be a valuable source of inspiration and guidance, for ourselves and for the students that we coached.

2.4 Design explorations

In parallel to this cycle's work about motivation and teenagers, we coached twelve first-year Industrial Design students. Each student participated in a half-year individual design project about 'designing playful interactions for teenagers', where they designed concepts that elicit play with inherent playful activity.

The projects started with a kick-off, where we briefed the students about motivation and teenagers, using the insights discussed in this chapter. Over half a year, we coached the students in a process of idea generation and concept development through creative sessions, user confrontations, design critiques and expert evaluations. Relevant literature, related work and our summaries were used as inspiration and guidance throughout the projects.

Eventually, every student developed a final concept and created a working prototype. These prototypes were informally evaluated with the target group and at an educational exhibition. In total, twelve low- to mid-fidelity prototypes were created. Three of these concepts are described in Fig. 2.7, 2.8 and 2.9: Dancing Shoes, Dynamic Clothes and Sway-It.

We used the coaching activities to develop a better understanding of the design research space and insights from theory. This way, we could translate our insights in usuable chunks of design knowledge for the students, while identifying and experiencing all the different factors that influence play for teenagers in public spaces. The design explorations also served as first applied examples of our vision of motivating playful activities for teenagers.

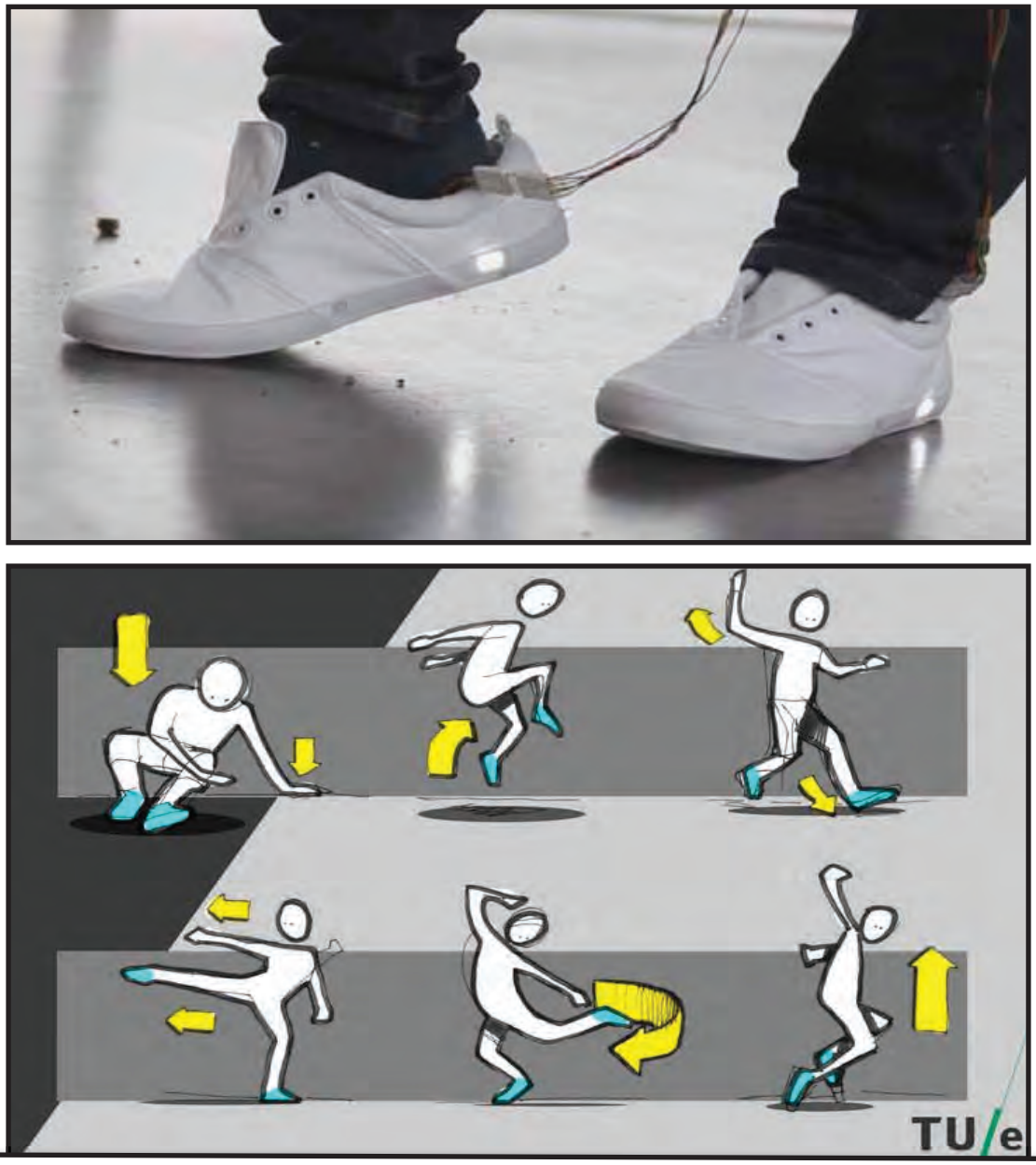

Figure 2.7
Dancing Shoes – Design exploration by Tamás Fejér

Dancing Shoes are shoes with LEDs where a user can change colour, intensity and pattern of the light by performing certain actions. Walking, jumping or tapping results in cool light effects, connecting the players' actions to their appearance.

2010. Coached by: Mark de Graaf & Rob Tieben
More information, including design and evaluation details, at:
playFulll.com/ dancing-shoes

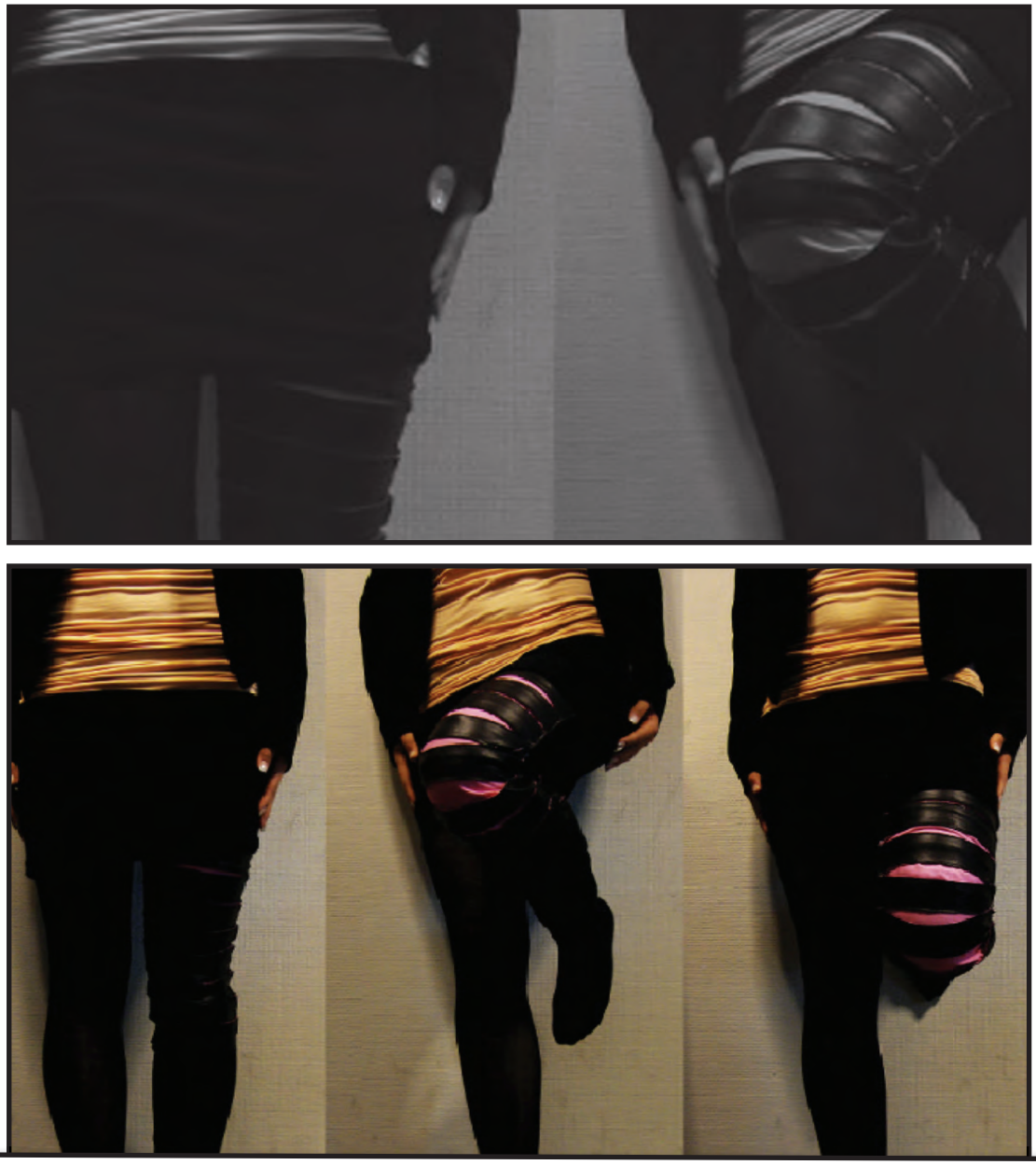

Figure 2.8
Dynamic Clothes – Design exploration by Jamie Maria Schouren

Dynamic clothes is clothing that alters appearance through physical actions such as walking or dancing. Standing still, they appear normal, but physical actions cause the seams to open, revealing the colourful fabric below.

2010. Coached by: Gijs Ockeloen & Menno Deen
More information, including design and evaluation details, at:
playFulll.com/ dynamic-clothes

Figure 2.9
Sway-It – Design exploration by Pepijn Fens

Sway-It is a LED-coloured seat, that changes colour depending on the user's actions. Different actions such as balancing, leaning or kicking result in distinct colours.

2011. Coached by: Mark de Graaf & Rob Tieben
More information, including design and evaluation details, at:
playFulll.com/sway-it

2.5 Synthesis

The synthesis sections in this thesis combine the insights from each design research cycle. In this cycle, the synthesis section builds upon the lessons learned from theory and related work about motivation and teenagers, and the design knowledge gained from the design explorations.

The insights from this cycle have been used to define three qualities for motivating teenagers: qualities that an activity for teenagers should support in order to elicit enjoyable social and active play. Following this, a design vision of free play was formulated, which served as main focus for the remainder of this design research project.

2.5.1 Qualities for motivating teenagers

The main goal of this first design research cycle was to discover *what type of social and active play is enjoyable for teenagers in daily life*? To answer this question, we studied theory and related work about motivation and teenagers, and applied the insights in design explorations.

Theory and related work about motivation were reviewed, covering topics such as Self-Determination Theory, persuasive technology, exergames, mobile health tracking and playful interactions.

This showed us that enjoyable play is intrinsically motivating play, and that intrinsically motivating activities allow and encourage competence, autonomy and relatedness.

User research about teenagers, youth behaviour and leisure activities showed the need for exploration, personalisation, self-expression and social interaction. Logically, the aspects of motivation and teenagers complement each other, as they describe the same human drives from different perspectives.

In the design explorations, we tried to apply these aspects, and simultaneously translated them to design knowledge through student coaching and design reviews. Informal discussion and reflection sessions throughout the design research cycle were used to combine the insights from theory, related work and design explorations, in order to identify and describe what type of social and active play is enjoyable for teenagers.

This resulted in three qualities that an activity for teenagers should support to elicit and sustain intrinsic motivation:

exploration and development
: the playful activity should support teenagers to explore possibilities, offer them challenges and let them develop their skills and identity through the (inter)actions.

freedom and self-expression
: the playful activity should support teenagers to express themselves, to act in their preferred way, and to create personalised goals, rules and paths of progression.

social interaction

the playful activity should support social interaction in a social context, such as co-operation, sharing, commenting and group actions.

2.5.2 Free play design vision

As explained in the previous section, social and active play that is enjoyable for teenagers should elicit and foster exploration and development, freedom and self-expression, and social interaction. Play that supports these qualities is a specific type of play. In this section, we will discuss and define this specific play in more detail.

Play involving exploration, freedom and social interaction exists in many forms and is described from various perspectives.

In our university (Eindhoven University of Technology), it is described as *playful interactions* (Bekker, Sturm & Eggen, 2010), *open-ended play* (Valk et al., 2012) and *emergent play* (Valk, 2012; Tieben, Sturm, Bekker & Schouten, 2014a). Playful interactions are open-ended and emergent: playful (inter)actions have no fixed rules or goals; and both the actions of the players, and the interaction between players and the design, determine the play that emerges (Bekker, Sturm & Eggen, 2010).

Others study this area from e.g. the perspective of *infinite play* (Hicks, 2004) and *free-play* (Morrison, 2010). Feltham, Vetere and Wensveen (2007) define this type of play as "a predominantly open-ended activity with fluid rules of engagement", privileging spontaneity and discovery. Morrison, Viller and Mitchell (2011, p. 2335) describe what they call *free-play*: non-narrative, non-competitive play without logical ending point, where the plot of the play continually evolves in order to keep the play alive, the activity constantly rejuvenates because the participants co-construct and co-author it, and where the playful activity is free from predetermined order or meaning.

Gaver (2002) discusses *ludic design*, and designs for contemporary design problems using aspects such as play, ambiguity and interpretation (Gaver, Beaver & Benford, 2003). Gaver (2009, p. 4) describes an *open-ended self-motivated form of play*: "an engagement that has no fixed path or end, but instead involves a wide-ranging conversation with the circumstances and situations that give it rise. Rules may emerge and goals may be sought, but these will be provisional inventions, makeshift tools to help the advance of curiosity and exploration."

In game theory, play is often described as "free movement within a more rigid structure", with the categories "gameplay, ludic activity and being playful" (Salen & Zimmerman, 2003). Our type of play connects to the free movement, ludic activity and playfulness in this definition.

Koven (2013) presents his philosophy of *well-played games*, and advocates the need for ever-changing games through the actions and interactions of the players. His philosophy confirms the importance of social interaction in motivational play. Both Márquez Segura, Waern, Moen and Johansson (2013) and De Kort and IJsselsteijn (2008) discuss the benefits of the social interaction and context of playing together, reporting positive effects of playing together such as increased enjoyment and motivation.

The descriptions above show the rich and diverse field that this type of play encompasses, with many dimensions and perspectives. Play that involves exploration, freedom and social interaction can be described with various overlapping and diversifying characteristics. We identified a set of elements of this type of play that most of the descriptions have in common, and that strongly correspond to the insights from our design research.

We call the type of play that we aim to design for *free play*, and define it as follows:

> *Free play is creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players.*

Designing for this type of intrinsically motivating play is our design vision for this design research project; free play is the vision that runs through all other cycles. Besides the definition of free play, the design vision contains the following elements:

- intrinsic motivation: the importance of focusing on intrinsic motivation and the needs for *competence, autonomy* and *relatedness*.
- teenager interest areas: designing for *exploration, social interaction, personalisation* and *self-expression*.
- qualities for motivating teenagers: the three qualities of (1) *exploration and development*, (2) *freedom and self-expression*, and (3) *social interaction*.

2.5.3 Conclusions, design knowledge and reflection

This first design research cycle focused on motivation, teenagers and play. The aim was to discover *what type of social and active play is enjoyable for teenagers in daily life?* This question was answered through an iterative process, combining insights from literature, user research and design explorations. We learned that we need to design for intrinsically motivating playful activities; activities that elicit and foster exploration and development, freedom and self-expression, and social interaction. We need to design for *free play*: creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players. Free play is the answer to this cycle's design research question; free play is what we envision as enjoyable social and active play for teenagers in daily life.

Design knowledge

This cycle has generated the following design knowledge, that is used as input in follow-up cycles:

free play design vision our vision of designing for free play, social and active play that is enjoyable for teenagers. Free play is the vision that runs throughout all other cycles. This vision contains the following elements:

- intrinsic motivation: the importance of focusing on intrinsic motivation and the needs for *competence, autonomy* and *relatedness*.
- teenager interest areas: designing for *exploration, social interaction, personalisation* and *self-expression*.
- qualities for motivating teenagers: the three qualities of (1) *exploration and development*, (2) *freedom and self-expression*, and (3) *social interaction*.
- free play definition: free play is creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players.

design explorations first examples and experiences of how to design for free play. This applied knowledge is used to guide and inspire future design decisions in follow-up cycles.

Reflection

In this cycle, we have learned about teenagers, motivation and play from various perspectives. The insights about intrinsic motivation and teenager interest areas have led to the qualities for motivating teenagers, and to the vision of designing for free play. The design explorations and related work in this cycle served as first examples of what this free play could look like, and how we could design for it.

At the end of this first cycle, we have a preliminary understanding of free play, but we have not yet designed for and evaluated free play with teenagers in their in situ contexts. The next step is to try to activate free play through interactive installations in public contexts.

The main focus of the next design research cycle is *how can we activate play in public contexts?* How can we elicit explorative, expressive and social play from teenagers? How can we motivate them to start playing, in a social and active way? Exploring and answering these questions will be the main challenge for design research cycle 2.

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Chapter 3

Design research cycle 2:
Activating play in public contexts through curiosity

Parts of this chapter have been published as:

> *Tieben, R., Bekker, M.M., Schouten, B.A.M. (2011). 'Curiosity and Interaction: making people curious through interactive systems'. In: Proceedings of BHCI 2011.*
>
> *Tieben, R., Bekker, M.M., Sturm, J. and Schouten, B.A.M. (2011). 'Eliciting casual activity through playful exploration, communication, personalisation and expression'. In: Proceedings of CHI-Sparks 2011.*

3.1 Introduction

The main goal of this design research project was to learn and show how we can motivate teenagers to engage in physical and social play in public spaces, using interactive technology (see Chapter 1).

In cycle 1, we learned that we need to design for intrinsically motivating playful activities; activities that elicit and foster exploration and development, freedom and self-expression, and social interaction - with inherent physical activity. We concluded that we need to design for *free play*: creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players.

The first cycle partly answered design research question one: *what type of social and active play is enjoyable for teenagers in daily life?* In this second cycle, we started answering question two: *how can we recurrently elicit this type of playful activities through interactive installations in public spaces?*

The work in this cycle builds upon the results and design knowledge from cycle 1. The free play vision and qualities for motivating teenagers are used as foundation for the design decisions in this phase.

3.1.1 Focus of design research cycle 2

At the end of cycle 1, we had an initial understanding of free play, but we had not yet designed and evaluated for free play with teenagers in their in situ contexts.

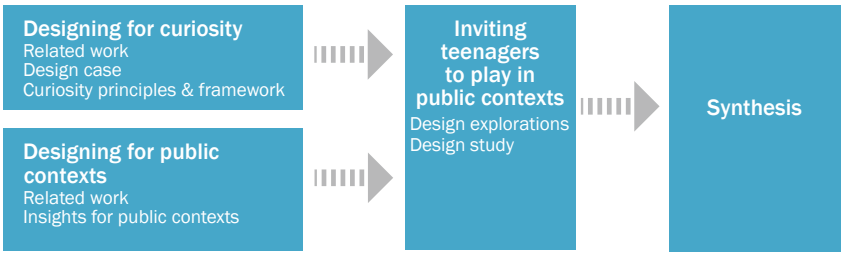


Figure 3.1: ***Structure of this chapter: activating play in public contexts through curiosity.***

Therefore, the main question for this second design research cycle was *how can we activate play in public contexts?* How can we elicit explorative, personalised, expressive and social play from teenagers, in public contexts? Exploring and answering these questions, through literature, design and analysis, was the focus of this cycle.

The abstract answer was clear from the beginning: we should make teenagers curious and motivate them to start exploring and playing. Achieving this, actually making teenagers curious in public contexts, was the main challenge for this cycle.

In this design research cycle, we have analysed literature and related work about designing for (1) curiosity and (2) public contexts. The insights from this analysis, in combination with the design knowledge from cycle 1, have then been used in several design explorations and a first design study.

This chapter will start with two distinct parts: first, our work about designing for curiosity (3.2), followed by designing for public contexts (3.3). The insights from these parts are then combined in Section 3.4, where we will discuss how we can invite teenagers to play in public contexts. Here we will present a series of design explorations (3.4.1), and the Magic Mirror design case (3.4.2), an interactive installation that elicits free play. We conclude this chapter with a synthesis section that answers the design research question (3.5). Fig. 3.1 gives an overview of the structure of this chapter.

3.2 Designing for curiosity

In this section, we present an overview of our work on designing for curiosity. We start with insights from literature and related work about curiosity and curiosity evokers, followed by a design case that elicits curiosity from passers-by. We conclude with an overview of curiosity principles, mechanisms and a process of a typical 'curiosity encounter'.

3.2.1 Curiosity and curiosity-evokers

Curiosity is the *strong intrinsic desire* we living beings have *to know or learn something* (based on Merian-Webster (2010)). It is a strong motivator for behaviour, especially for children and teenagers, as it often decreases with age (Harter, 1981). Curiosity is commonly used to draw attention to stories, products and services. Advertisements, gift-wrappings, gossip magazines: they all deploy curiosity in order to 'reach' the user. Cialdini (1993) and Vorst (2007) both give a large number of real-world examples.

Curiosity is also a strong motivator in public contexts: a big billboard with a puzzling advertisement to make viewers think about the subject, or the spontaneous gathering of people looking to the top of a building because one person looked upwards. Making people curious in order to activate free play can therefore be a powerful strategy.

In design research literature, mostly surprise and ambiguity are being studied, both pivotal elements of curiosity. Two inspiring examples are Zheng, Bromage, Adam and Scrivener (2007) with their work on surprise, and Gaver, Beaver and Benford (2003) who share their series of ambiguous design explorations. Recently, Hobye (2014) published his thesis on designing for Homo Explorens; curiosity and social play in public contexts. He describes many examples of curiosity in public contexts, mostly focused on exhibitions and performative designs.

Curiosity is a well-known design element in the world of game design: mystery, sensory stimuli and the advance in levels and storyline are examples of the use of curiosity in games (Garris, Ahlers & Driskell, 2002; Yee, 2006).

In psychology, curiosity is described as one of the driving factors of human behaviour. Berlyne (1960, 1967) defined two dimensions of curiosity (see Fig. 3.2): on one axis sensory curiosity, such as novel sensations and stimuli, versus cognitive curiosity, i.e. the desire for knowledge. The other dimension ranged from diversive curiosity, i.e. actively seeking varied sources of novelty and challenge, to specific curiosity, i.e. actively seeking depth in one's knowledge and experience with a particular stimulus or activity (Berlyne, 1960; Kashdan, Rose & Fincham, 2004).

Berlyne (1960) also states that curiosity is induced by novelty, complexity, uncertainty and conflict. Loewenstein (1994) clarified that curiosity reflects a human tendency to make sense of the world, and that we are curious about things that are unexpected or that we cannot explain. Theories describing the curiosity-drive, such as the information-gap theory (Loewenstein, 1994) and the incongruency theory (Rauterberg, 1995) describe the 'gap in our knowledge' that makes us curious: this gap should not be too big, nor too small, but exactly 'triggering' enough.

Garris, Ahlers and Driskell (2002) showed that curiosity is evoked by incongruity of information, complexity, novelty, surprise, violation of expectations, incompatibility between ideas, inability to predict the future, and information that is incomplete or inconsistent.

Vorst (2007) presents a literature study from the ancient (pre)history to now, summarising what curiosity is, and showing what evokes curiosity; he mainly adds partial exposure

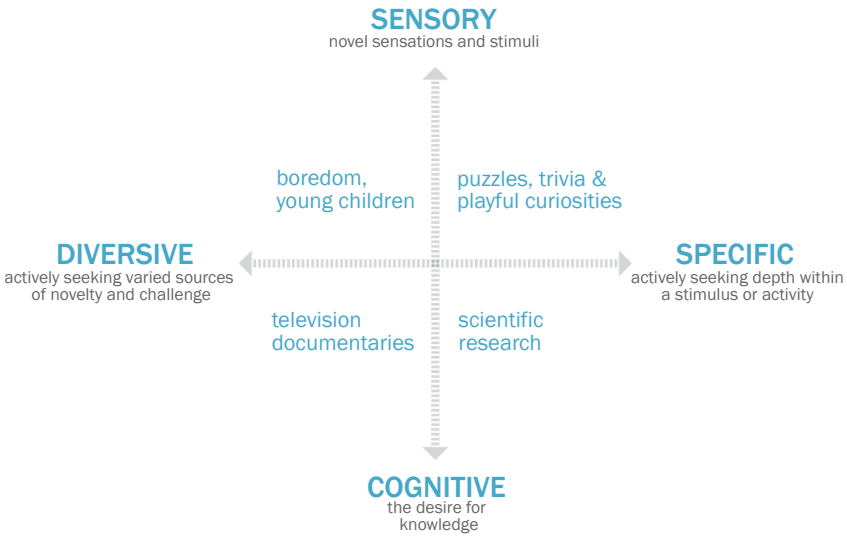


Figure 3.2: ***Four types of curiosity (inspired by Berlyne (1960) and Loewenstein (1994); Figure based on Anderson (2013)).***

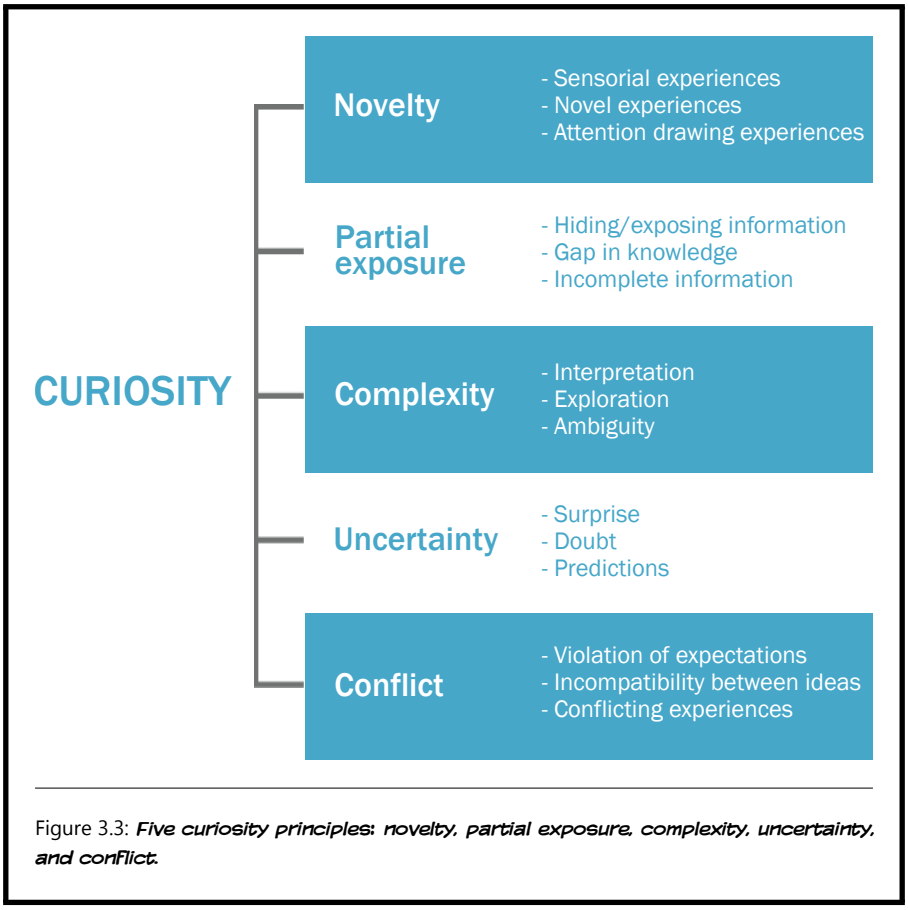


Figure 3.3: ***Five curiosity principles: novelty, partial exposure, complexity, uncertainty, and conflict.***

(to information and/or stimuli) to the list of evokers, with a striptease as best-known example.

Summarised, we can define five main principles for evoking curiosity: *novelty, partial exposure, complexity, uncertainty* and *conflict* (see Fig. 3.3); in an encounter, evoking curiosity can happen as explained in Fig. 3.4.

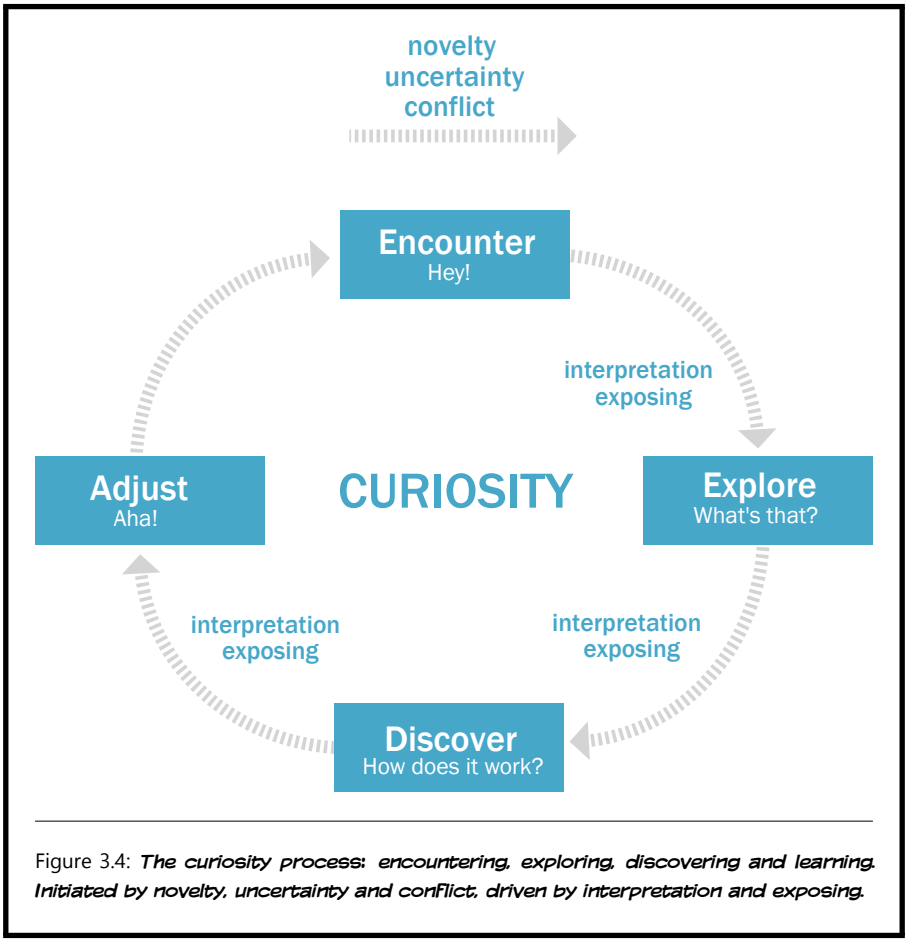


Figure 3.4: *The curiosity process: encountering, exploring, discovering and learning. Initiated by novelty, uncertainty and conflict, driven by interpretation and exposing.*

3.2.2 Curious-action Speakers: curiosity through interactive prototypes

To explore how we can apply these curiosity evokers in interactive systems, and to evaluate if they can be successfully used to elicit curiosity, we iteratively developed the Curious-Action Speakers (see Fig. 3.5). In several iterations of design and evaluation, we developed six interactive speakers with an embedded webcam that transform action into sound output. Using this installation, we could quickly implement and evaluate different interaction scenarios: when someone would walk through a corridor and pass the speakers, then he/she would hear sounds from each speaker (see Fig. 3.6).

Our goal was to explore if we could elicit curiosity and explorative behaviour through an interactive system, using novelty, partial exposure, complexity, uncertainty and conflict. We developed five interaction scenarios, mappings of the actions of passers-by translated into sound output from the speakers, with each scenario focusing on a specific curiosity evoker. We evaluated the speakers in the corridor of a school; we expected each of the scenarios to influence the way in which students walked through the corridor. We will now briefly present the implementations of the five interaction scenarios. They will be explained in more detail in the evaluation section.

Novelty: out-of-context animal sounds An 'out-of-context' situation was created, by playing the background noises from a farm. When a person would get close to a speaker, loud noises of scared animals would be given as feedback.

Partial exposure: fragmented sounds We played fragmented audio samples from popular movies, in order to make passers-by curious about the 'total picture'. Audio fragments were played softly; inviting passers-by to listen closely and to 'recall' from which movie it was taken. After a few seconds of listening, the sample would fade out, and start from another speaker.

Complexity: uncorrelated interaction through sound By coupling a variety of user actions to music samples in an uncorrelated way, we invited the users to make sense of the complex situation. We expected the users to explore different ways of interacting, by performing various actions and then listening to the results.

Uncertainty: distorted sequences In this scenario we altered sequences, and thus distorted the expectations of the passers-by. Each speaker played a number; speaker one would say "One!", speaker two "Two", and so on. By disabling one of the last speakers, the expectation of the users was distorted: they would expect a "Six!", but the system would not respond at all.

Conflict: cognitive distortion We created a conflicting situation by placing coloured footsteps on the floor in the corridor. People passing a speaker would hear the color they

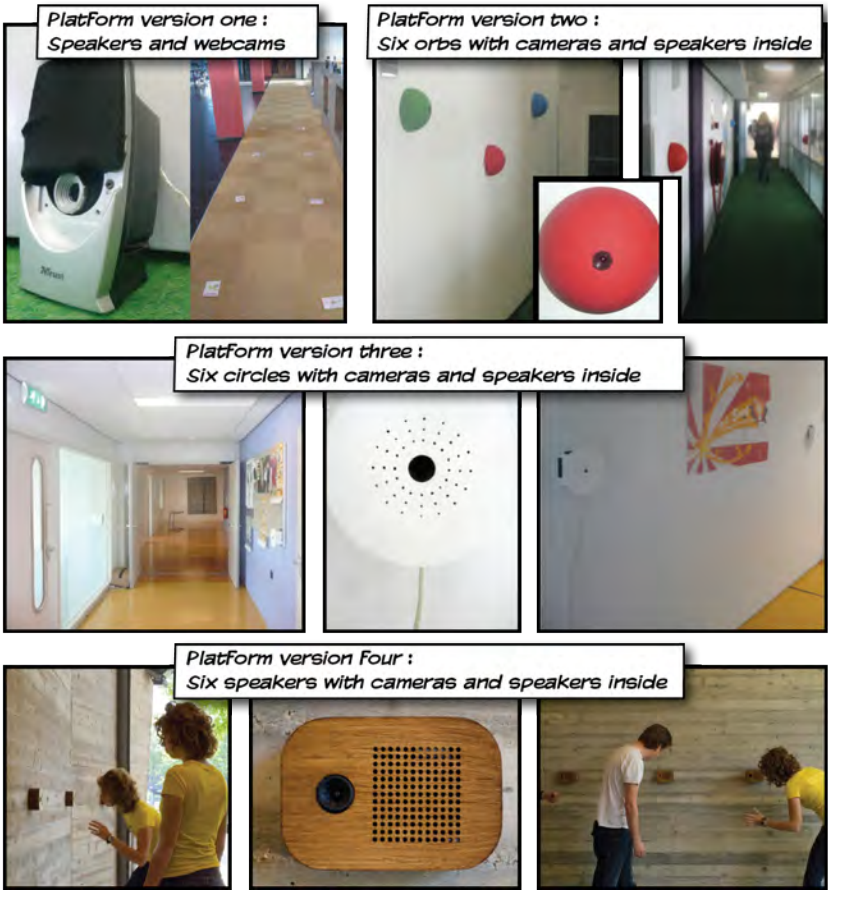


Figure 3.5: ***Four versions of the Curious-action Speakers: interactive prototypes that elicit curiosity.***

Figure 3.6
Curious-action Speakers – Design study by Rob Tieben

Six interactive speakers with an embedded webcam that transform action into sound output. Using this installation, several interaction scenarios were implemented and evaluated, e.g. when someone would walk through a corridor and pass the speakers, then he/she would hear sounds from each speaker.

2010.
More information, including design and evaluation details, at:
playFulll.com/curious-action-speakers

walked on, e.g. "Red!" while walking on the red footsteps. The last speaker always responded with the wrong colour, creating a mismatch between the real situation and the output from the system.

3.2.3 Evaluation

The Curious-Action speakers were evaluated in several iterations; first, in informal evaluations in our university, followed by a week long evaluation in another university.

Evaluation setup

We expected that the five interaction scenarios would result in a variety of user behaviours in the corridor: people would probably respond in different ways to the scenarios, walking in a different pattern than normally.

In the following paragraphs, we describe the way in which we evaluated the influence of the interaction scenarios, and the behaviour they caused. The actual observed behaviour, and the most important conclusions, are covered in the subsequent sections.

The speaker platform was installed in a corridor in a vocational school (students 17-24 years old). The corridor led to a self-study area; students walked through this corridor several times a day on their way to and from the self-study area. The system was implemented in the school for five days (Monday-Friday). Due to the setup of the university's curriculum, different students were present each day: as a result, the majority of the students on a specific day had not encountered the system before.

Each day, a different interaction scenario was active: on Monday, the 'Animal-sounds' interaction, on Tuesday the 'Movie fragments', and so on. Each interaction was active for at least four hours; during these periods, the system worked stand-alone. On average, per day 25 students worked in the self-study area, passing the system 2-4 times each. An observer was 'hidden' in an office at the end of the corridor; in addition, the cameras in the speakers recorded all movement in the corridor (visual only). The observer described all behaviour of passers-by; in addition, each passer-by was rated on a scale from 'no visible reaction to system, no change in walking pattern' to 'visible reaction to system, large change of walking pattern'.

Special attention was given to the changes in behaviour: the way in which the speakers influenced the natural behaviour of individuals and groups, and how groups of peers responded and interacted. The fact that a study was being conducted was not communicated to the students during the week.

Evaluation results

Out-of-context animal sounds *Hey, what is that?*

By creating a situation that is clearly out-of-context, we evoke curiosity through *novelty*. This means that something is new, or out of place, in a context and someone wants to know or feel 'what it is'.

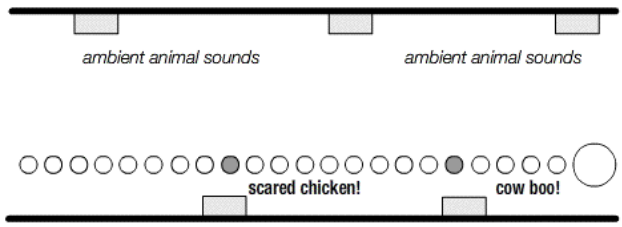


Figure 3.7: ***Out-of-context animal sounds: speakers produce background sounds related to a farm. If a student gets close to a speaker, the sound of a scared animal is played.***

Novelty is associated with sensorial, novel and attention drawing experiences. Often, the curiosity evoked by novelty is quickly 'fulfilled', and then the curiosity is gone: the novelty has worn off.

Our assumption was that the interactive speakers would elicit short explorative behaviour. We expected students to stop and investigate the speakers, quickly understanding that a nearby movement would result in the sound of a scared animal. This shallowness would lead to a short spur of curiosity and exploration, before the student would be satisfied and walk on.

Example of a typical user encounter as observed during the evaluation:
Luuk and Jack walk through the school to their next lesson. Luuk mentions "Look, what are those?" He walks closer to a speaker, and suddenly a disturbed cow boos. Laughing, Jack walks to another speaker, and discovers a scared chicken. Together, they walk onward, scaring animals while they walk by.

Most of the students stopped to explore the system on the first encounter: they briefly activated several speakers, and listened to different animal sounds. After this short exploration they walked onward. On a next encounter most people walked by ignoring the system.

Novelty worked as a strong, but short, evoker of curiosity. The interactive speakers were clearly novel, drawing a lot of attention, and herewith eliciting explorative behaviour. After this novelty had been 'fulfilled', the speakers lost their strong attraction.

Novelty seems well suited to draw initial attention to an interactive system; however, this novelty quickly wears off, and additional principles have to be used if sustained or repetitive curiosity is needed.

Fragmented sounds *I want to know what is hidden behind...*

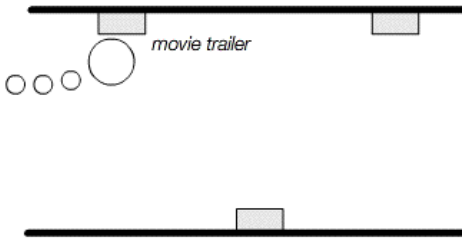


Figure 3.8: ***Fragmented sounds: sound fragments from popular movies are softly played from a speaker. If a student stops to listen, the sound fades out and is played from an adjacent speaker.***

By hiding or exposing parts of information, we make people curious about the total image. In a way, we point out a gap in someone's knowledge by providing incomplete information (*partial exposure*), and if the user is interested in this information, he/she will want to fill this gap. The interest of the user and the size of the gap are important: the information should not be too exposed, nor too little or not interesting at all.

We assumed that the partly exposed information would draw the attention of the students, since popular movie fragments were used. We expected them to stop, listen to the samples, and to recognise the origin after a few moments.

Example of a typical user encounter as observed during the evaluation:
Linda walks to her next lesson. On turning the corridor, she hears sound coming from an object attached to the wall. While walking, she eyes the objects without altering her stride, and walks onward.

Only a handful of passers-by stopped to listen to the sound samples; the majority of passers-by walked on without stopping, just glancing at the speakers.

The system barely drew attention in comparison to the previous scenario; in addition, most of the students who did notice it just continued walking. Apparently, the movie samples and the system did not evoke enough curiosity to elicit users to stop and explore.

We assume that two factors caused this. First of all, this system was less obtrusive than the animal sound scenario, and therefore less out-of-context; the animal sounds were short distinct 'shouts' ("Boo!") whereas the movie fragments were longer, more continuous samples. As a result, this scenario attracted less attention from the users.

Second, the content was not interesting or intriguing enough; even when users stopped to listen, they walked onward after a few seconds. On hindsight, partially exposing uninteresting information did not create the curiosity we aimed for; clearly, both the information and the hidden part should trigger the users.

Uncorrelated interaction through sounds *How does that work?*

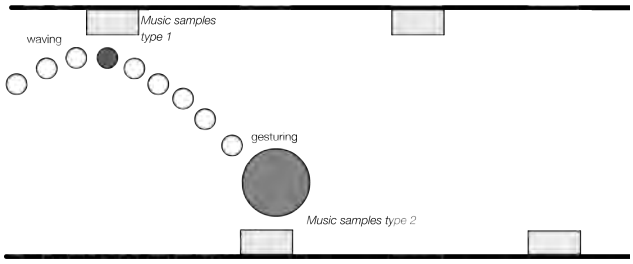


Figure 3.9: ***Uncorrelated interaction through sounds: different actions in front of a speaker result in different sound samples. The correlation between a specific sound sample and action is seemingly random.***

This scenario invited users to make sense of the situation, to explore and discover how the system worked. It was intended to be more complex than the animal sound scenario, where the users could only discover that movement resulted in animal sounds. In this scenario, every action (e.g. waving, walking by) resulted in different sound output, and even similar actions gave ambiguous results (*complexity*).

We expected this scenario to elicit interpretive behaviour: students trying all sorts of actions, in order to discover what they could do with the system. Exploration, we assumed, would be more intense and take longer than the shallow exploration in the animal sound scenario, based on previous explorations with music (while designing the speaker platform).

Example of a typical user encounter as observed during the evaluation:
Mark and Wouter walk through the corridor, being surprised by the sudden mixture of sound samples. Mark walks to a speaker, and waves in front of it, starting a new sample. Wouter walks quickly past three speakers in a row, creating a symphony of different samples. After a minute of exploration and playing, the two walk onwards.

The strong feedback in this scenario drew a lot of attention; approximately half of the passers-by started interacting with the system, discovering the link between action and

music, and activating various speakers in a row. Users tried different sort of gestures, discussing with and mimicking each other in their explorations. On subsequent encounters, a "walk-through-and-use" phenomenon displayed itself: users would walk through the corridor, trying a few different gestures while passing each speaker.

The variable and ambiguous output elicited a lot of curiosity: passers-by tried to find out "how the system worked", and while doing this they discovered additional ways of interacting (e.g. waving, walking by, blocking the camera, etc). Their discovery was rewarded (musical output), and at the same time they encountered a new aspect that had to be interpreted (new sample). This combination is important; the reward should be interesting enough to trigger a new cycle of exploration and discovery.

Distorted sequences *Hey, wasn't it supposed to do...?*

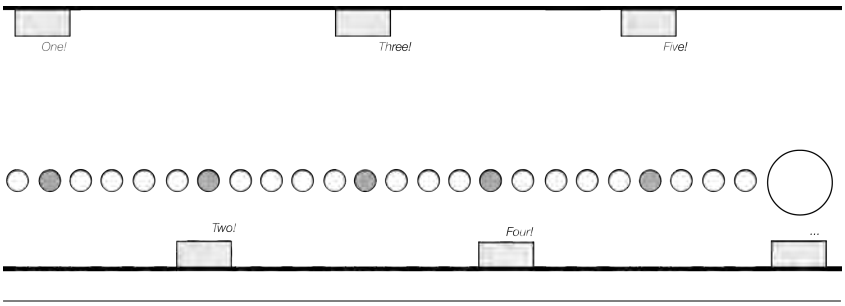


Figure 3.10: ***Distorted sequences: walking through the corridor results in a sequence of numbers – "One!" from the first speaker, "Two!" from the second, and so on. One of the last speakers is quiet, not responding to the passer-by at all.***

By altering the sequence of numbers, and thus distorting the expectations (*uncertainty*), this scenario created a mismatch between expectation and perceived situation. Previous design explorations had shown us that passers-by immediately create expectations while walking through a corridor; not fulfilling these expectations did often create doubt and surprise.

We assumed that the first speaker would elicit a short span of novelty: a speaker playing "One!" when you walk by is clearly out-of-context. Since this was all the speaker did, we expected students to walk on after a few seconds of exploration. We predicted that most students would notice the quiet speaker, commenting on it to peers and perhaps even stopping to try and activate it.

Example of a typical user encounter as observed during the evaluation:
Pelin and Pepijn walk through the corridor, activating a one-two-three pattern. After a brief

exploration, they realise that movement results in a number, and they walk on - four-five-..silence.. Slightly roused, Pelin shouts "Six, you idiot!". Pepijn comments that it must be broken. On a next encounter, Pepijn softly mimics the voices while walking by. Now, speaker four is quiet, and Pepijn stops to wave in front of the speaker. After a few seconds, he walks on, again stopping at the (now active) "Six!" - looking surprised and confused.

The results of this evaluation were unexpected: multiple passers-by started counting aloud with the system, even on first encounters, and were visually and verbally surprised by the lack of reaction from the silent speaker. Approximately one out of four passers-by walked back and started to wave in front of the speaker. Some users even started to talk to the speaker and peers, usually ending with an "it must be broken...".

The counting numbers pattern, and the expectations it immediately created, proved to be powerful for creating uncertainty and curiosity: users were clearly distressed by the mismatch with their expectations, walking back and trying to activate the speaker. From their comments, it seemed that they did not know if their expectations were wrong, or if the system was malfunctioning.

Cognitive distortion *No, that's wrong!*

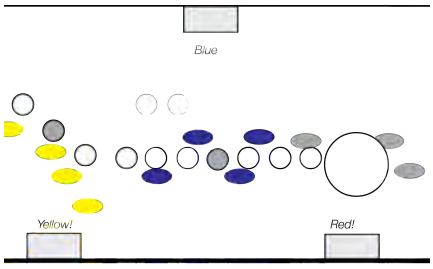


Figure 3.11: ***Cognitive distortion: Footsteps create coloured areas in the corridor. When someone passes a speaker, the corresponding colour is said aloud. The last speaker announced an incorrect color.***

This interaction scenario revolves around *conflict*: conflicting experiences and incompatibility between ideas. It seems similar to the distorted sequence scenario; however, where the former is about surprise and doubt, this scenario creates conflict. The paintings of Escher are a perfect example of curiosity through conflict: things should not be possible, yet they seem possible, and one wonders why.

We assumed that this scenario, due to its relative obtrusiveness and the addition of footsteps, would create a strong short span of novelty. In addition, we expected a short realisation of conflict: a surprised look or pause, before continuing onwards.

Example of a typical user encounter as observed during the evaluation:
Menno, Jan and Tom walk through the corridor, following the red footsteps. The speakers respond with "Red! Red! Red! Blue!". Tom walks on without noticing; Menno and Jan look back with a pondering expression on their face.

In this evaluation, we observed three types of behaviour: most of the people almost totally ignored the system, just looking at the speakers while crossing the corridor. Some of the others commented on the system: "It's somehow detecting on which colors we walk - but it isn't correct all the time". The remainder of the passers-by started to explore how the system worked: they tried different ways of walking-by, in order to analyse how the system measured things. However, more than half of all the passers-by changed their walking pattern to match the footsteps, walking on the steps or jumping from step to step.

This interaction scenario did attract attention, but it hardly elicited explorative behaviour. We assume that the coloured footsteps are the main reason for this: people focused their attention on the footsteps, adapting their walking pattern to the path. This resulted in less attention for the speakers and the sound output.

While setting up this scenario, an interesting observation was made: the footsteps were not yet placed, but the speakers already mentioned colours when someone walked by. Passers-by assumed that the speakers responded to the color of their clothes, commenting about the correctness or stupidity of the system.

Conclusion

Overall, the Curious-action system elicited curiosity and exploration; clear differences were observed in the intensity and type of exploration, depending on the active interaction scenario.

Each of the interaction scenarios focused on a specific curiosity principle, although they were not mutually exclusive (see Fig. 3.12).

We have presented five interaction scenarios that all elicited curiosity and exploration in different ways, and with varying levels of success. These scenarios elicited four types of behaviour: normal behaviour, the same behaviour as would have occurred if the system was not there; explorative behaviour, where users explore different possibilities; playful behaviour, where users play with the system; and pattern behaviour, where users interact almost absent-mindedly while walking by.

Based on the evaluations, we concluded that it is possible to elicit curiosity using isolated curiosity principles. However, combining principles in order to catch and hold the attention of the passer-by is more powerful. For example, one could create a clear out-of-context situation (novelty) to draw the attention of the user, then drag the user into cycles

	Novelty	Partial exposure	Complexity	Uncertainty	Conflict
Animal sounds	X				
Fragmented sounds	x	X			
Uncorrelated interaction	x		X		
Distorted sequence	x		x	X	x
Cognitive dissonance	x		x	x	X

Figure 3.12: ***The relation between curiosity principles and interaction scenarios. Big crosses represent a strong relation, small crosses a weak relation.***

of exploration and discovery (complexity). On a next visit, the system could respond in a different way, creating doubt (uncertainty) and starting a new cycle of exploration and discovery (complexity).

3.2.4 Curious-action framework

The design explorations and study about curiosity provided us with a wide range of insights about designing for curiosity, based on both theory and practice. However, this cloud of 'things that are important' was hard to communicate to others or to apply in a design process.

We decided to synthesise the variables and factors we identified in a preliminary framework or initial model. We aimed to create an overview of important factors for designing for curiosity that could aid us and others in a design process. The creation of this framework was also our first attempt to synthesise insights from literature, design and evaluation and to communicate design knowledge.

A curiosity framework was created, which visualises the process of encountering a public installation, and the variables that influence the triggered behaviour.

This framework is a first iteration: a rough overview of the most important insights that we gained during our studies in this design research cycle. It is not intended to be complete, nor to be a summary of theory: it is a first attempt at creating a tool that can help designers in a design process to deal with curiosity.

The framework served as starting point and first iteration for the frameworks developed in the other design research cycles. It was our first attempt to summarise and communicate our findings about curiosity, and has been published and discussed at several scientific venues.

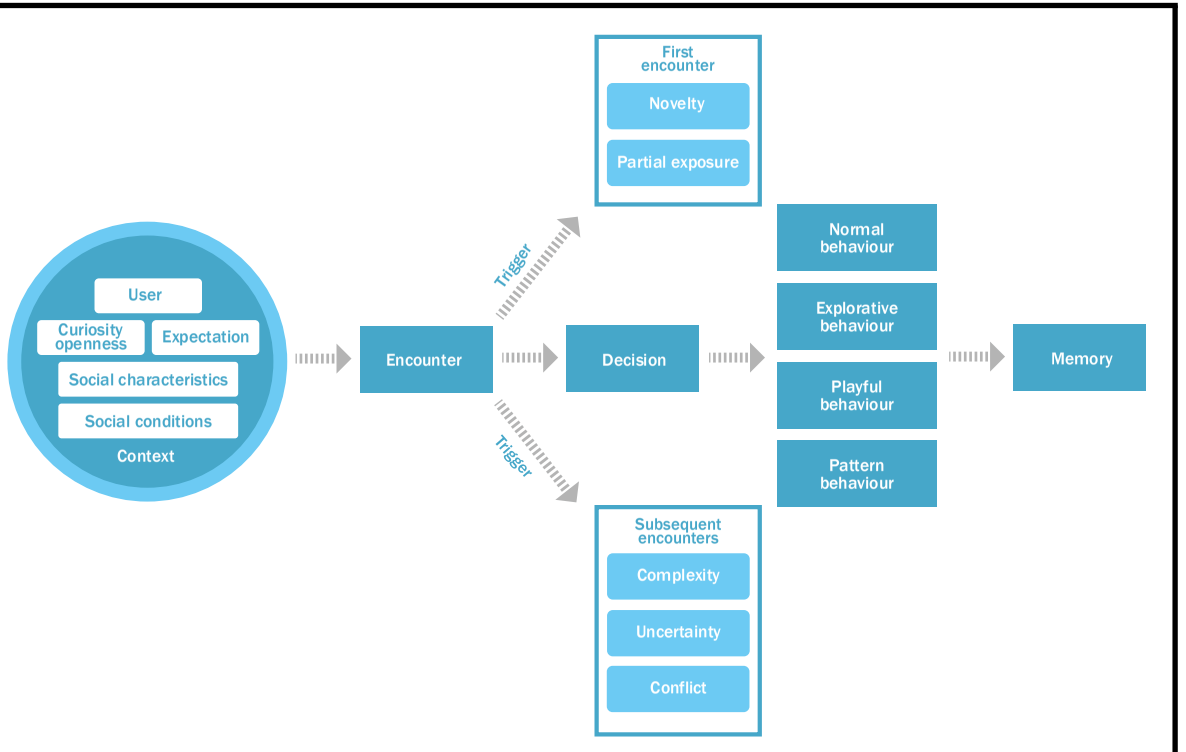


Figure 3.13: *Curious-action framework for eliciting repetitive curiosity in public spaces.*

The user, influenced by four variables, encounters the system in a specific context. On the first encounter, the novelty and partial exposure principle create the curiosity. On subsequent encounters, the complexity, uncertainty and conflict principle take this role. Four types of behaviour can occur: normal, explorative, playful and pattern behaviour.

This is a preliminary framework, intended to provide an overview of elements that should be considered when designing for curiosity. It is not a final version, nor a summary of theory; it presents our understanding of the design space at the end of this design research cycle.

The curiosity framework visualised the process of encountering a public installation, and the variables that influence the triggered behaviour (see Fig. 3.13). Its contents are based on the work in this design research cycle.

The user, influenced by four variables, encounters the system in a specific context. On the first encounter, the novelty and partial exposure principle primarily create the curiosity. On subsequent encounters, the interpretation, uncertainty and conflict principles take this role. Four types of behaviour can occur: normal, explorative, playful and pattern behaviour.

The framework presents the following elements:

Context: the context is the pivotal element - it shapes the entire process. The spatial shape of the context, the social influences, the community, the environment, and so on: they all determine how the encounter is experienced, what decisions are made, and most of all, what behaviour is performed.

User: the passer-by has certain traits: he/she can be a curious person, or not at all; he/she can ignore social pressure, or be extra perceptible to it; and so on.

Curiosity openness: the level of openness towards curiosity. If a passer-by is on the telephone and running to catch a train, different behaviour will be performed than by a bored passer-by who is just wandering around.

Expectation: the system will always create a certain expectation. This expectation is influenced by previous experiences, the visual characteristics of the system, the environment, etc.

Social characteristics & social conditions: the social conditions and social characteristics (De Kort & IJsselsteijn, 2008) in which the system is placed influence the decision. A quiet corridor will allow different exploration than a corridor filled with fifty students.

Encounter-Decision-Behaviour-Memory: the general process consists of an encounter with the system; the passer-by decides to behave in a certain way; certain behaviour is performed; and the passer-by remembers the experience. Curiosity is triggered during the encounter phase, to elicit the user to start exploring, and thus to deviate from the normal behaviour.

Novelty: eliciting curiosity through something that is new or unusual.

Partial exposure: eliciting curiosity by hiding and exposing information, by showing a gap in knowledge.

Complexity: eliciting curiosity by inviting the user to make sense of the system and the possible interactions.

Uncertainty: eliciting curiosity by surprise, doubt, or by deviating from the predictions.

Conflict: eliciting curiosity by creating an incompatibility between expectations and/or subsequent experiences.

Normal behaviour: normal behaviour, the same as would have occurred if the system was not there.

Explorative behaviour: short or intense exploration. Different interaction possibilities that are performed by the user to explore possibilities.

Playful behaviour: playful behaviour with the system. The user knows what the system will do, and interacts with the system to create a certain response. Usually done in groups.

Pattern behaviour: almost absent-mindedly interacting with the system while walking through the corridor.

3.2.5 Reflection and discussion

This study about curiosity was our first attempt to understand play experiences in school contexts. The direct results, and all the insights and experiences in running such a study, were of great value for the rest of this project. While conducting this study in a school area, we also became aware of the strong influence of the environment and social conditions on the users and their actions. Designing for public contexts was therefore a second focus area in this design research cycle (see Sect. 3.3).

In discussions with colleagues and at conferences, however, we identified one caveat. In this study, we focused on curiosity, and to do this we isolated curiosity; as a result, the curious-action speakers were perfectly suitable as tool to study curiosity, but offered little value in terms of user experience, playful interaction or free play.

Some critics wondered if, by isolating the curiosity from all aspects that make a 'good experience', we did not destroy the core of the experience, and as a result studied an 'unreal' situation. We partly agree and disagree.

We agree that, by minimising the experience, we hampered the playful experience and social interaction possibilities. Simultaneously, we disagree, as this minimalist design allowed us to focus on and study curiosity in depth.

To remedy this issue, we have from this study onward focused on evaluating experiences from a holistic perspective. This way, we could study aspects such as curiosity in their 'original habitat' of a playful experience. This is covered in more detail in the following design research cycles.

This work has already been published in 2011 (as Tieben, Bekker and Schouten (2011)), and has received attention from various sources (such as Valk et al. (2012), Hobye (2014)). An interesting development is that others have used this work as inspiration or for reflection, providing us with valuable insights about the application, generalisability and usefulness of this work.

Hobye's (2014) dissertation reflects on this work, and emphasises the "lack of extended exploration". We wholeheartedly agree: this case was focused on short bursts of exploration, and we intentionally designed for interactions that would end after a short moment of exploration.

Hobye continues "prolonged engagement (..) indicates an interest from the participants that moves beyond mere curiosity and towards an actual interest in exploration for the sake of exploration itself". This is, in other words but with the same message, exactly what we want to achieve with designing for free play. Curiosity should be the starting point, drawing users into a social playful experience. Then the interest and interactions of

the players should take over, and create a socially driven playful activity. Players should play for the inherent satisfaction of performing the activity (intrinsically motivated).

How we can design for this free play was the question and challenge in the remainder of this design research project.

3.3 Designing for public contexts

In the previous section, we have discussed curiosity and how we can design for curiosity. This section focuses on public contexts, and identifies important elements for designing for public contexts.

In Human-Computer Interaction (HCI) literature, designing for public contexts has been studied from various perspectives: social interaction in (semi-)public spaces, the role of players and spectators, best practices for design research, and many related topics.

In this section, we describe a selection of these publications, and the relation to the work in this thesis (see Fig. 3.14 for an overview of the sources used). We discuss (1) the different places, spaces and conditions that are present in (semi-)public contexts, (2) the roles that people can fulfil in relation to a public installation, (3) the activities, actions and phases of interaction that can occur and (4) other influential factors. We end with a discussion of the most important insights about designing for public contexts.

3.3.1 Spaces and places

HCI literature commonly distinguishes the concepts of *space* and *place* (Harrison & Dourish, 1996). Akpan, Marshall, Bird and Harrison (2013) summarise: "*space is commonly described as the geometric structure that enables or constrains certain kinds of behaviours, whereas place refers to the ways in which the space gains social meaning over time through interactions within it; thus place includes the memories, experiences, norms and patterns of behaviour associated with a space*".

Suchman (1987) already stated in her Theory of Situated Action that both the material and social conditions influence the (possible) actions of users. This shows the challenge when designing for public contexts: both the diversity of the space and the characteristics of the place strongly influence the users and their actions.

From a space perspective, a corridor in a school is a narrow area where people go from A to B, but from a place perspective the strong social norms and patterns of behaviour in this corridor become apparent, such as groups of peers passing each other, the time pressure to go to the next class, and the school rules for this specific area.

Safety and health regulations such as fire exits and a continuous flow of passers-by also influence and constrain the area and experience (O'Hara, Glancy & Robertshaw, 2008). In addition, there are many tacit or even hidden rules and patterns in a place, that can only become visible when a design is added to the existing situation. This emphasises the importance of iterating design and evaluation when designing for these contexts.

Source	Technology	Context	Users
Harrison and Dourish, CSCW, 1996	Virtual reality, multimedia spaces,MUDs	Discourse about space and place	N/A
Sheridan et al., HCI, 2004	Wearable public displays	Art and technology festival	Visitors of festival
Reeves et al., CHI, 2005	Mobile personal displays, interactive installations and performances	Diverse public spaces	Various public areas
Finke et al., DIMEA, 2008	Interactive game on large public display	Public space at university campus	Students in university building
O'Hara et al., CSCW, 2008	Interactive game on urban display	Public areas in three different cities	Visitors and passers-by of public areas
Snibbe and Raffle, CHI, 2009	Interactive camera/ projector systems	Public culture and science exhibits	Visitors in public areas
Nielsen et al., IDC, 2009	Interactive table	Department store	Visitors of store (children and adults)
Müller et al., MM, 2010	Interactive public screens	Urban environments	Visitors of public areas
Fischer and Hornecker, CHI, 2012	Interactive media façades	Public urban environment	Visitors and passers-by of public areas
Grønbæk et al., ACE, 2012	Outdoor interactive installation (swing)	Permanent at urban playground	Visitors of public area (children and adults)
Müller et al., CHI, 2012	Interactive public displays	Lab and shop windows	Study participants and passers-by
Akpan et al., CHI, 2013	Interactive camera/ projector system	10 different public contexts	Visitors and passers-by of public areas

Figure 3.14: ***Interactivity in public contexts: different sources, technologies, contexts and users.***

The presence of an interactive installation in a public context automatically creates certain areas, e.g. the area where spectators stand and the area where players interact with the system. Fischer and Hornecker (2012) define seven of those areas that are relevant when designing for interactive installations. They call these areas 'spaces', which should not be mixed up with the earlier mentioned spaces and places.

Display spaces are the areas from which a display can be seen; the term display includes all elements that serve as a display in the installation, including e.g. a group of observers that attract attention from passers-by. The *potential interaction space* includes all areas where interaction could occur; the *interaction space* is the space used by one person while interacting with the system. *Social interaction spaces* emerge as soon as several people come together and social encounters and interaction can occur. Simultaneously, *gap spaces* can emerge; they are and create the distance between human and system or between humans. *Comfort spaces* are spaces near architectural elements that provide comfort, such as a pillar to lean against, or an area to observe from while being 'out of the way'. Finally, *activation spaces* are the areas where parts of the system or interaction can be seen by passers-by, but interaction is not possible. Initial curiosity is often created in these areas (Fischer & Hornecker, 2012).

In our situation, the social aspects of these areas are important: the size of the display space highly influences the possible actions, as teenagers are constantly observing each other, and are aware that others are observing them. A large display space, visible by hundreds of teenagers, will therefore result in other actions than a small private display space.

In addition, we want to elicit social play, so we should design the potential interaction space in such as a way that a lot of social interaction spaces will emerge, when people are playing with or observing the installation.

Finally, we want people to play with our installations, so we should invite them to move from observing in the display and comfort space to participating in the interaction space. This move from one space to another corresponds with a change from one role to another, and is covered in the next section. In addition, we need to make passers-by curious and invite them to come closer and explore. How to design for this curiosity was discussed in Section 3.2.

3.3.2 Roles in public contexts

Interaction in public contexts has been described from a variety of perspectives, resulting in many models. Fischer and Hornecker (2012) compare existing models, and distinguish two types of models: *interaction process models*, describing the different actions users take from approach to interaction, and *role-based models*, describing the performative interaction and the roles and transitions that appear.

Both types of models are useful for our situation: role-based models can tell us more about the different roles we need to design for, while the interaction process models can help to explain the different actions and phases that need to be considered. We will first

discuss the role-based models, followed by the interaction process models in the following section.

Role-based models often describe three roles: active performers (*actors*), participants who co-engage with the performer by e.g. helping or giving hints (*spectators*) and passive observers (*audience*) (Brignull & Rogers, 2003).

Sheridan, Dix, Lock and Bayliss (2005) present a role-based model for technology-based performances in public contexts such as night clubs. They distinguish between performer, participant and observer; even though they discuss situations where a performer uses technology to entertain the public, we can still learn several things from this model.

First of all, they discuss the interactions between the roles of performer, participant and observer, showing that the latter two roles are fluid and that technology connects the three. In addition, they stress the importance of taking the context (place) and environment (space) into account when designing for such a situation, as the context and environment change the performance, but also vice-versa. Last but not least, they discuss the mediating role that technology takes in creating the experience, which we fully agree with. This mediating role of technology is paramount in our vision, since technology should only elicit and mediate the playful interaction, and then disappear into the background. The playful experiences we design for should be socially-driven, through the interaction between players, and not technology-driven.

Finke, Tang, Leung and Blackstock (2008) discuss how bystanders, spectators and actors move from peripheral awareness to focal awareness and direct interaction. They present a framework where they show the boundaries between those roles, and the steps that are taken by a user from entering a space and glancing at the installation, to finally interacting with the installation and receiving feedback and results.

While enlightening, this framework is too limited for our situation: the linearity from bystander, to spectator and actor is too rigid. We have for example created several installations where passers-by are already interacting with the installation before they notice that there is an installation. More importantly, the order of steps totally changes on recurrent encounters, as passers-by would already know what the system does, and therefore can immediately decide whether they want to play, watch or ignore the installation.

For our case, the roles and their relation and fluidity are important to keep in mind, as they influence the enjoyment and experience (De Kort & IJsselsteijn, 2008). Designing for the roles of actor, spectator and bystander is vital in our public contexts; and especially being aware of the relation between those roles, and the fluid way in which people shift from role to role.

3.3.3 Interaction processes

A second type of models that is used to describe interaction in public contexts are *interaction processes*, models that describe the different actions users take from approach to

interaction. In general, two main phases are distinguished: the phase where the attention of the passer-by is attracted, and the phase where the passer-by interacts with the installation.

The first phase is called *attracting attention* (Müller, Walter, Bailly, Nischt & Alt, 2012) or *invitation phase* (Valk et al., 2012), and corresponds to the *encounter* phase in our curiosity model (see Section 3.2.4). The second phase we call the *interaction phase*, which corresponds to the *ongoing engagement phase* (Müller, Walter, Bailly, Nischt & Alt, 2012), the *exploration and immersion phase* (Valk et al., 2012) and the *decision and behaviour phase* in our curiosity model (Section 3.2.4).

To attract attention, Müller, Walter, Bailly, Nischt and Alt (2012) describe six techniques that are used for communicating the interactivity of a public display or tabletop: (1) a *call-to-action*, often a text label, (2) an *attract sequence*, moving objects or a slideshow, (3) nearby *analog signage*, like a label or manual, (4) the *honeypot effect*, the effect of people being attracted by persons already interacting with a device, (5) *persons inviting passers-by* to interact and (6) *prior knowledge* of recurrent visitors.

Once attention has been attracted, the users have to start interacting. Nielsen, Fritsch, Halskov and Brynskov (2009) identified five types of *initiation behaviour* by users: *walk-up-and-use*, *watch-and-join*, *watch-and-take-over*, *interact-and-run* and *return*.

Müller, Alt, Michelis and Schmidt (2010) present this whole attracting attention phase in more detail, identifying *passing by*, *viewing and reacting* and *subtle interaction*, followed (if the motivation exists) by users *interacting*. They also stress that the curiosity of onlookers has to be raised, in order for them to cross the *threshold* between passing-by and viewing and reacting.

Müller, Walter, Bailly, Nischt and Alt (2012), and O'Hara, Glancy and Robertshaw (2008), describe three types of interaction that can occur in this first phase: *incidental or implicit interaction*, where the user unintentionally manipulates the system without noticing an effect, *inadvertent interaction*, where the user unintentionally manipulates and notices the effect, and *explicit interaction*, where the user intentionally manipulates and notices the effect, and truly enters the interaction phase, as discussed next.

In the interaction phase, as Müller, Alt, Michelis and Schmidt (2010) describe, users can interact with a system (if motivated), followed by *follow up actions* such as taking a photo. They discuss *manipulations* which lead to *effects*, where manipulations are all physical actions - movements, gestures, expressions and utterances - around and as input into a system, and effects are the results of the manipulations, from the system but also on the performer itself. Müller, Alt, Michelis and Schmidt (2010) perceive manipulations and effects as more than only the input and output with the system: they also include the social interactions between users. This is vital in our vision as well, as social interaction is, for us, a large part of the playful experience.

Nielsen, Fritsch, Halskov and Brynskov (2009) identified four types of social interactions in their evaluations: *family interaction, group interaction, individual interaction* and *social interaction*. They combine this with three interaction modes: *explorative interaction*, *playful*

interaction, and *playful exploration*. This partly corresponds with the normal, explorative, and playful behaviour in our model; we added the pattern behaviour, which only occurred on recurrent encounters, and is not covered in the models described before.

Müller, Alt, Michelis and Schmidt (2010) lastly present the extent to which a performer's manipulations and effects are visible: *hidden*, *partially hidden*, *transformed*, *revealed* or *amplified*. They add four broad design strategies that can be used in the design of a public installation: *secretive*, where manipulations and effects are hidden; *expressive*, where both are revealed; *magical*, where effects are revealed but manipulations hidden; and *suspenseful*, where manipulations are visible, but the effects are only revealed when the spectator can perform him/herself. These distinctions can inspire different modes of interaction, which can be useful for recurrent encounters with a system.

Users' actions in a public context can be hampered by *evaluation apprehension* (O'Hara, Glancy & Robertshaw, 2008): users' fear that their behaviour is judged by others in the vicinity. The threshold for starting to interact should therefore not be too large.

This threshold can be overcome by users' curiosity, a *compere* (person who guides and helps to overcome shyness), the honeypot effect, and by allowing accidental interaction, where the user is manipulating the system without noticing it at first (O'Hara, Glancy & Robertshaw, 2008).

From the literature about interaction processes, the different types of attracting attention, initiation and interaction are especially relevant for our case. However, in this existing work there is limited to no attention for recurrent encounters with public installations. In addition, there is limited material available that studies the types of play that occur on first and recurrent encounters in public contexts.

We are interested in the combination of types of play and recurrent encounters: what type of play occurs, how do play and encounters change over time, and so on. This will be discussed in the following design research cycles.

3.3.4 Other influential factors

Many factors influence users' behaviour in public contexts. Besides the considerations and factors already described in the role-based and interaction process models, there are other insights that can be gained from literature.

Snibbe and Raffle (2009) look at public interaction from a cinema perspective, and describe many important factors for *social immersive media*. First of all, they describe six important design principles that can be used for successful social interaction: *visceral*, experiencing the system through full-body interactions on a physical and emotional level; *responsive*, immediate, clear and predictable responses; *continuously variable*, continuously changing media with infinite variability; *socially scalable*, interactions that are designed to be shared with others; *socially familiar*, media that augments and reinforces existing collocated social behaviours; and *socially balanced*, interactions that equally emphasise a user's awareness of herself, other users and the media itself.

They continue with four types of narrative models, the type of story that a user can experience while interacting: *experiential*, where a continuous reality is created which is predictable yet variable; *performance*, where users and the piece are moving forward like an improvisational dance; *episodic*, where narrative episodes are used to tell a story; and a *game*, where users are engaged in goal-oriented narratives. Montola, Stenros and Waern (2009) reflect on this temporal aspect from another perspective, discussing different types of temporal games with varying styles and durations, and the influence of late arrivers and early leavers.

Lastly, Snibbe and Raffle (2009) also explain how user behaviour can be controlled with different interaction techniques: *energising, calming, competing, performing, disinhibition, learning* and *dwell time*.

Combining it all, Snibbe and Raffle (2009) suggest three approaches that work well in their experience: *continuous interaction*, where the systems responds continuously to full-body interaction, in contrast with discrete interaction where the body is a cursor or pointer; *recording and replaying user actions*; and *using shadows and silhouettes* to represent the user instead of a full-color representation.

From the above we can learn that it is important to choose a specific social and narrative model, and an interaction technique, when designing for social installations. The insights and experiences from Snibbe and Raffle (2009) concur with insights we gained from design explorations, and have informed our design decisions in design research cycle 3 and 4.

From a different perspective, Akpan, Marshall, Bird and Harrison (2013) describe how people learn from each other in public contexts: through *cooperative exploration*, *social learning* or by first observing others and then *mimicking*, which can lead to *chains of interaction*.

Emergent champions can arise in public settings, people who coordinate and explain to others, which concurs with the *spontaneous organisation* observed by O'Hara, Glancy and Robertshaw (2008).

Lastly, Grønbæk, Kortbek, Møller, Nielsen and Stenfeldt (2012) stress the importance of creating familiar interaction in these settings, so users know what to do; they describe the challenge of inviting people to join in and to let go of their usual behavioural patterns.

Designing for these social ways of exploring and learning was an important focus for our case, as in this way the exploration occurs in a social context, and chains of interaction can emerge for current and future experiences.

3.3.5 Challenges in design and research for public interactions

The previous section discussed important challenges for designing for public interactions, and identified factors that influence the behaviour and experience of users. However, existing literature does not yet explain how to solve these challenges; there is still a gap in explaining and illustrating how we should design for playful interactions in public spaces.

In this section we discuss three main challenges and the gaps in literature that need to be filled before we can understand how to design for free play in public spaces.

Challenge 1: the influence of space and place

The space and place where a design is installed strongly influences the users and their actions. Different types of areas emerge when an interactive installation is added to a public space; these areas relate to the (inter)actions of passers-by, audience, spectators and players. In addition, there are many tacit or even hidden rules and patterns in a place, that only become visible when a design is added to the existing situation.

Literature and existing frameworks create awareness about the influential factors in a space and place; however, they do not provide us with solutions for how to design for a specific context. Every context requires specific design decisions; only by exploring and iterating in situ can we understand the specific factors in an environment.

An overview or framework is missing that communicates these factors and a process for designing with them. Additionally, a collection of design examples can illustrate how a design can be adapted to a specific context, using the design knowledge from the framework.

Challenge 2: the mediating role of technology

Interaction in public spaces creates fluidity in the roles of players, spectators and audience; the (social) interaction between people is paramount to the experience in the public space. Technology should mediate the interaction between player and system, but also the interaction between players - the social interaction between people is a vital part of the input and output of an interactive system.

Literature confirms our vision that technology should only elicit and mediate the playful interaction, and should then disappear into the background. The playful experiences we design for should be socially-driven through the interaction between players, and not technology-driven.

It is important to create proofs-of-concept that illustrate and justify this belief. Too often, technology is the main focus and driver in interactive installations, which can result in socially isolated players instead of in an environment full of social and playful interactions.

Challenge 3: the interaction process

A player moves through several roles and phases in the process of approaching and interacting with a public installation. An interactive installation should support these different roles and guide users through the exploration and interaction process, on first and recurrent encounters.

Existing frameworks are not directly applicable to our situation; in some, the linearity between roles and phases is too rigid, describing the interaction with a 'passive' interactive installation such as a kiosk. Other models do not allow for returning users on recurrent encounters, focusing instead on single immersive encounters.

How to design such an installation requires further studying, through explorations and iterations. Annotations of the design decisions and applied design knowledge in successful public installations would provide a useful tool for designers. This way, designers can get a better insight about designing for public playful interactions on first and recurrent encounters.

Filling the gaps

The challenges show that there are many important factors to consider when designing for public playful interaction, but the how is still missing. Inspiration and guidance for designers is required, through best practices, process descriptions and annotated examples.

This design research project has to solve these challenges, and can start filling the gaps by creating a framework for designing playful activities in public spaces, accompanied by a collection of many examples and proofs-of-concept.

The insights and challenges discussed in this section have been used throughout the design research cycles: both as inspiration for the design process, and as important factors to focus on in the evaluation phases.

3.4 Inviting teenagers to play in public contexts

In this design research cycle, we have analysed designing for curiosity and public contexts as described in the previous sections. In parallel, we have explored how we can design interactive prototypes that invite teenagers to play in public contexts using curiosity. In this section, we will present our explorations about designing for curiosity, play and teenagers in public contexts, in the shape of design explorations and rapid user evaluations.

Groups of students from Industrial Design (TU/e) and Game Design & Technology (Fontys ICT) have, coached by us, designed concepts for teenagers that elicit physical active play, in half-year projects. In parallel, we have designed and evaluated several prototypes and installations ourselves.

In these design processes, we used the insights from theory and design practice as input and guidance for design decisions, applying the conclusions from the first two design research cycles.

3.4.1 Design explorations

In this design research cycle, we coached six second-year Industrial Design students, and six groups of five third- and fourth-year Game Design & Technology students. In projects of half year, they designed concepts about 'social and active play for teenagers'.

The projects started with a kick-off, where we briefed the students about motivation, teenagers, curiosity and public spaces, using the insights discussed in this chapter. We coached the students in a process of idea generation and concept development through creative sessions, user confrontations, design critiques and expert evaluations. Relevant literature, related work and our summaries were used as inspiration and guidance throughout the projects.

Eventually, final concepts and working prototypes were developed. These prototypes were informally evaluated with teenagers in schools, swimming pools and leisure areas.

We will first present three prototypes that were developed by our students. These three examples were chosen because they nicely illustrate our free play vision, and were successful in eliciting free play during the informal user evaluations. The concepts are described in Fig. 3.15, 3.16 and 3.17: Bomb-It, dotMirror and LightScribe.

The student prototypes were only evaluated with a handful of users each. To explore designing for and evaluating free play with larger groups of users in real-life contexts, we developed and evaluated the Magic Mirror installation. This interactive installation was evaluated during a full day at a high school.

We used these design explorations to develop a better understanding of the design research space and insights from theory. This way, we could translate our insights in usable chunks of design knowledge for ourselves and the students, while identifying and experiencing all the different factors that influence play for teenagers in public spaces. The design explorations also served as applied examples of our free play design vision.

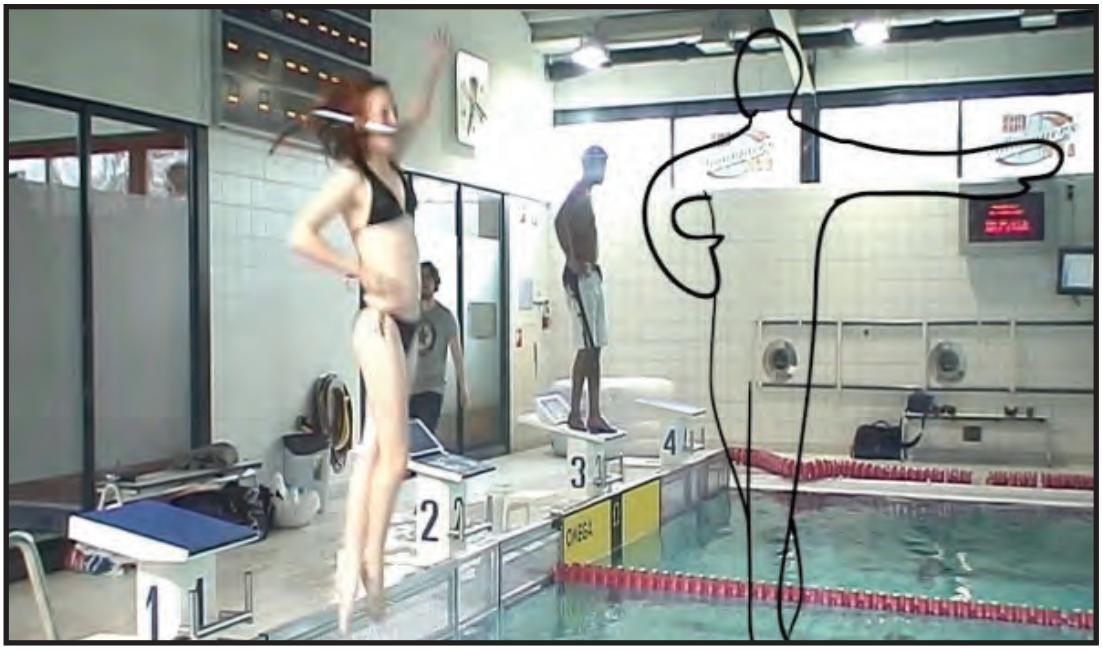
3.4.2 Magic Mirror

Scenario: *Linda, Pelin and Mark enter the main school hall during their lunch break. They see a comic-like video stream of the hall, projected on the wall. When walking closer to the projection, they recognise themselves in comic-style, and start waving and jumping, playing with their self-image. They play for a while, and discover a small camera hidden in the wall; Mark makes a crazy face in front of the camera, broadcasting it to all his peers via the large screen. On subsequent breaks, the effect in the video stream changes, varying from fun-house mirror effects to video delays.*

Intentions: The aim of this installation was to make teenagers curious in the main hall of their school, and seduce them to start playing. To explore the effect of the installation on all students in the school, we chose a publicly visible location in the middle of the hall. This way, all students would encounter the installation during their breaks.

This study had a qualitative and explorative nature: we were interested in the installation's success in eliciting free play, but just as much in the general influence of the installation on the school. How would students and teachers respond to this novel object, how would social interaction unfold in the area, what would be the influx of new players, etc.

Design: The installation consists of a large display or projection, and a hidden camera; a live video stream from the camera is altered by effects, changing the appearance of the users and the environment. The large display, live video stream, and always-on feature draw passers-by close to the screen: they see their video-reflection, and are invited to move around in order to experience the playful effects. Once users are playing with the video stream, social curiosity can seduce other passers-by to interact. The effects change for every break, renewing the curiosity and interest for the installation.



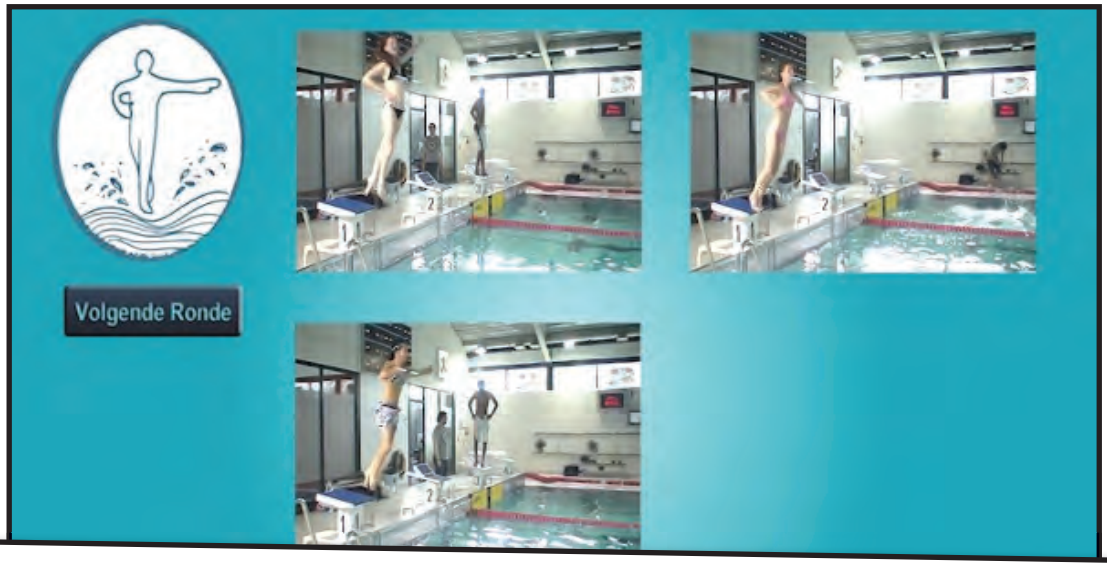


Figure 3.15
Bomb-It – Design exploration by vd Bogaard, Donkers, Jacobs, Leenders, Verhoeven and v Woelderen

Bomb-It is a game for the swimming pool, where a side-view camera records players' jumps, and displays the last four on a big display. Players can review and compare their splashes, dives, saltos or bombs in a social and active playful activity.

2011. Coached by: Menno Deen & Rob Tieben
More information, including design and evaluation details, at:
playFulll.com/ bomb-it

Figure 3.16
dotMirror – Design exploration by Troy Reugebrink

dotMirror is a mirror with an interactive layer that displays your silhouette in a magical way. Little holes in the mirror allow the projection of a camera-tracked silhouette, resulting in a beautiful effect whenever someone moves in front of the mirror.

2012. Coached by: Ben Schouten
More information, including design and evaluation details, at:
playfulll.com/dotmirror

Figure 3.17
LightScribe – Design exploration by Tamás Fejér / by Hanna Zoon

Lightscribing is a photography technique where moving light sources are used to draw beautiful light paintings. Combined with a group of teenagers or an app, lightscribing results in a social activity where physical play leads to creative results.

2010 / 2012. Coached by: Mark de Graaf & Rob Tieben / Ben Schouten
More information, including design and evaluation details, at:
playFulll.com/lightscribe

Figure 3.18
Magic Mirror – Design study by Rob Tieben

Magic mirror is an interactive video projection that alters a mirror image of the school hall with various funny video effects. Users in the hall see themselves at the large projection, in for example a comic-like way or with a transparent ghost delay. The video effects change throughout the day.

2011. More information, including design and evaluation details, at:
playFulll.com/ dynamic-clothes

The installation only displays an altered video stream: there is no goal or gameplay. Users have to come up with actions and intentions themselves, in order to be able to play. The video effects all require movement before they show 'funny' results, eliciting physical activity. For example, one effect creates a ghost-like video image of the user's previous position; by running around in front of the camera, the users can interact with their own reflection. The direct feedback allows exploration, simultaneous play and turns of acting and observing; in addition, it allows cooperating and giving and following instructions.

The installation displays the video stream en large for the entire school hall, which invites broadcasting, watching and commenting on each other. The interaction pivots around expression and social interaction; most likely, groups of teenagers will react to other's actions, both positively and negatively, and will try or show off movements themselves.

Evaluation: We evaluated the Magic Mirror in the main hall of a Dutch secondary school in an informal user evaluation (students in hall watching the installation: 250, actual users who interacted with the device within 3m of camera: 46). We installed the mirror early in the morning, and observed the hall for three breaks.

Our focus was on the actions of players, bystanders and spectators, and on the general level of attention in the hall. Notes were taken during the observations, and later transcribed and informally analysed.

The camera in the installation recorded during the evaluation period; this data was used to complement our written notes.

Students explored and played with their video image: they would wave, walk upfront to the mirror, and watch their appearance change. They interacted together and alone, all the time laughing and commenting on each other. In addition, they used the installation to broadcast written text and images to their peers, writing or drawing on a piece of paper and holding this in front of the camera. This started innocently with the youngest students, with notes like 'it's lunch break!' and hearts with names. When older teens joined, this evolved into sexual drawings and comments - to great hilarity of the students, but less from the teachers.

Users encountered the installation, became curious and started exploring. The social curiosity was a lot stronger than expected: once someone was interacting, others would see this and join, started yelling to friends, or even dragged peers from other parts of the building. In crowded moments, 'leaders' controlled the interaction, but in more quiet moments the timid students would come forward to explore as well.

We observed two types of play: first of all, the (expected) play of waving and moving, where teens explored, mimicked each other, and tried to cooperate in order to create new effects. Second, the installation was used as a broadcast device: teenagers would run to the camera to broadcast their joke, other students would show their shirt with text, and so on. The openness and ambiguity of the installation stimulated this play: since there was no apparent goal, users had to give meaning to the installation themselves, so they came up with all sorts of creative uses.

The playful activity revolved around watching each other and giving feedback, but also around the strong personalisation, exploration, expression and social interaction that occurred. This all motivated the students to join and play in their own way.

3.5 Synthesis

In this design research cycle, we have explored and discussed literature and related work about curiosity and public contexts. The insights from this cycle and the previous cycle have been applied in design explorations of inviting teenagers to play in public contexts using curiosity. This section synthesises the insights from this cycle, and reflects on the lessons and best practices that we have learned through the iterations.

3.5.1 Curiosity and design: inviting teenagers to play in public contexts

Curiosity In this design research cycle, we have studied literature and related work about curiosity, and applied these insights in iterations of design and user evaluations. This has resulted in different ways to invite and convince passers-by to break from their normal behaviour, in both first and recurrent encounters.

Five principles have been identified for making people curious: novelty, partial exposure, complexity, uncertainty and conflict. These principles can be used to convince people to start exploring, drawing them into an explorative playful activity. The Curious-Action Speakers case study illustrates how these principles can be translated to design.

The curious-action framework was developed based on the insights from literature, related work and the design iterations. This is a preliminary framework that serves as a first rough sketch of the important phases and factors influencing an encounter with an interactive system in a public area.

Public contexts In parallel to the work on curiosity, we have studied designing for public spaces. This project was about designing for public contexts, diverse and social environments with many factors that influence users' behaviour.

Through a review of literature and related work, we have identified a range of factors and best practices about designing for public contexts: space and places, roles, interaction processes and other influential factors. This extensive list shows that there are many factors influencing the experience of the users and audience in a public context, and that most of these factors cannot be directly controlled by a designer. However, a design can be installed in such a way that it optimises the interaction in an area, if the designer is aware of and uses the influence of factors such as the space, place, roles and interaction processes.

A playful activity in a public context should connect to the place, space and the users. It should fit in, and connect with, the interaction that occurs in an area, in order to allow rich interaction with all users in the public area.

We have also identified three challenges in designing for public spaces, and discussed the gaps that exist in literature regarding these challenges. The influence of space and place, the mediating role of technology and the interaction process are three important

considerations for the experience of an interactive installation in a public space. Explorations and iterations are required before we can explain and show how to design for these challenges. This should result in a framework discussing the process and influential factors, accompanied by examples and proofs-of-concept that show how to translate this to design.

Design and evaluation The insights about curiosity and public contexts have been applied and further explored in design explorations and rapid user evaluations. Several interactive installations that invite teenagers to play in public contexts have been presented and discussed.

The design explorations and evaluations corresponded with many of the insights about curiosity and public contexts: e.g. the different ways to make people curious, the influence of different player roles, and the richness in player actions while exploring, playing and learning in a social context.

Through the designs and evaluations, and by critiquing the results with students, teachers and fellow design researchers, we further developed our understanding of designing for curiosity and public spaces. New insights and best practices surfaced in these discussions, on both explicit and tacit levels.

These important realisations are:

- make sure that the required actions in the playful activity connect to the place, space and users. Requiring actions that are totally unbalanced with the environment, such as sitting on the floor in a train station, creates a large threshold for participation, and can thus hamper the explorative process.

- design for, and allow, different types of play and behaviour. Different types of players will play in different ways; in addition, do not underestimate users' creativity in appropriating and personalising the system, but encourage it. Activity wise, allow or even reward actions such as spectating, interacting while walking by, and accidental interaction. This way, players can interact and play in their preferred way, which can lead to a broader player base and richer play.

- try to create open activities in the broadest sense of the word: let users think and negotiate about the constraints of the playful activity while playing, and thus allow flexibility in aspects such as rules, goals, required actions, group compositions and duration of play. This way, the playful activity can cater to more types of players and can lead to more diverse play, while also having the potential to transform into novel and unexpected ways of playing.

3.5.2 Conclusions, design knowledge and reflection

This second design research cycle focused on curiosity and free play in public contexts. The main question for this cycle was: *how can we active free play in public contexts*? This question was answered in an iterative process of design explorations and analysis of literature and related work; with a focus on designing for curiosity and public contexts. Design

studies applied this knowledge, and helped to understand designing for curiosity in public contexts in more detail.

The answer to the question is, most of all, making passers-by curious and inviting them to start exploring and playing. Five curiosity principles were identified, that can be used to start playful explorations on both first and subsequent encounters. In public contexts, it is important that these playful activities connect to the place, space and the users, and that the threshold for starting is small. Last but not least, it is important that the playful activity is open in play and behaviour possibilities.

Design knowledge

This cycle has generated the following design knowledge, that is used as input in follow-up cycles:

curiosity principles and curious-action framework five principles for making passers-by curious in a framework for eliciting repetitive curiosity in public spaces. The framework and principles can be used to invite passers-by to start exploring on first and subsequent encounters. The principles are: novelty, partial exposure, complexity, uncertainty and conflict. These principles are used to make teenagers curious, and return in the designs of cycle 3. In addition, the principles and framework are used in the layers and types of free play in cycle 4.

insights designing for public spaces important lessons about designing for public spaces, in specific connecting to the different areas, roles, phases and users. This design knowledge is used in future design cases, and returns in design value 3 in cycle 3, and in the layers of free play in cycle 4.

design explorations and proofs-of-concept examples and experiences of how to design for, and study, free play experiences in public spaces. This is applied knowledge that is used to guide and inspire future design decisions in cycle 3 and 4.

Reflection

In this second design research cycle, we have learned more about free play: we have started exploring how to design for, and study, free play in public contexts. We have been successful in drawing teenagers' attention and seducing them to start playing, using the curiosity principles. We have learned that in public contexts, many factors influence the users' behaviour; when designing for these contexts, the different areas, roles, phases and users should be taken into account. The design explorations and studies in this cycle have served as examples, first proofs-of-concept and as applied knowledge for future design cases.

The playful moments we designed for, however, were incidental and had a very short duration. This was caused by our focus on activating play, and the resulting limited 'depth of play' in the installations. The possible playful actions were shallow in freedom and results.

Our goal in this project was to design for truly free play: creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players. This cycle successfully achieved the first step for this, activating play in public contexts. As a result, the following design research cycle focused on the next step: *how can we design for free play in public contexts?* The insights and design knowledge from this design research cycle are improved and developed further in the following cycle, on a conceptual, applied and methodological level.

Acknowledgements

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Chapter 4

Design research cycle 3: designing for free play in public contexts

Parts of this chapter have been published as:

> *Tieben, R., Sturm, J., Bekker, M.M., and Schouten, B.A.M. (2014). 'Playful Persuasion: designing for ambient playful interactions in public spaces'. In: Journal of Ambient Intelligence and Smart Environments, 6.4, pp. 341-357.*
>
> *Tieben, R., Sturm, J., Bekker, M.M. and Schouten, B.A.M. (2013). 'Eliciting recurring curiosity through playful interactions'. In: IDC 2013 workshop on Behaviour Change Interventions: Teenagers, technology and design at IDC 2013.*

4.1 Introduction

The main goal of this design research project was to learn and show how we can motivate teenagers to engage in physical and social play in public spaces, using interactive technology (see Chapter 1).

In cycle 1, we learned that we need to design for intrinsically motivating playful activities; activities that elicit and foster exploration and development, freedom and self-expression, and social interaction - with inherent physical activity. We concluded that we need to design for *free play*: creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players.

Cycle 2 showed how curiosity can be elicited from passers-by, using five curiosity principles. In addition we learned that, when inviting people to play in public contexts, it is important that these playful activities connect to the place, space and the users, and that the threshold for starting is small. Last but not least, it is important that the playful activity is open in play and behaviour possibilities.

This third cycle continues with answering design research question two: *how can we recurrently elicit this type of playful activities through interactive installations in public spaces?*

The work in this cycle builds upon the results and design knowledge from cycle 1 and 2: the free play vision, qualities for motivating teenagers, curiosity principles and framework, and the insights about designing for public contexts are used as foundation for the design decisions in this phase.

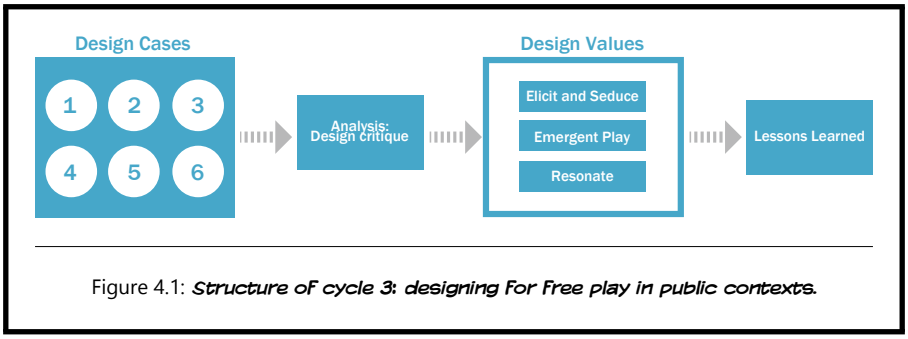

Figure 4.1: *Structure of cycle 3: designing for free play in public contexts.*

4.1.1 Focus of design research cycle 3

The previous design research cycle focused on activating play in public contexts; we used curiosity to invite teenagers to start playing with interactive installations. The playful moments, however, were incidental and had a short duration.

This third design research cycle continued where cycle 2 ended, by iteratively improving and developing the design knowledge and insights about designing for free play, teenagers and public contexts. The goal, and main question for this design research cycle was *how can we design for free play in public contexts?*

This cycle focused on designing interactive installations that elicit free play. In line with the design research approach, we iteratively designed and evaluated a range of prototypes: our own work, projects of students we coached, and results from design competitions and other events we organised. These design cases have been analysed from a holistic perspective in design critique sessions with colleagues (see Section 4.3). In these sessions, we identified common elements in the design and usage of the prototypes.

The goal of this analysis was to identify and describe *design values*: core mechanisms or principles of our design vision. These values are grouped 'best practices': our understanding of and our advice on how to design for free play. The results from the analysis in this cycle, combined with the insights from the previous design research cycles, allowed us to derive three design values for free play.

In this chapter, we will first describe six design cases that illustrate how free play can be elicited in different ways and situations (4.2). These cases have been analysed through design critique (4.3). Then, we will present and discuss the three design values (4.4), and the lessons learned about designing for these values (4.4.4). We will conclude with a reflection and by answering the design research question (4.4.5).

4.2 Design cases

The goal of this design research cycle was to design for free play, which is creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players. As such, this cycle consisted of a large number of design explorations, user confrontations and user evaluations: we have supervised more than sixty students in design projects in line with our design vision; we have organised several game jams (game design competitions) about free play with more than hundred participants in total (see 'Gamesjam.nl', 2014); and we have developed and evaluated several interactive installations ourselves.

The focus of these evaluations was on the play that occurred and on how it evolved during a play session: in what way did players create rules, goals or meaning, what type of social interaction took place, and so on.

The evaluations provided us with inspiration and ideas for future iterations, they allowed us to evaluate the success of the installations, and most importantly they were the input for the analysis that led to the three design values, as explained in Section 4.3.

In this section, we will present a selection of six design cases. These cases have been selected because (1) the concept fitted the free play vision well, (2) they have been evaluated with 10 or more users, and (3) they embodied a specific insight or lesson that exemplified our design vision.

For each case, we will describe the design of the installation and give a summary of the evaluation observations. We present the cases from a holistic and birds-eye perspective with limited details, in order to give an overview of the six cases; this way, the similarities between the cases and the challenges they had in common become clear without risking confusion by an abundance of details. The cases illustrate our design vision (how can we design for free play) and the design research process we followed, clarifying our intermediary insights and understanding at that time.

4.2.1 PhotoDrop, silhouette tower game

Description: PhotoDrop is a game for the swimming pool, where a camera above the pool records swimmers' silhouette, and displays this on a large display. This silhouette is then transformed into a Tetris-like building block, so that swimmers can build a virtual tower using their silhouettes. Players can for example try to build the highest tower.

Observations: PhotoDrop, as well as the two games we describe next (Treasure Race and Waterdraw), were evaluated in several iterations with students from our school (Fontys ICT). The final versions were evaluated with seven groups of six teenagers (10-14 years old), where each group played for five minutes with each game.

Play sessions for PhotoDrop showed strong social interaction and cooperation: players tried to create the highest or most beautiful tower. The playful activity in this game matched the users' interest, and stimulated them to create their own gameplay. Users for

example cooperated in trying to create the highest tower or the biggest block, by creating one big silhouette together.

Conclusion based on observations: PhotoDrop invited creative social play, as players had to cooperate to create the most efficient building blocks. Different strategies for playing emerged by groups of players that tried to achieve their self-determined goals. Players enjoyed themselves and (re)played several times.

4.2.2 Treasure Race, underwater treasure hunt

Description: Treasure Race is a game for the swimming pool, which uses floating objects, a display, and RFID readers. A series of floating objects (treasures) are thrown into the pool; teams of players then have to find and scan the objects to eventually find an hidden treasure, competing in a treasure hunt race. Playing rules and strategy are left undefined, to be decided by the players themselves.

Observations: In the evaluation, the gameplay mainly revolved around trying different strategies to win; competition and cooperation emerged in various shapes. Types of play, and feedback from players differed from team to team; varying from calm strategic play to competitive free-for-all rush play. Users implemented their own goals and rules, and the types of play varied between groups of players: some liked competition and speed, whereas others played in a slower pace.

Conclusion based on observations: Treasure Race elicited more competitive play than PhotoDrop, but in a flexible way. Teams of players tried to win, but negotiated about rules to create their own game moments. Actions from players in one team were copied by others, and outlawed and incorporated in the rules.

4.2.3 Waterdraw, draw and play with colour

Description: Waterdraw is another game for the swimming pool, where players can virtually paint on a display. Players swim around with coloured blocks, and are recorded via a top-side camera. Every object virtually paints with a specific colour; the system also responds to other coloured items such as swimming suits. This way, players can create their own drawings, or play a 'fill-the-map' game, where the goal is to fill the entire screen with a colour.

Observations: The observed play in the evaluation was creative and social: players used all sort of coloured objects to draw, blocking each other and at other moments cooperating. Rules and goals were implemented, and changed, while playing. Players created drawings with the blocks, and shared ideas and results with others.

Figure 4.2
PhotoDrop – Design exploration by Jole, Lemmen, van Loon, Hoogers and vd Horst

PhotoDrop is a game for the swimming pool, where a camera above the pool records swimmers' silhouette, and displays this on a large display. This silhouette is then transformed into a Tetris-like building block, so that swimmers can build a virtual tower using their silhouettes. Players can for example try to build the highest tower.

2012. Coached by: Menno Deen & Rob Tieben
More information, including design and evaluation details, at:
playFulll.com/ photodrop

Figure 4.3
Treasure race – Design exploration by Gommans, Hoogers, van Dam, Titulaer.

Treasure Race is a game for the swimming pool, which uses floating objects, a display, and RFID readers. A series of floating objects (treasures) are thrown into the pool; teams of players then have to find and scan the objects to eventually find a hidden treasure, competing in a treasure hunt race. Playing rules and strategy are left undefined, to be decided by the players themselves.

2012. Coached by: Menno Deen & Rob Tieben
More information, including design and evaluation details, at:
playFulll.com/treasure-race

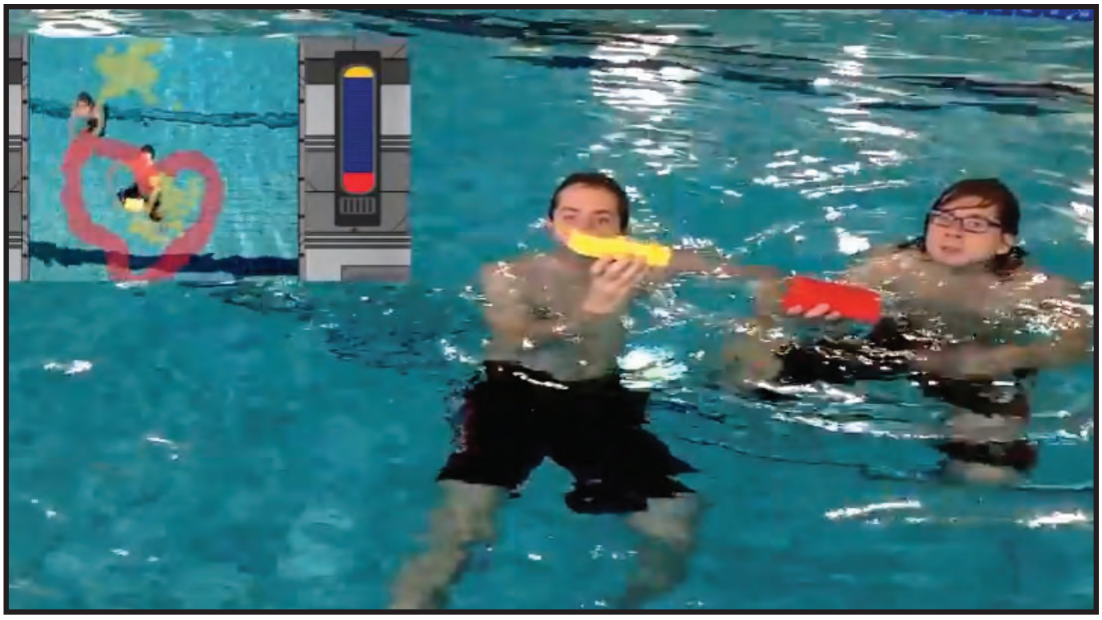

Figure 4.4
WaterDraw – Design exploration by Blok, van Gastel, Pauwels and Voeten

WaterDraw is another game for the swimming pool, where players can virtually paint on a display. Players swim around with coloured blocks, and are recorded via a top-side camera. Every object virtually paints with a specific colour; the system also responds to other coloured items such as swimming suits. This way, players can create their own drawings, or play a 'fill-the-map' game, where the goal is to fill the entire screen with a colour.

2012. Coached by: Menno Deen & Rob Tieben
More information, including design and evaluation details, at:
playFulll.com/waterdraw

Conclusion based on observations: The activity of 'drawing in water' was popular and stimulated creativity. Players used the system for digital graffiti, to show off swimming tricks, and to try and fill the entire map with their colour. Some players preferred the fill-the-map game and its competition, while others were just doodling and exploring.

4.2.4 TeaSeat, active sitting and teasing

Description: TeaSeat is a set of seating elements in a schoolyard; on the seats, several physical actions can be performed such as wiggling or hanging to one side. These actions are then translated to the other seat, which tilts or vibrates as a result. The goal of Teaseat was to elicit active social play during the lunch break, such as teasing and flirting between seated users.

Observations: TeaSeat was informally evaluated with 10 teenagers at a high school. In addition, the installation was used by dozens of players at three exhibitions. Sitting and playing showed to be a good combination: there was strong social interaction, and moments of active play and 'just sitting and chatting' occurred.

The installation was only evaluated with invited users, and this version was limited in play possibilities: users could only sit and wiggle. Still, it seemed to connect to the users' daily life: it was similar to their normal lunch break activities, and the users enjoyed the active sitting, teasing and the social interaction.

Conclusion based on observations: Teaseat was a nice example of inviting users to perform a small action (sitting down) and then inviting them to do more and more. The unexpected flipping of one's chair resulted in enjoyment, and made players and audience want to try it themselves. Sitting rapidly evolved into standing or balancing on the chairs, creating moments of playful active 'sitting'.

4.2.5 Whisperballs, throwing whispered messages

Description: Whisperballs are interactive balls that allow players to record audio messages by squeezing them. Another player can then squeeze the ball again, to listen to the message. Users can throw balls with messages to each other, or leave them to be found for someone else.

Observations: The Whisperballs were informally evaluated in an office setting, and later at a high school with five teenagers. The evaluation was a failure: the balls did not invite users to explore, and when we invited them, no free play occurred. Playing with the balls was not enjoyable according to the users. In addition, when a recording was made, it contained insults or funny sounds most of the time.

The objects were not visible and inviting enough: most people simply ignored the balls. In addition, this medium or implementation was apparently not suited for the teenagers' interests.

Figure 4.5
TeaSeat – Design exploration by Abdeli, Janssen, Kersteman and Scheffer

TeaSeat is a set of seating elements in a schoolyard; on the seats, several physical actions can be performed such as wiggling or hanging to one side. These actions are then translated to the other seat, which tilts or vibrates as a result. The goal of TeaSeat was to elicit active social play during the lunch break, such as teasing and flirting between seated users.

2012. Coached by: Gijs Ockeloen & Rob Tieben
More information, including design and evaluation details, at:
playFulll.com/teaseat

Figure 4.6:
WhisperBalls – Design exploration by Rob Tieben

Whisperballs are interactive balls that allow players to record audio messages by squeezing them. Another player can then squeeze the ball again, to listen to the message. Users can throw balls with messages to each other, or leave them to be found for someone else.

2011
More information, including design and evaluation details, at:
playFulll.com/whisperballs

Conclusion based on observations: The Whisperballs were not successful in eliciting free play, yet they still taught us valuable lessons. The interaction with the balls was subtle and hidden: the recording and listening was personal and for one player at a time. In both the office and the school setting, this type of interaction was not inviting enough, the result was not 'visible' enough for others to try it as well, and the result was not rewarding enough for players themselves to play again.

We learned from this case that both the action and the effect should be visible or rewarding enough for a specific context and target group.

4.2.6 Photo Vault, solving and creating cool photos

Description: The Photo Vault (Tieben, Sturm, Bekker & Schouten, 2013) is an interactive installation that consists of a wooden cabinet, a display, a camera, and four big buttons. In its initial state, the installation asks for an access code; when a button is pressed, the users see themselves through the camera, altered by a video effect. When a code has been entered, i.e. all four buttons have been pressed, then the code is checked, and feedback is given through mastermind-like clues. When users manage to enter the correct code, the installation counts down, and a picture of the users is taken.

All pictures that were taken on the present day were displayed on an external display somewhere else in the school. The code and the video effect stayed the same for one day, and changed each day.

Evaluation setup: The Photo Vault was installed and evaluated at a high school during one full week. The cabinet was placed in a main corridor; the external display in another corridor. No introduction or explanation was given, neither at the start nor during the week.

From a teachers' meeting area in an adjacent corridor, we observed all interactions and discussions during the entire week; in addition, the camera in the cabinet recorded all day long, and all user-taken photos were saved with a timestamp.

The evaluation had two main goals. First of all, we wanted to evaluate whether we were able to elicit short moments of play recurring in every break. Therefore we examined when users played with the installation, how long, and in what group sizes.

Second, we were interested in how players interacted with the installation, with other players and with onlookers: e.g. did they discuss the installation, how did they play and did they create their own types of play and meaning?

Evaluation results: During the five days, 1569 (not unique) players played with the Photo Vault, making 2365 photos together (see Fig. 4.8). Both individuals and groups interacted with the installation.

On day 1 most students just explored the interaction opportunities of the installation ("what does this thing do?"); on day 2, many students wanted to try it themselves and make a photo, resulting in the highest number of players. On the remaining three days, the absolute number of players slowly declined, but the number of photos taken kept

increasing; players tried different poses and compositions, in order to take cool and fun pictures.

On all days except the first, students came to the cabinet in the morning, to see what the new effect was, and to comment on this. A few users then tried to find the code; once discovered, the correct code for that day rapidly spread through the school. Subsequent users either already knew the code, or they would ask and be told by other students in the vicinity of the cabinet.

During the week, it seemed that there were many returning players; although we did not track individual players, we did observe that over 90% of the players on Wednesday to Friday did already know 'how to play' with the installation, indicating a previous play experience or at least knowledge from hearsay or observation.

Playing style gradually changed during the week: the first days, users were playing with the effect, and posing for different pictures. The last days, groups of students tried to create 'special' photos, such as jumping in the air when the photo was taken, dancing and moving to create a blurry picture, climbing on top of each other, etc.

Conclusion based on observations: The Photo Vault was successful in eliciting free play: it created many moments of social play, with varying types of play such as exploration and self-expression, and totally different actions depending on the type of players that were interacting.

The playful activities were creative and autonomous: players tried many ways of posing and composing, in order to create unique photos of themselves and peers. In addition, actions and interactions of players changed the playful experiences: if one player started jumping, others would try this as well. This was e.g. followed by a couple kissing, which was then mimicked by others.

Overall, this case gave us a good insight in the richness and variety that free play can have. We learned many lessons about designing for free play through this case, and also about conducting design research on free play in a school context.

4.3 Analysis through design critique

A total of 20 design cases, including the six cases described above, have been analysed in design critique sessions with colleagues. The goal of this analysis was to find common elements in the design and evaluated use of the prototypes, on different levels and contexts.

Design critique is a systematic and objective examination of an idea, phenomenon or artefact, where work is presented by the designer, criticised in a group, and its virtues and failures are debated (Hokanson, 2012). Design critique is often used in design education and design studios.

Design critique "allows interaction designers to achieve a nuance in their design research that can only be achieved by understanding *particular* designs and environments in very specific terms as opposed to *general* ones" (Blevis, Lim, Roedl & Stolterman, 2007). It is a way of creating design knowledge and a (generative) tool in design practice.

Figure 4.7
Photo Vault – Design study by Rob Tieben

The Photo Vault is an interactive installation that consists of a wooden cabinet, a display, a camera, and four big buttons. In its initial state, the installation asks for an access code; when a button is pressed, the users see themselves through the camera, altered by a video effect. When a code has been entered, i.e. all four buttons have been pressed, then the code is checked, and feedback is given through mastermind-like clues. When users manage to enter the correct code, the installation counts down, and a picture of the users is taken.

2012
More information, including design and evaluation details, at:
playfulll.com/photo-vault

Day	Players	Photos Taken
1	342	222
2	412	475
3	335	488
4	261	578
5	219	602

Figure 4.8: ***Number of players and photos taken per day in the Photo Vault user evaluation.***

The design critique method had five distinct advantages for our situation, in line with the remarks of Blevis, Lim, Roedl and Stolterman (2007):

1. "design critique accommodates the need to understand the effects and contexts of any particular interaction design on a number of different levels denoting a number of different contexts", for example the way in which the interaction design mediates between individuals and groups in a specific context.

2. "design critique provides a mechanism for nuanced discourse and understanding of particular interaction designs, especially when to do otherwise would lead to overly reductive discourse and understanding".

3. "design critique accommodates and fosters discourse at individual, communal, and societal levels about the nature and effects of particular interaction designs".

4. "design critique accommodates and invites contrast and comparison between particular interaction designs and historically significant exemplars – contrasts and comparisons which yield an historically informed and predictive view not easily managed by empirical studies alone".

5. "design critique accommodates and provides a mechanism for comparisons that are massively multi-dimensional and cross-contextual".

Setup and results of design critique sessions and analysis	
Per group	1. Ten design cases (design, scenario & observations) presented to two participants. 2. Discuss similarities and differences in design and observed play between cases. 3. Describe key elements common in several cases; sort and group. 4. Informally define a series of design values.
Analysis	1. Sort and group all key elements and design values from group critique sessions. 2. Iteratively improve and define, resulting in three core design values.

Figure 4.9: ***Setup and results of design critique sessions and analysis.***

We used a group-form design critique (Hokanson, 2012), where design researchers criticised the design cases, in order to identify common elements and to generate insights for design improvements (see Fig. 4.9). Three design critique sessions of one hour were conducted, with one design-researcher participating in all three sessions, and two different colleagues in every session. All seven design researchers were experienced in play or game design.

Through these sessions, three design values were identified: core mechanisms or principles of our design vision. These values are our understanding of and our advice on how to design for free play. The design values were:

- Elicit and seduce
- Emergent play
- Resonate with values, emotions and activities

The design values will be described and discussed in the next section.

4.4 Synthesis: design values framework

In this section, we present the design values as derived from the analysis of the design cases. These design values have been integrated in a preliminary framework, building on and combining the insights from previous design research cycles. The contents of the framework therefore reflect and present the intermediary design knowledge developed through the first three design research cycles.

The description of the three design values is followed by a discussion of lessons learned about each design value. We will conclude this chapter with a reflection and by answering the design research question of this cycle.

4.4.1 Design value 1: elicit and seduce

This design value revolves around *eliciting and seducing* someone to come and play. In the case of games, a player decides or plans to start playing. In our case however, users encounter one of our installations, for example while walking through the school. We have to draw them into playing, and we do that by making them curious.

We invite users to play and to interact through elicitation and seduction: eliciting is "drawn out by trickery or magic" (Stevenson & Lindberg, 2010); seducing is "the process of deliberately enticing a person to engage in some sort of behavior" (Anderson, 2011). We trigger the users' curiosity, tease them and convince them to come closer and to start exploring.

We use a variety of mechanisms and principles for this: curiosity can be evoked through novelty, partial exposure, complexity, uncertainty and conflict (see Section 3.2.4). Installing a novel installation in a school can already be a good starting point to elicit and seduce with. Scaffolding (Verenikina, 2003), gradually increasing the users' knowledge or the interaction possibilities, and ambiguity in interaction (Gaver, Beaver & Benford, 2003) are both mechanisms that can be used to strengthen and reactivate the exploration process, by renewing the curiosity.

The context of an installation strongly influences the type of curiosity that needs to be evoked: areas with the same visitors every day (e.g. a school) require different designs than areas with a high influx of new visitors (e.g. an airport). To continue the elicitation and seduction on recurrent encounters, the curiosity has to be renewed over time; the installation could for example show what previous users have accomplished.

Besides system qualities that create curiosity, we also use social curiosity and the honeypot effect - the fact that passers-by often want to know what other people are looking at or doing. Designing installations in a way that optimizes player visibility for passers-by can therefore also lead to new curiosity.

This social aspect can also have a negative influence: the social status of players influences whether other passers-by start playing (e.g. if unpopular teenagers are playing, then other students might decide to not join).

4.4.2 Design value 2: emergent play

Our second design value is *emergent play*: we design for social and physical play that emerges from the interaction with our installations. The installations we create only initiate and mediate the playful activity: players mostly interact with each other, their body, the environment and with onlookers. The players decide for themselves how they play and how they act.

Basically, once users start interacting, then the real play emerges: playful interaction with their peers, in their own way, and different every time they play. Such emergent play satisfies the needs for autonomy and relatedness, which helps us to create intrinsic motivation.

Emergent play is "play that is not defined beforehand, but that evolves as a result of interaction" (Valk, 2012). Montola, Stenros and Waern (2009) add that in emergent play a combination of infinite affordances and unpredictable environments leads to surprising coincidences and occurrences, and eventually to fun experiences that have not been planned by any designer or participant. An example of emergent play is a child playing with a stick: one minute, it is a sword, then a wand, and later a walking stick. The play emerges in the interaction with the object and the other players; the players decide how and what to play.

Designing for emergent play is important in our vision: the emergent play is driven and guided by the players themselves, connecting it to their playing style all the time. In addition, emergent play helps to renew the curiosity for subsequent encounters, because emergent play inherently changes over time.

We cannot design emergent play, we can only design *for* emergent play; one way we do this is to design for open-ended play (Valk et al., 2012). The playful activities we design are not governed by rules, nor can they be won or lost. In fact, we do not create games in the sense of Salen and Zimmerman (2003) their "system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome". Instead, we design open-ended playful interactions (or free play), where players themselves can create rules and win conditions, if any.

Related to this is our focus on social interaction; the playful activities get meaning, become rewarding and are more enjoyable (only) through the presence of others. Play only emerges, becomes fun and worth while, because users play with the installation, with others, and for others.

4.4.3 Design value 3: resonate with values, emotions and activities

Our third design value focuses on connecting to and using the daily interests and activities of the target group. We want to persuade teenagers to play throughout the day, for which we need playful installations that are intrinsically motivating over a longer period, and that fit into their daily life.

Connecting to the user's daily life is important: many Dutch teenagers for example find it unacceptable to look sweaty in public. Designing a playful installation that requires intense physical activity would therefore be a misfit, and would likely be unpopular in the main hall of a school.

Resonating with values, emotions and activities means knowing what drives the target group, and designing playful interactions that resonate with these drives. In our case, a literature review complemented with focus groups and observations showed us four core interest and activity areas for Dutch teenagers (see Section 2.3): exploration, social interaction, personalisation and expression. This can be seen in popular digital media such as Facebook and YouTube, but also in daily activities such as hanging around, communicating and flirting.

We aim to create playful interactions that resonate with teenagers' values and emotions. Design opportunities are for example enabling teenagers to express their identity, inviting them to give feedback on others, or making it possible for them to broadcast their opinion.

In addition, playful interactions can connect to or even resonate with existing activities; e.g. by enlarging or altering daily activities in such a way that they inherently require or use casual activity. For example, a popular school activity is 'hanging around and chatting a bit' in the breaks; this sitting and watching could be made to resonate by creating interactive seating elements that allow teasing and flirting through physical actions.

4.4.4 Lessons learned

In this design research cycle, we have learned valuable lessons about persuading free play, designing for the design values, and implementing and evaluating in public contexts. Through the design and analysis of the design cases, we have improved our design knowledge on an implicit and explicit level. This design knowledge primarily applies to our context and target group, but is also generalisable to other settings.

In this section, we will briefly discuss the most important lessons and insights. These lessons became apparent in the design critique, and in reflections on the design and evaluation iterations. They are not truths, nor the only way to design for free play; they are qualitative descriptions of important lessons, meant to inspire and guide fellow designers.

Elicit and seduce

The initial presentation or launch of an installation shapes the first encounters and the subsequent interaction of the users with the installation. One way of launching is a kick-off, where the interaction with the installation is explained or shown to (some of) the users. This guides the interaction, ensuring that users (inter)act in the aimed-for way.

In addition, a kick-off aids the eliciting and seducing, since some users will already know the installation and the way in which it functions, and can share this with others.

A different way of launching is letting the users encounter and explore the installation without introduction. This allows the users to give their own meaning to the installation, and it lets action and interaction emerge. Advantage here is that the exploration phase is prolonged, and that users can develop their personalised way of interacting with the installation. A risk is that users might never discover the proper way of interacting.

The Magic Mirror evaluation (see Sect. 3.4.2) illustrates this lesson: in the first break, a school caretaker introduced the installation to several students, and dragged them into the camera's field of view. In the second break, new students discovered the installation by themselves. Two different exploration processes occurred in these breaks, varying in social interactions, group size and preliminary explorative actions.

Keep the cost-for-interacting at a suitable level, when designing for everyday encounters in everyday situations. Many factors influence a user's actions: the user's traits, state (busy vs. waiting), time of the day, location (school vs. station), social environment (onlookers

vs. alone), etc. The threshold, the action that is required in order to interact with the installation, can be lowered by making the required action quick, short and similar to normal actions. Different situations therefore require different thresholds, or costs, for interacting.

Designing for playful moments in a corridor (Curious-Action Speakers, 3.2.2) allows and requires different user actions than designing for a school yard (TeaSeat, 4.2.4) or a swimming pool (Waterdraw, 4.2.3). In a corridor for example, users are passing-by, and have only limited time to interact; as such, a walk-through-and-use interaction is suitable for this situation. In a school yard, however, users are spending a longer period of time, and can therefore be persuaded to play more intense and with a longer duration.

An installation's *complexity, ambiguity and variation in interaction can both invite and repel users*. Complexity and ambiguity can initiate a new cycle of exploration, renewing the interest for the installation and creating repetitive curiosity. It can also lead to mastery: players can be triggered to keep playing if they recognise opportunities for skill development.

At the same time, complexity can confuse and repel users, possibly driving them away permanently, especially if they are never stimulated to interact again.

Complexity, ambiguity and variation are powerful mechanisms to prolong or renew interest, but a balance is needed between complexity and the user's capabilities and understanding. This balance is also dependent on the environment, situation and users.

In the development of the Photo Vault (see Sect. 4.2.6), this balance became apparent. In an earlier version, we would only show the video feed with funny effects after a full code had been entered ("wrong code, now we are recording you"). However, users would press one or two buttons and walk onwards, never discovering that the installation contained a video feed. We changed this by immediately showing the video feed after a button was pressed, but only took a picture after the correct code was entered. This way, users were drawn into a cycle of exploration.

Social curiosity can be used to elicit and seduce through an installation and its users. First of all, if spectators see other people interacting and playing with an installation, then they will likely want to try it themselves. Second, some users will discover something new while interacting with an installation, and will invite peers to come, watch and participate. Allowing users to repeat or review their accomplishments aids this social sharing. Lastly, it is important to design for spectators and people waiting for their turn: the installation could give them feedback, allow them to interact while observing or could invite them to become a participator themselves.

Both the Magic Mirror (3.4.2) and the Photo Vault (4.2.6) illustrated this lesson. In both cases, the social interaction around the installation area led to strong social curiosity: teenagers would observe, laugh and comment on each other, switching roles throughout the break.

Emergent play

One can specifically *design for open-ended gameplay* in order to elicit emergent play. Users, especially in groups, are creative in giving meaning, playing and interacting. In semi-public environments, one user can be enough to create a new way of playing with an installation, since spectators will often join and copy behaviour. Refraining from incorporating rewards such as scores can open new types of play beyond competition and rigid rules.

Playful installations like Bomb-It (3.15) and PhotoDrop (4.2.1) illustrate this lesson. These installations did not provide hard rules or goals, and therefore users had to give meaning to the playful activity themselves. As a result, players came up with all sorts of rules and ways of playing, depending on the group compositions and actions of peers.

Design for social play, social rules, social goals and social negotiation. If the goal is to elicit social play, then users should be able to negotiate rules and goals while and through playing. The installation should support this process and all possible outcomes; hence the necessity for an open and not constraining installation.

In addition, users will play by mimicking or adapting each other's actions. This can be supported by designing the installation in such a way that the users, their actions and their results are visible. At the same time, opportunities for griefing (e.g. players who intentionally harass other players) and socially unacceptable behaviour should be limited by reducing the duration of the result of a user's action.

The evaluation of the Photo Vault (4.2.6) illustrates this lesson: the playful activity pivoted around the social interaction of posing, reviewing and sharing photos. Social play occurred in many ways, varying from groups helping and mimicking each other, to peers watching from a distance and making crude remarks about others' photos.

Design for different personalities and playing styles. Users will interact in different ways with an installation: for example, some leader types will play in the center of the attention, while other users will explore on their own in a quiet moment. Differences in gender, age, character traits, group size and so on will all influence playing styles. It is important to design for these different styles, so that both strong and timid interactions result in valuable responses for the users. Allow different playing styles to emerge while users interact with the installation.

The evaluation of the Photo Vault (4.2.6) showed big differences in players and playing styles. Early in the morning for example two young teenagers would arrive, and they would try to discover the secret code for that specific day. During the breaks, groups of teenagers played with the installation, with a few players in the centre of everyone's attention. The installation design allowed and stimulated these different playing styles, in order to cater to a range of player personalities.

Resonate with values, emotions and activities

Connect to normal behaviour, in order to resonate with the user group. If passers-by should participate in a playful activity, then it is important to design for short moments of play, and for play that connects to the user's daily activities and fits within their environment.

Daily play, especially the start, should be relatively close to normal behaviour, be it in location, time, action or co-users. This can be achieved by inviting users to play for just one second: by letting them deviate from their normal behaviour for one step, doing one tiny interaction, or letting them make one change to the installation's state.

In addition, user's normal behaviour can be used: for example, use all activity in an area as input, whether it is people walking by or stopping to interact. Focus on normal behaviour, and let it resonate.

TeaSeat (4.2.4) connected and resonated with the user group, by changing passive sitting into active sitting and teasing. Users could sit down, wiggle, and were then drawn into a larger activity of teasing their peers.

For teenagers, *design for 'watching, being watched and broadcasting'*. The activities of teens in a public place often revolve around watching peers, and they are constantly aware that others are watching them. Design for this; not only does the presence of others highly influence the actions that teens will perform, but the tendency to watch and comment can be used to elicit and prolong play.

In addition, broadcasting is important; sharing one's actions, the actions of others and one's opinion with peers. This happens face-to-face and via social media - all day long. Again, this should be kept in mind and used when designing, both to elicit play and to prevent negative side effects such as bullying. Do not forget spectators, nor their power and potential.

Design cases such as PhotoDrop (4.2.1), Waterdraw (4.2.3) and Photo Vault (4.2.6) all illustrate this 'watching, being watched and broadcasting': they all pivot around self-expression. Teenagers are invited to express themselves through their actions, and can review their own results and those of others.

4.4.5 Conclusions, design knowledge and reflection

This third design research cycle focused on eliciting free play. The main question for this cycle was: *how can we design for free play in public contexts?* This question was answered through iterations of design and evaluation: many interactive prototypes have been designed, implemented and evaluated with teenagers.

A selection of these design cases has been presented in this chapter, and was used in an analysis to find common elements in the design and use of the installations. Eventually, three design values have been identified, that give the answer to this cycle's question: (1) by *eliciting and seducing* people to start with explorative play, (2) by encouraging *emergent play* where the players drive the playful experience through social interaction and (3) by *resonating with users' values, emotions and activities*.

The presented design cases show how these design values can be applied; the lessons learned that accompany them explain important insights that we gained while designing in this cycle.

Design knowledge

This cycle has generated the following design knowledge, that is used as input in the fourth design research cycle:

design values framework three design values that can be used as guidance when designing for free play: elicit and seduce, emergent play, and resonate with values, emotions and activities. These values are used in the layers of free play from cycle 4, and return in the conclusion and discussion chapter.

lessons learned important insights about designing for free play in public contexts, in specific for teenagers. These lessons return in a more generalised version in the conclusion and discussion chapter.

proofs-of-concept applied knowledge and examples of our design vision. The design cases from this chapter clarify how the design vision can be applied, they inspire future work, and they are used in the creation of the layers and types of free play in cycle 4.

Reflection

In this design research cycle, we have designed many interactive installations that elicited free play. The three design values and lessons learned explain how we design for free play. We have seen varying types of free play that occurred with our designs, with many different player types and types of play. With several designs, the play totally evolved during a play session, driven by the actions and social interaction of the players and passers-by.

These results were promising; however, in this cycle, we only evaluated informally and for relative short durations. The attraction to the installations could be mostly caused by novelty; when the novelty wears off, it is important that the installations retain their attractive power, through other elements.

Designing for, and studying this required high-fidelity prototypes that are evaluated over longer periods of time; this was the focus of the next, and last, design research cycle. The installations should elicit playful moments day after day, through the system and the actions of other players. Therefore, the design research question for the next cycle was: *how can we design for and study recurrent free play in public contexts?*

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Chapter 5

Design research cycle 4: design research about recurrent free play

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>
> *Tieben, R., Sluis-Thiescheffer, W., Sturm, J., Bekker, M.M. and Schouten, B.A.M. (2014). 'Playful (inter)action: teenagers, high schools and six playful designs'. Demo paper for IDC 2014.*

5.1 Introduction

The main goal of this design research project was to learn and show how we can motivate teenagers to engage in physical and social play in public spaces, using interactive technology (see Chapter 1).

In the first three cycles, we learned that we need to design for *free play*: creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players.

We focused on eliciting creative and autonomous play through design explorations, based on insights from evaluations and related work. Many interactive installations were iteratively designed and evaluated, all trying to elicit free play. Analysis of these design cases resulted in three design values and 'lessons learned': principles and mechanisms for designing for free play in public contexts.

The work in this final cycle builds upon the results and design knowledge from the previous cycles: it combines insights and experiences about designing for teenagers, public contexts, and free play. The design values, and all the design explorations and proofs-of-concept from previous cycles, are used in the design processes in this cycle, but also as input in the analysis and synthesis sections.

This cycle answers design research question two and three: *how can we recurrently elicit this type of playful activities through interactive installations in public spaces?* and *how can we conduct design research about such playful activities for teenagers in public spaces?*

5.1.1 Focus of design research cycle 4

Design research cycle 3 focused on designing for free play in public contexts. It resulted in a series of prototypes and evaluations, accompanied by three design values and lessons learned.

The playful moments in cycle 3 were promising yet episodic; most of the evaluations focused on first encounters and short play sessions. The attraction to the installations could be mostly caused by novelty. Further design research was therefore required, in order to know whether our installations could elicit free play on recurrent encounters, day after day (in line with design research question 2). Therefore, the main question for this cycle was *how can we design for and study recurrent free play in public contexts?*

To answer this question, we first of all needed high-fidelity prototypes that could be evaluated in situ for longer periods, to study if and how we can design for free play that lasts over time. Second, we had to find suitable methods and a process for studying this free play over time (design research question 3). This resulted in the following three aims for this design research cycle:

Success Design and implement an installation that recurrently elicits free play for a period up to a month.

Types of free play Identify and describe the types of free play that occur with the installation.

Methods Evaluate and study the installation and the playful activities that occur.

To achieve these aims, we first reviewed literature and related work about play experiences over time (5.2). The majority of this cycle will cover the design, implementation, evaluation and analysis of two high-fidelity prototypes that have been evaluated for periods of a month at high schools (see Fig. 5.1).

These two cases both focused on recurrently eliciting free play (success), but each had a different emphasis on the other aims (see Fig. 5.2). Analysis of these two cases eventually resulted in a framework about designing for free play: three layers of free play and five types of free play, as presented in Section 5.5. This framework or model presents the design knowledge from all four cycles, inspired by the bridging concepts format.

5.2 Play experiences over time

In literature, play during child development is extensively studied: the toys, interaction, meaning and structure of play for children, and the changes from 0 to 12, are discussed in detail (e.g. Piaget, 1962; Fisher, 1992; Smith and Pellegrini, 2008; Goldstein, 2012). There is less literature available about how play with one specific toy changes over time.

Lego is a good practical example of a toy that children use over a long period of time. Every element of Lego can connect to every other element, so there are many building possibilities that are increased with each new set of Lego. New building ideas are shipped with some of the boxes, to inspire children to create new constructions with the same set of

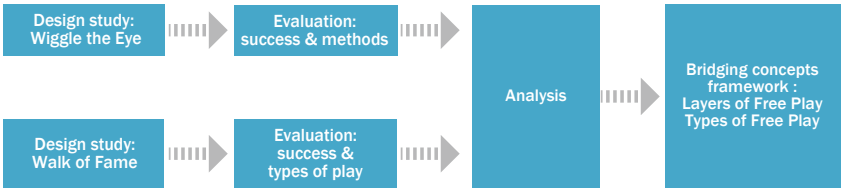


Figure 5.1: *Structure of cycle 4: design research about recurrent free play.*

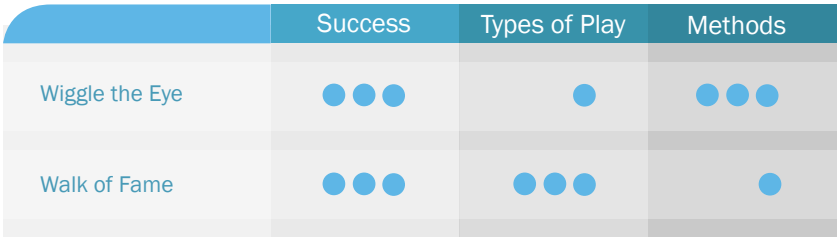


Figure 5.2: *The two design cases in this cycle, each with a different focus.*

Lego (Lipkowitz, 2012). It is *"a toy that prepares the child for life, appeals to the imagination, and develops the creative urge and joy of creation that are the driving force in every human being"* (Christiansen in Lipkowitz, 2012). Children's play with Lego changes over time, because the child grows up and receives additional blocks, but also because Lego stimulates the imagination and creativity of the child by allowing it to play in different ways; a good example of free play over time.

In Human-Computer Interaction (HCI), there is limited literature available about play experiences over time. Goldsmiths' Interaction Research Studio has published extensively about long-term user studies with interactive systems; while not exactly free play, they design via a lucid design approach, utilising aspects such as ambiguity, interpretation and sensor legibility (Gaver, Beaver & Benford, 2003; Gaver, 2009). The Drift Table (Gaver, Bowers, Boucher & Gellerson, 2004), Prayer Companion (Gaver et al., 2010) and Indoor Weather Stations (Gaver et al., 2013) are three examples that inspired and informed us about designing for play experiences over time.

The Drift Table is an electronic coffee table that displays aerial photography controlled by weights on its surface. The Prayer Companion is a device that displays streams of information to nuns to suggest possible prayers. The Indoor Weather Stations are devices that encourage environmental awareness in a ludic way by revealing the home's microclimate in a ambiguous way.

These designs have been installed for months or even years in real-life contexts. The open nature of the designs stimulated the users to adapt and give meaning to them in their own way. The long-term deployment allowed the designs to become fully incorporated in the daily life of the users, which gave a rare insight in the way that products are used and appropriated over time. Several conclusions from these studies are valuable for our case as well.

Gaver, Bowers, Boucher and Gellerson (2004) reported three conclusions about the Drift Table that directly confirm our vision. (1) "Support social engagement in ludic activities"; we fully agree, as we have seen in previous design research cycles how vital the social interaction and engagement is for free play experiences. (2) "Allow the ludic to be interleaved with everyday utilitarian activities"; this corresponds to our focus on resonating with the user and context, as connecting everyday activities with playful activities offers many free play opportunities. (3) "Don't expect ludic designs to leave everyday activities untouched": in our case of designing for public spaces, we have seen repeatingly that passers-by and audience join in with the playful activities, integrating daily life into play (and vice-versa).

The case of the Praying Companion (Gaver et al., 2010), which was a relatively extreme example compared to our situation, showed how engagement with a system has to grow over time, and can totally change over time. The Indoor Weather Stations (Gaver et al., 2013) triggered more reflection about this engagement, as the results were paradoxical: after an initial period of interest and enthusiasm, most participants expressed disappointment about the devices and reported that they stopped engaging - yet they did develop

a lingering affection for the devices and did not want to return them. Users developed relationships with the devices, identifying with them and personalising the usage.

Our direct goal in this project was not to evaluate our designs for such long periods; nevertheless, the insights are important to keep in mind during the design and evaluation process. In addition, these discussions can help to position our conclusions in a larger frame.

5.2.1 User experiences over time

User experiences over time have been studied in more detail within HCI. Several studies show that product adaptation goes through distinct phases over time (Silverstone & Haddon, 1996; Karapanos, Zimmerman, Forlizzi & Martens, 2009). This can be a good parallel to the interaction with a playful installation over time, since there are overlaps (and differences) between the use of products and playful installations.

Karapanos, Zimmerman, Forlizzi and Martens (2009) present three distinct phases for product adaptation: *"an initial* orientation *to the product dominated by the qualities of stimulation and learnability, a subsequent* incorporation *of the product in daily routines where usefulness and long-term usability became more important, and finally, a phase of increased* identification *with the product as it participated in users' personal and social experiences."*

In our case of public playful installations, these phases are different. Orientation still occurs as the first phase, mainly through exploration: what does this installation do, and what can I do with the installation. Incorporation and identification will, if they occur, most likely merge together: users might incorporate a playful installation in their daily routines by playing every day. The reason they play is probably because they identify with the playful activity and the personal and social experiences: the social interaction, enjoyment and urge to play again can lead to incorporation and identification in daily life.

We can learn from the above that designing for incorporation and identification can lead to optimal user experiences over time. In this thesis, our focus is on designing for free play; therefore, we will not focus on the phases of adaptation, or the way in which interaction with our installations changes over time. This is, although highly interesting, outside the scope of this thesis, and subject for future work.

5.3 Wiggle the Eye: interactive seats for physical and social play

The main question for this design research cycle was *how can we design for and study recurrent free play in public contexts*? For this, two high-fidelity prototypes were developed and evaluated at high schools. In this section, we discuss the Wiggle the Eye case, where we mainly focused on successfully eliciting recurrent play and on evaluation methods.

To evaluate if we could successfully elicit free play on recurrent encounters, we developed a high fidelity prototype that could be evaluated at a high school for at least a month. This installation had to elicit playful activity from teenagers on a daily base.

We also explored what evaluation focus, methods and process were best suited to study the installation and the playful activity. The combination of free play, teenagers and public spaces provided a challenging situation, which required an adaptation of existing evaluation practices.

In this section, we first describe the design and implementation of the Wiggle the Eye installation, followed by the evaluation and findings.

5.3.1 Installation design

In this section we discuss the Wiggle the Eye concept, the design and the development of the physical installation.

Ideation & concept development

This design case was inspired by two previous concepts: Sway'It[1] (see Sect. 2.4), a balancing seat that changes color depending on the user's actions, and TeaSeat[2] (see Sect. 4.2.4), a set of connected seats where wiggling on one seat results in vibration and tilting of the other seat (see Fig. 5.3). The starting point for our creative process was the active sitting in a playful and social way that occurred in these concepts.

The Wiggle the Eye concept was created after several creative sessions:
Wiggle the Eye is a playful installation that elicits physical and social play. It is a set of wiggle benches and one central streetlight; each seat contains a sensor and vibration motor. By sitting and wiggling on one of the interactive seats, players control the central streetlight and the vibration motors in other seats. This novel outcome stimulates players to be physically active while sitting, in order to discover what is possible with the installation.

Design of installation

The concept was further developed through creative sessions and feasibility studies; more details can be found in Tieben, Valk, Rijnbout, Bekker and Schouten (2014b).

[1] by Pepijn Fens
[2] by Abdeli, Janssen, Kersteman, and Scheffer

Figure 5.3: *Inspiration for the Wiggle the Eye concept: Sway'It and TeaSeat.*

The final Wiggle the Eye installation (see Fig. 5.4) consisted of five wiggle benches with different sizes. Every bench had two spring elements; an accelerometer that measures wiggling activity; a vibration motor that can vibrate continuously or with slow or fast pulses; and a microcontroller that controlled the vibration motor and accelerometer. A central street light completed the installation: a five-meter high streetlight pole with a moving-head disco lamp on top. The lamp was controlled by another microcontroller that defines position, color and intensity of the light. Each bench and the lamp contained an XBee module for wireless communication.

5.3.2 Design of interactions

Six different behaviours or interaction designs were developed for Wiggle the Eye, using the available input and output parameters (see Fig. 5.6). Fig. 5.7 and 5.8 show all interaction designs: the installation setup, a photo, interaction design, scenario of use, evaluation context and evaluation setup.

5.3.3 Evaluation of Wiggle the Eye

Each interaction design was evaluated with users, in the context of high schools and exhibitions (as seen in Fig. 5.7 and 5.8). Fig. 5.9 presents a summary of the evaluation findings for each interaction design. Due to space limitations we will not discuss the findings of each iteration in detail.

If we analyse the evaluations from a holistic perspective, we can summarise the following findings.

Figure 5.4: ***Wiggle the Eye installation: five wiggle benches and an interactive streetlight.***

Figure 5.5
Wiggle the Eye – Design study by Rob Tieben, Pepijn Rijnbout and Linda de Valk

Wiggle the Eye is a playful installation that elicits physical and social play. By sitting and wiggling on one of the interactive seats, players control the central streetlight and the vibration motors in other seats. This novel outcome stimulates players to be physically active while sitting, in order to discover what is possible with the installation. The installation is public, so one's actions influence the experience of other players, resulting in strong social interaction.

2013 & 2014
More information, including design and evaluation details, at:
playFulll.com/wiggle-the-eye

	Input	Output
Bench	Is wiggling, duration of wiggling, duration of non-wiggling	Vibration (short pulses, long pulses, continuous)
Lamp	—	Position of light (aiming at bench / inside lamp / ground), color of light, intensity of light, and pattern of light

Figure 5.6: ***Input and output parameters for Wiggle the Eye.***

- Overall, the installation was successful in eliciting social and active play. It attracted a lot of attention, users wiggled, interacted with each other and enjoyed themselves. During the in situ evaluations at high schools, the installation became an active sitting area. However, the observations and informal interviews showed that understanding and creating a (correct) mental model of the interaction design was often difficult for the users.

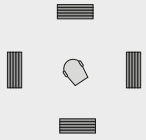
- In these types of social environments, a large number of users is present simultaneously. This can lead to mass exploration and mass interaction: crowds of uncoordinated users interacting with an installation at the same time, trying to make sense of it. Our first interaction designs focused on sequential interactions ("what happens if bench A is wiggled, followed by bench B?"); we had totally overlooked collective uncoordinated exploration ("all benches are wiggled at the same time while single users evaluate the result of their actions"). As a result, mass interaction led to noise, which hindered the users in understanding the effect of their (inter)actions.

  These initial chaotic explorations showed us the importance of both individual and collective control: 'Energize me' lacked individual control, and was therefore unplayable for single users. All other interaction designs lacked collective control, and were therefore unsuited for mass interaction. Therefore, the more popular an installation became, the harder it was for users to understand the interaction possibilities.

- Output modalities are important for initial exploration and for recurrent play. A good solution for initial exploration is to give users immediate and distinct feedback on their actions, to show that the installation is interactive and to motivate them to keep exploring. A slower or more complex type of feedback should be used simultaneously to elicit social interaction and to draw recurrent players in new cycles of exploration and play.

Interaction one: Tease the Others

Interaction design:



Interaction design:
The lamp moves in circles, from bench to bench. If a bench is wiggled while in the light, then both that bench and the opposite one vibrate.

Evaluation context:
Main hall of university, design workshop (n=80), three days, during public event (open house) and normal opening hours (n=30).

Scenario of use:
Rose and Jamie are sitting on opposite benches. They wiggle a bit while talking - nothing happens. Then, Rose wiggles while the light shines at her: now, both benches start vibrating! Laughing, they tease each other, and then decide to wait until someone else joins them, so they can surprise that person by causing a vibration.

Evaluation setup:
Informal evaluations (observations, interviews & group discussion) during:
(a) design workshop of 45 minutes, 2x ±40 prospective students from high school; (b) guided tours of 5 minutes, 2x ±20 prospective students; and (c) sporadic observations during 3 days of normal usage, ±30 observed users.

Interaction two: Wiggle Pong

Interaction design:

Interaction design:
The lamp moves in a semi-circle, from one group of benches to the other. If a bench is wiggled while in the light, the light blinks, changes direction and moves back to the other group. If the other group 'bounces the light back', then the light's color intensity and movement speed increase. If nobody bounces the light back, then the light turns red and the game starts over again.

Evaluation context:
Three days of free use in university main hall (n=30).

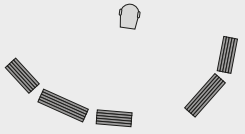
Scenario of use:
Michael and Judy are each sitting on a bench in one corner, and Eric is sitting on another. Eric wiggles while the light shines on him, and sees that the light blinks and moves towards Michael and Judy. They wiggle when the light reaches them, and the light moves back to Eric. Together, they discover that they can play Pong by wiggling at the right moment.

Evaluation setup:
Informal evaluation (observations & interviews & group discussion) during:
(a) sporadic observations during three days of normal usage; ±30 observed users.

Figure 5.7: ***Wiggle the Eye: interaction design, scenario, evaluation context and evaluation setup.***

Interaction three: Hey, Who Woke Me

Interaction design:



Interaction design:
The lamp is asleep; wiggling on the benches awakens it. The awakened lamp moves to an active bench, and makes it vibrate if someone is still wiggling. The longer the lamp is awake, the more irritated it becomes. At a certain moment, all benches start vibrating wildly, after which the light goes back to sleep.

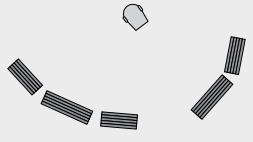
Evaluation context:
Two times one week at schoolyard of school #1 (n=750).

Scenario of use:
Eva and Jon sit on the benches and wiggle a bit. Slowly, the lamp wakes up, shines towards them, and then goes back to sleep. Curious, they wiggle harder. The lamp wakes faster this time, and makes their benches vibrate. Friends join, and together they keep wiggling until all benches start vibrating. After this outburst, the lamp goes back to sleep and fades out.

Evaluation setup:
Three week evaluation at high school #1 (in June), with:
(a) daily covert observations during morning and lunch break;
(b) weekly informal interviews with teenagers, caretakers and teachers.
Week 1 and 3: scenario 'Hey, who woke me?'
Week 2: scenario 'Joystick' (see iteration four).
Week 3, part of students absent due to exams.

Interaction four: Joystick

Interaction design:



Interaction design:
Joystick is an interaction scenario in which every bench controls one dimension of the lamp and vibration modules (colour, position X and Y, intensity, vibration on/off).
Players have to work together to fully control the lamp.

Evaluation context:
One week at schoolyard of school #1 (n=750).

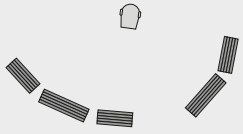
Scenario of use:
Mary sits on a bench, and starts wiggling a bit. She notices that the light becomes brighter the harder she wiggles. She moves to another bench, and discovers that this one controls the left-right direction of the lamp. Smiling, she wiggles until the light shines directly into her friend's eyes.

Evaluation setup:
Three week evaluation at high school #1 (in June), with:
(a) daily covert observations during morning and lunch break;
(b) weekly informal interviews with teenagers, caretakers and teachers.
Week 1 and 3: scenario 'Hey, who woke me?'
Week 2: scenario 'Joystick' (see iteration four).
Week 3, part of students absent due to exams.

Figure 5.8: ***Wiggle the Eye: interaction design, scenario, evaluation context and evaluation setup (continued).***

Interaction five: Energize me

Interaction design:



Interaction design:
The lamp is asleep; wiggling on the benches awakens it. Wiggling on a certain bench results in a specific colour. The total amount of wiggle-activity determines the activity of the lamp. If all five benches are wiggled simultaneously, then the lamp starts moving and blinking rapidly, and all benches vibrate strongly.

Evaluation context:
Four weeks at schoolyard of school #2 (n=370).

Scenario of use:
George and Simon are sitting on a bench, wiggling softly. They notice that the lamp is moving slowly, with a blue colour. Their friends join, and wiggle at another bench: the lamp becomes purple. They spread over all five benches: the lamp becomes white, moves wildly and blinks rapidly. Suddenly, all five benches start vibrating, to the hilarity of George, Simon and their friends.

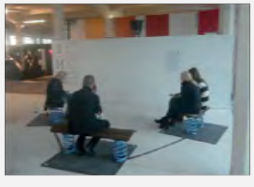
Evaluation setup:
Four week evaluation at high school #2 (in September), with:
(a) weekly covert observations during morning and lunch breaks;
(b) weekly informal interviews with teachers and caretakers;
(c) daily small diary study by one class (15 students)

Interaction six: Simply Direct Me

Interaction design:

Interaction design:
Wiggling on a bench results in the lamp shining on that bench in a specific colour (red/green/blue). If a bench is wiggled for three seconds, it starts vibrating in one heavy pulse.
If two or three benches are wiggled simultaneously, the bench with the fastest wiggling is selected over the others.

Evaluation context:
Eleven days at exhibition (n=1100-1500)



Scenario of use:
Cristine approaches the benches and sits down, curiously wiggling a bit. Immediately, the lamp shines brightly on her in red. When she stops wiggling, the light turns off; when she wiggles faster, the light becomes brighter. After a few seconds of wiggling, her bench starts vibrating wildly to the surprise of Cristine.

Evaluation setup:
Eleven days at exhibition with 1100-1500 visitors, with:
(a) covert observation in three sessions of two hours spread over the week (observed users = ±300).
(b) informal interviews with exhibition staff.

Wiggle the Eye: interaction design, scenario, evaluation context and evaluation setup (continued).

Interaction Design	Summary of Evaluation Findings
1. Tease the Others	Installation attracted a lot of attention, users sat down and started wiggling. Users had trouble discovering the input-output relations. Users moved on after a short period (<1 minute) of play. Physical setup was not social enough due to distance between benches.
2. Wiggle Pong	Users did not discover how to play the game. Timed actions with this platform showed to be impractical and difficult. Playing without knowing the rules was impossible.
3. Hey, Who Woke Me	Benches were popular, installation became a social active sitting area for groups of students. Students were playing, talking, wiggling, standing and having fun. Students understood that if they wiggled for a while, the benches would start to vibrate. The installation was so crowded that there were always 10+ users wiggling at the same time, preventing individual exploration. There was very limited focus on the light. Mental models were either too simple or too complex.
4. Joystick	No students discovered how to control the installation using the benches; the crowdedness of the installation (10+ users sitting and wiggling at the same time) prevented individual users from seeing the result of their action. Coordination in mass interaction hardly occurred; designing for mass interaction is hard. Mental models were mostly "it's broken! It doesn't vibrate anymore!". No play possibilities if users did not figure out the rules.
5. Energize me	First two weeks, raining all day, limiting the novelty and exploration process. Overall, benches were used less and calmer than at previous school. Installation became a low-activity social sitting area; sporadically, all users started wiggling together to make the benches vibrate. Comments such as "you have to wiggle way too hard before it vibrates!". Mass interaction was possible: a few times, 20+ users wiggling together. Threshold for enjoyable feedback (wild light & vibration) was too high; users on all benches had to wiggle before the result was rewarding enough. Individual feedback was too 'small', not rewarding for individual users to wiggle. Diary study showed average daily enjoyment between 'Enjoyable' and 'Very Enjoyable', average daily duration between 'Not used' and 'Less than one minute'.
6. Simply Direct Me	Easy to discover interaction possibilities for new users (wiggling = light; long wiggling = vibration). Hardly any social interaction between users on different benches. Short play sessions (around 1 minute).

Figure 5.9: *Summary of the evaluation findings for each of the six interaction designs.*

The balance or mix of these two is precious: during the evaluations at schools, many teenagers interacted with the installation on a daily base, and as such expected more complexity or different interaction designs. However, even in the last week other users encountered the installation for the first time. Designing for this balance of novel and experienced users proved to be difficult.

- These evaluations showed the complexity of this type of in situ evaluations, and all the external factors that can influence user behaviour. Schools and schoolyards differ for example: one school had cosy outdoor seating areas, while another school had a few concrete benches. As a result, the number of teenagers spending their break outside differed, affecting the popularity of the installation.

  Weather conditions also highly influenced user behaviour. One week during the evaluation at the first school, the weather was extremely hot for the Netherlands. As a result, many students stayed inside, in shaded areas or played in a slow energy-saving way. At the second school, the first two weeks saw constant rain: this demotivated users to start interacting with the installation, negatively influencing the novelty and exploration process.

Evaluation and discussion of methods

Several evaluation methods were used and assessed during the two evaluations at high schools. Our goal was to evaluate which methods were best suited for this user group and context, and to simultaneously answer our design research questions. In this section, we will briefly describe each method and evaluate its suitability for our design and research space.

Covert observations:

- Covert observation (Patton, 2001): observing user behaviour at the schoolyard from a covert position
- Frequency: week 0 - entire day; week 1 - entire day; week 2 - both breaks; week 3 & 4 - lunch break
- Goal: observe and analyse how users interact and play with the installation
- Benefit: evaluate natural behaviour of users
- Drawback: no insight in why actions happen
- Results & discussion: covert observation gave us a good overview of the activity at the schoolyard, such as the exploration, social interaction, playful activity and other behaviour. Students quickly became aware of our presence, asking us questions in the school. On a few occasions, students showed awareness to our presence from the schoolyard by waving or pointing.

Informal group interviews with teenagers:

- Informal interviews: semi-structured interviews (Blandford, 2014) with 5-10 random teenagers at the schoolyard during their break, about their experiences with the installation
- Frequency: all four weeks - every Wednesday during lunch break
- Goal: gain insight in their understanding of the installation and reasoning for actions
- Benefit: quickly gain feedback from users
- Drawback: influences evaluation & delivers informal results
- Results & discussion: these interviews showed us that teenagers had all sorts of (incorrect) mental models about the interaction with the installation, providing us with a good insight in their exploration process. Main drawback was that by interviewing students, they became more aware of the fact that a study was going on, which influenced their attitude and behaviour.

  Students that had been interviewed, for example, would approach us with questions and theories about the installation, and would proudly share that they discussed their ideas about the installation with their peers.

Informal interviews with school staff:

- Informal interviews: semi-structured interviews with school staff (e.g. teachers, care takers, managers)
- Frequency: all four weeks - once in middle of week
- Goal: reflect on influence of installation on students in class, corridors, etc.
- Benefit: receive expert feedback on the attitude and behaviour of students
- Drawback: indirect information, based on staff interpretations
- Results & discussion: these interviews gave insights in how the installation changed the atmosphere in the school. Teachers reflected e.g. how everyone was discussing the installation or how groups of students suddenly cooperated. This was all based on anecdotes the staff remembered and at a later moment discussed with us.

Activity monitors:

- Activity monitors (Brage, Brage, Franks, Ekelund & Wareham, 2005): wearable devices that measure activity such as walking, sitting or running, distributed to all students (18) in a class, repeated three times in total.
- Frequency: Week 1,3,5 - Monday and Thursday, entire day
- Goal: measure and compare sedentary activity during six weekdays, spread over two weeks with installation, and one week without.
- Benefit: allows us to compare activity levels of students with and without interactive installation in a quantitative way.
- Drawback: changes in sedentary behaviour can be caused by other factors.

- Results & discussion: the measured activity levels differed highly from day to day, no significant differences could be found between with and without installation. The weather differed strongly in the evaluation period, varying from constant rain in the beginning to sunshine at the end. This resulted in teenagers staying inside the school when it rained, and going outside in nice weather.

  Additionally, the acceptance of wearing the monitors varied: some students proudly showed the sensor to their peers, jumping and shaking with it to explain how it worked. Others were less accommodating, and hid the sensor in their clothes or even put it in their locker.

Diaries:

- Diaries (Romero, Baren, Markopoulos & Ruyter, 2003): daily collection of experiences in the context of the actual experience; including a simple Likert-scale and smileyometer (Read & MacFarlane, 2006) in a paper booklet. Handed out every afternoon by the teacher for one class of 18 students.
- Frequency: all four weeks - every day
- Goal: measure students' enjoyment and duration of interacting with Wiggle the Eye
- Benefit: temporally close to the moment of interest and in school context
- Drawback: filled in by teenagers themselves, without oversight or control for serious answers
- Results & discussion: most of the diaries were filled incompletely or faulty. Many diaries contained remarks about the smileyometer ("childish!") or just random crosses through the page. One reason for this could be that the diaries had to be filled in at the end of every afternoon, standing between the students and their free afternoon. Second was that a balance had to be found: we could not use complex words or methods, as all students had to understand it - but these methods showed to be too childish for the teenagers.

MemoLine, UX Curve for children:

- MemoLine, UX Curve for children (Vissers, De Bot & Zaman, 2013): retrospective tool for recalling and relocating long-term user experiences, ran at the end of the evaluation period with one class of 18 students.
- Frequency: at end of evaluation period, in week five
- Goal: recalling and reflecting on experiences with Wiggle the Eye
- Benefit: gives insight in the memories and important play moments with the installation
- Drawback: requires users to recall experiences and activities correctly
- Results & discussion: applying this method failed on two levels. First of all, most teenagers did not understand the timeline concept, even after completing the first

timeline together with the researcher. This resulted in mismatches between events in different curves, and in frustration and refusal from several participants. Second, this session was held at the last day before the Autumn holiday, so the atmosphere in the class was wild, with limited focus and dedication of the students; this also resulted in unfinished or imprecise completions.

5.3.4 Conclusions

The Wiggle the Eye case mainly focused on (1) successfully eliciting free play on recurrent encounters, and on (2) evaluation methods.

Wiggle the Eye was successful in eliciting free play; the installation attracted a lot of attention, users wiggled, interacted with each other and enjoyed themselves. The installation became an active sitting area in the schoolyard of the high school.

Many moments of free play occurred, with social and active play during the breaks. The interaction design however proved to be too complex: play possibilities were hard to discover for the users, mainly because mass exploration led to chaos, and not to collective coordinated exploration. Insights have been presented for designing in these situations, and for solving the interaction design problems.

The application of different evaluation methods resulted in a mix of positive and negative experiences. Covert observations, (group) interviews with teenagers and reflective interviews with staff worked well, providing us with a good overview of the exploration and interaction actions (as also suggested by Stenros, Waern and Montola (2011)). Diaries and the UX curve resulted in unusable data due to target group and practical issues. The activity monitors did not deliver usable results with this sample size and duration.

5.4 Walk of Fame: moving through space in a performative way

The main question for this design research cycle was *how can we design for and study recurrent free play in public contexts*? For this, two high-fidelity prototypes were developed and evaluated at high schools. In this section, we discuss the Walk of Fame case, where we mainly focused on successfully eliciting recurrent play and on evaluating types of play that occurred.

To evaluate if we could successfully elicit free play on recurrent encounters, we developed a high fidelity prototype that could be evaluated at a high school for at least a month. This installation had to elicit playful activity from teenagers on a daily base.

A secondary aim for this design case was to identify and describe the types of free play that occurred with this installation.

Evaluating methods that can be used for this design research space was a lesser focus: the lessons learned in the Wiggle the Eye case were used to select a combination of evaluation methods for this design study.

In this section, we first describe the design and implementation of the Walk of Fame design case, followed by the evaluation of the installation at a high school.

5.4.1 Design & implementation

This project consisted of three main iterations, where the focus shifted from ideation to development and eventually to evaluation. During the ideation and development iterations, the installation was informally evaluated with more than 300 users; the final version was evaluated for four continuous weeks in a high school with 180 students.

Ideation

In design research cycle 2, we designed the Curious-Action speakers, a series of interactive speakers in a corridor (see Section 3.2.2). People walking through the corridor activated sounds from each speaker, resulting in people walking back and forth through the corridor to discover all possible sounds. This powerful 'walk-through-and-use' interaction was the starting point for our ideation in this design case.

An ideation process that explored 'playing by walking' in several bodystorms (method described by Oulasvirta, Kurvinen and Kankainen (2003)) led to the enjoyable activity of performing, reviewing and mimicking silly walks. By recording a person walking through a corridor, and subsequently projecting this recording on the wall, a social and active process started: people would walk through the corridor in silly ways (marching, backwards, running, etc), they watched the recordings with hilarity, and then eagerly created a new recording.

The core principle of this process was walking in a silly way, and reviewing that recording with peers. To reactivate this process on recurrent encounters, we cut the recording in half: the top half of the projection is the upper body of the current player, the bottom half

Evaluations during the development process of the Walk of Fame installation	
V1	One week at university of ICT; ±100 passers-by per day (ages 18-25); ±60 play sessions; ±90% men.
V2	One day during open house with visitors; 4 groups of 5 players during demos (ages 16-18); ±12 play sessions; 50% men, 50% women.
V3	One day at public event; ±50 passers-by (ages 6-70); ±30 play sessions between 2s and 180s; mostly families visiting; children played, (grand)parents observed and gave feedback; mixed genders.
V4	Two weekends at a break-dance hiphop festival, in entrance hall of youth & concert building, between 4pm and 2am; thousands of passers-by, ±200 players (ages 16-30); mixed genders.
Methods: covert observation, informal interviews and brief analysis of recordings.	

Figure 5.10: ***Evaluations during the development process of the Walk of Fame installation.***

is a recording of the lower body of the previous player. This way, a composition of two recordings was made, where players had to cooperate to create funny compositions.

The ideation process resulted in the *Walk of Fame* concept:
Walk of Fame is a playful installation which frames moving through space in a performative way. By moving through the camera's view, the image of a player is recut on top of another recording, creating an unexpected and ludicrous video composition. This novel outcome stimulates players to move their bodies in different ways to create new configurations. The installation is public, so the act of playing and the resulting recordings are visible for others to see, which adds a social and performative quality to the experience. This allows the players to use the installation for the thrill of performing and as a means of communication.

Development

In this section, we describe the iterative development process of the Walk of Fame installation: cycles of design, development, evaluation and analysis. In this process, more than 300 users played with the Walk of Fame installation (see Fig. 5.10), giving us good insights in usability, enjoyment and performance.

Numerous design decisions were taken and refined during this development process, based on the evaluations; three major insights are discussed in this section.

- From the first version onward (see Fig. 5.11), Walk of Fame attracted a lot of attention, was self-explanatory, and was experienced as enjoyable by players and onlookers. Strong social interaction occurred: cooperation, giving feedback, mimicking and having fun in groups. Passers-by often started walking in silly ways, making big steps or jumping up and down while walking.

- Initially, the system automatically mapped top and bottom slices, aligning the upper and lower body parts. Evaluations showed that imperfect compositions (e.g. the upper body walking in front of the legs) created hilarious results, and immediately triggered the users to try again in order to improve the timing of their recording.

  Therefore, the auto-aligning was replaced by an easy-to-learn, hard-to-master principle: six seconds of a player walking by were recorded, and played in sync with the previous recording. This way, players would always see a composition, but to create a perfect composition they had to practice and try again, to eventually walk perfectly with the same speed in two subsequent recordings.

- Users appeared frustrated at times: when they created a nice top slice, and wanted to record and try several bottom slices, then their top slice would disappear (as it was overwritten by a new recording). We considered letting users choose which slide to record on, so they could create perfect compositions, but eventually decided not to: this way, users had to walk back-and-forth through the corridor several times in order to create their preferred composition. In addition, the auto-rotating through recordings limited the historic visibility of the slides, automatically removing socially unwanted recordings such as obscene gestures.

Final installation

Scenario: *Menno and Mark turn a corner in their school, and see two classmates walking in a funny way over a red carpet. After watching for a minute, they realise that you can record yourself by walking over the carpet. Menno tries it, running over the carpet; Mark follows, adding his upper body to Menno's running legs. Walking back and forth, Menno and Mark create a series of hilarious compositions, while their peers watch the projection from a distance.*

Hardware characteristics (see Fig. 5.12):

- Installation in a corridor of a high school
- Red carpet parallel to the wall, sensor in start and end of carpet
- Short-throw projector, projecting on the wall above the carpet
- Wide-angle camera on opposite wall, recording the projection area above the carpet

Software / interaction characteristics:

- When someone steps on the carpet, six seconds of video are recorded

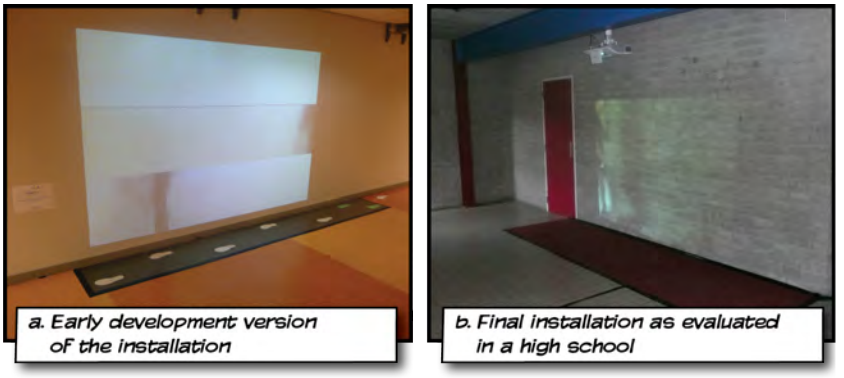


Figure 5.11: ***Walk of Fame installation design.***

- This video is cut and combined with the previous recording, resulting in two or three slices
- The composition is projected on the wall, in a loop of six seconds
- After 5 minutes of inactivity, the system resets and shows a standard example recording (2 persons walking over carpet)

5.4.2 Evaluation

The evaluation of the Walk of Fame had two main aims, as explained before in Section 5.1.1. Our goal was to evaluate the:

- success: design and implement an installation that recurrently elicits free play for a period up to a month.
- types of play: identify and describe the types of free play that occur with the installation.

A five-week study at a high school was setup, in which the Walk of Fame installation was evaluated for four weeks, followed by a reflection week. The study results were analysed in several sessions, resulting in answers to the research aims, and in a framework of designing for free play (see Fig. 5.13 for an overview of this process).

In the following sections, we describe the installation and study setup, evaluation methods, data collection and the analysis process.

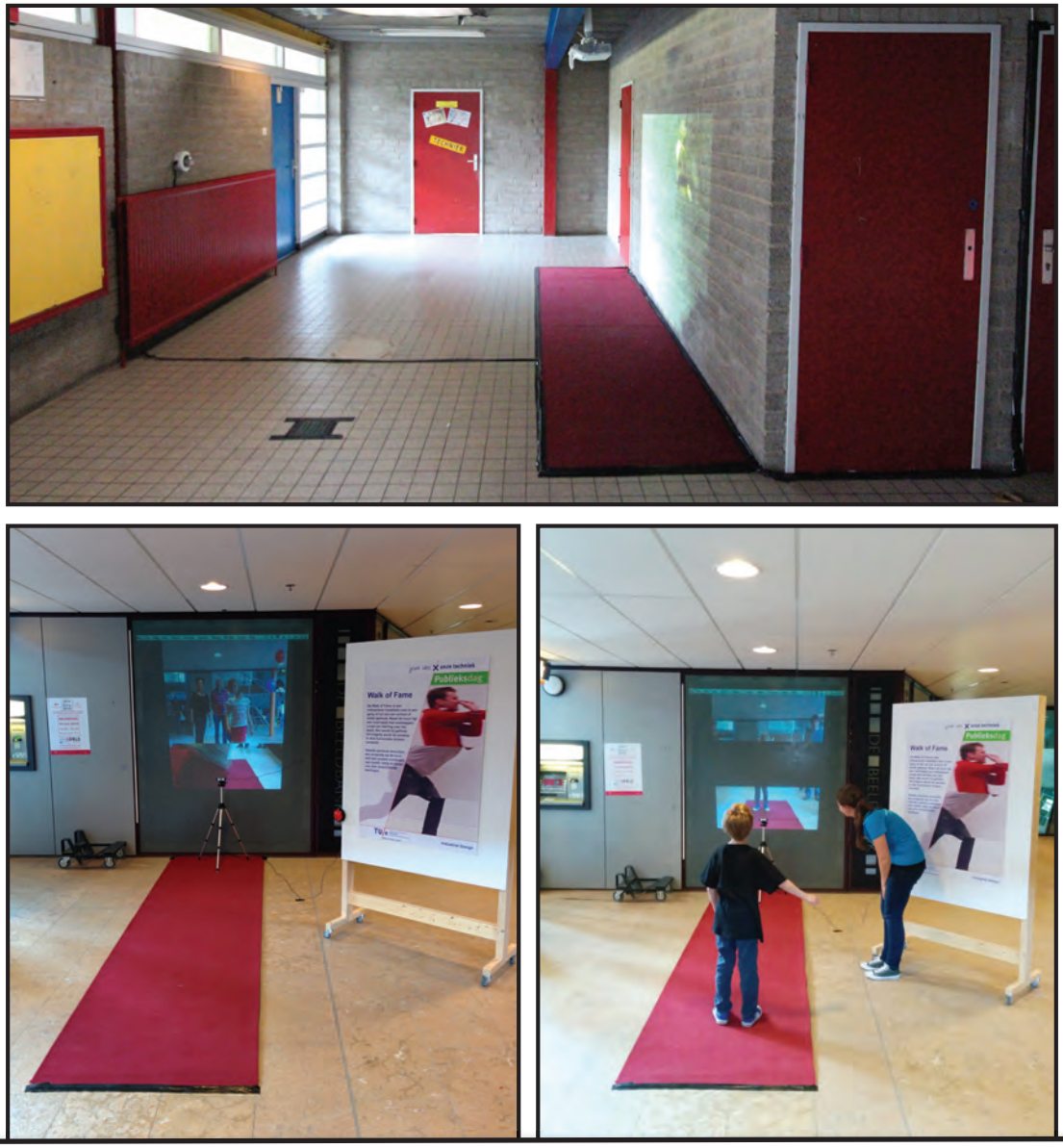


Figure 5.12
Walk of Fame – Design study by Rob Tieben

Walk of Fame is a playful installation which frames moving through space in a performative way. By moving through the camera's view, the image of a player is recut on top of another recording, creating an unexpected and ludicrous video composition. This novel outcome stimulates players to move their bodies in different ways to create new configurations. The installation is public, so the act of playing and the resulting recordings are visible for others to see, which adds a social and performative quality to the experience.

2013 & 2014
More information, including design and evaluation details, at:
playfullll.com/walk-of-fame

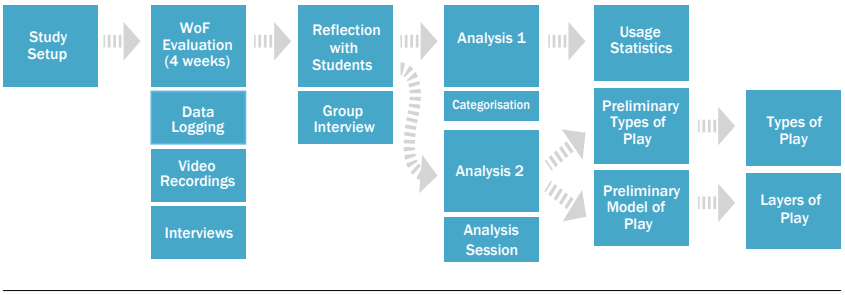


Figure 5.13: ***Process and results of the Walk of Fame evaluation.***

Installation setup & context

Walk of Fame was installed in a high school for middle and practical education in the middle of the Netherlands (VMBO school, 180 students, ages 12-17). The installation was implemented in a corridor in the school building, between two classrooms and a gaming area where students could play physical activity games (Wii, Kinect, etc) during their breaks (see Fig. 5.11). Students therefore encountered the installation while waiting for their class to start (±20 students waiting, once per day), and when they choose to play in the game area during their breaks (20-30 passers-by per break). Every student in the school encountered the installation at least two times per week, with a maximum of several times per day for some groups of students.

The installation was present in the school for four weeks. In week one and two, a version with two slices was active; in the remaining weeks, a version with three slices. The installation was removed at the end of week four.

Study setup & methods

The goal of this study was to (1) evaluate the success of Walk of Fame in eliciting recurrent play, and (2) to identify and describe the types of free play that occurred.

A combination of subjective and objective methods was used (see Fig. 5.14): data logging by the system, video recordings and interviews with students. This combination allowed us to evaluate the playful activity from different perspectives. From earlier evaluation studies, we knew that these methods were suitable for use in this research space.

The exploration, social interaction and freedom in play was of vital importance for this evaluation; hence, it was important that students could play whenever and however they wanted, not hindered by inquiries, questionnaires or even the awareness that they were part of a study. At the same time, we were interested in the reasons for their actions, and their experienced enjoyment; for this, students had to actively participate in our study.

This challenge was solved by recruiting a small group of students as active participants, and interviewing them on a weekly base. This way, the majority of students in the school had no direct contact with us, allowing them to play relatively free and unaware of the study. In addition, researchers were only present on Wednesdays, limiting the disturbance and influence of their presence.

Interacting with our 11 active participants allowed us to study their experiences through recall and retrospection, and by analysing the video recordings of their play sessions. The sample size (11) was big enough to analyse differences and similarities in play actions, but small enough to build a good bond between researcher and participant. Earlier evaluation studies with teenagers had shown the importance of this. Following the same students over the entire evaluation period allowed us to compare their type of play, reasoning and experiences over time.

The duration (four weeks with active installation, one week of reflection) allowed us to study the usage beyond the initial novelty effect. Students encountered the installation at least once per week, and on average once per day. This way, both first and recurrent encounters could be studied and compared.

(A) Data logging

The installation logged all user interactions: when someone stepped on the red carpet and a video recording was made, the system logged the date and time of the recording.

(B) Video recordings from WoF perspective

The installation saved all recordings made by users, from the perspective of the camera on the opposite wall; these six second recordings were linked to the data logging (date and time).

This method had two main limitations: only the area above the red carpet was recorded, and only the six seconds after someone stepped on the carpet. Therefore, this method did not record interactions in the physical vicinity of the installation (e.g. audience actions or player discussions), nor actions before or after the six seconds (e.g. players planning or practising certain actions before recording).

(C) Video recordings from external perspective

Every Wednesday during the breaks, a separate camera recorded the entire corridor with the Walk of Fame. This perspective showed us all user actions in the installation area, including the actions in the vicinity of the installation and between Walk of Fame recordings.

A downside was that students were aware of this camera, and responded to it by waving or gesturing; hence, we only installed the camera one day per week.

(D) Interviews

Walk of Fame was installed near an electronic game area, where students could play Kinect or Wii games during their breaks. A teacher asked 15 frequent visitors of this area if they wanted to participate in a user study, in the week before the study started. 11 students

Method	Participants	Interval
A Data logging	All students that interact with installation	Continuous
B Video recordings from WoF perspective	All students that interact with installation	Continuous
C Video recordings from external perspective	All students that enter installation area	Every Wednesday, both breaks
D Interviews	11 students	Every Wednesday
E Group interview	11 students	Wednesday in week 5

Figure 5.14: ***Methods, participants and intervals for the evaluation of Walk of Fame.***

agreed (14-15 years old, 6 female, 5 male), and consent was asked from them and their parents.

Every Wednesday, these students were interviewed in random groups of two (and one group of three); previous evaluations with teenagers had shown that this was an optimal group size. The semi-structured interviews (Blandford, 2014) of 10 minutes covered the (play) experiences with the installation, their motivation, social interaction and the types and process of play.

(E) Group interview

In week 5, after the installation had been removed, a group interview with all 11 participants was performed. In this group session, the experiences of the students with the installation were discussed from a reflective perspective, with a focus on the differences between players and over time.

Synthesising data

All data collected in the evaluation was synthesised.

A collection of all play sessions in the four-week period was made, combining the data logging (A) and video recordings from WoF perspective (B). A session was defined as *a series of subsequent recordings where the interval between two recordings is less than 30s*. Sessions were removed where (1) researchers were calibrating/repairing the system or (2) the system was malfunctioning (camera not working; this occurred one day).

For each session, the date and time of the first recording was listed, the duration of the session, and the corresponding video recordings.

The video recordings from external perspective (C) were sorted per day and break, resulting in 8 videos; these videos were then cut into sessions, to match the recordings from the WoF perspective.

The interviews and group interview (D & E) were made anonymous and were transcribed.

Analysis 1: overview of sessions and general insights

The goal of this analysis was to provide an overview of the different types of sessions, summarising data such as number of players, gender differences, play frequency, duration, and sessions types. All sessions were independently analysed by two researchers. Both researchers were immersed in the data as they both participated in previous Walk of Fame evaluations. Disagreements were discussed until agreement was reached.

The type of interaction in every session was categorised in empty, unaware passer-by, walker, player or other (see Fig. 5.15). Then, the type of social play was categorised for the walkers and players, in solitary, parallel and social play. Finally, the gender of interactors was noted.

The results from this analysis were used to create summaries, usage statistics and diagrams, in order to provide an overview of the different type of sessions, as presented in the next section.

General findings

In the evaluation, many types of interaction and play were observed. In this section, an overview is given from a holistic perspective, accompanied by examples. This overview is not complete; it intends to provide a basic insight in the playful interactions that occurred with the Walk of Fame installation.

Walk of Fame was used for 18 days over a period of four weeks. In this period, 317 play sessions were recorded, ranging from six seconds to 5.5 minutes in length, with an average duration of 32 seconds. A total of 608 persons (270 male, 338 female) interacted with the installation (see Fig. 5.16); this number included a large number of returning users, as the school had only 180 students.

From the 317 play sessions, 31 were unaware passers-by (10%), 98 were solitary play (31%), 83 parallel play (26%), and 105 social play (33%) (see Fig. 5.17).

In conclusion, the observations show that many teenagers engaged in interaction with the Walk of Fame, with evenly spread genders, and a mix of solitary, parallel and social play.

Users played in a social, performative way: a player would perform a certain action, such as acting out or walking in a funny way. Others would follow, trying to complement or mimic this behaviour. After a while, a player would come up with a new idea, and everyone would follow this idea.

Play with the Walk of Fame was inherently social: users played in a social context, with and for others, and the players' actions were driven by social interaction. In many sessions, the focus of the player's attention shifted from the installation to the other players, making the installation disappear in the background.

Examples of common social interactions that occurred are:

- cooperating and imitating: players cooperated in order to create a funny composition; someone had an idea and tried something new, and other players joined in to try this as well.

- communicating and flirting: one group of teenagers was playing while another group was spectating. With every action they performed, the teenagers were aware that others were watching and commenting; in fact, a lot of actions were executed because peers were present. A boy showing how strong he is, a girl dancing in a sensual way, or a group making obscene gestures to the camera: all were part of a social play process of communication, negotiation and other social interactions.

- playing for the sake of playing: we observed many occasions where the play experience pivoted around one player acting in a funny way, which was immediately

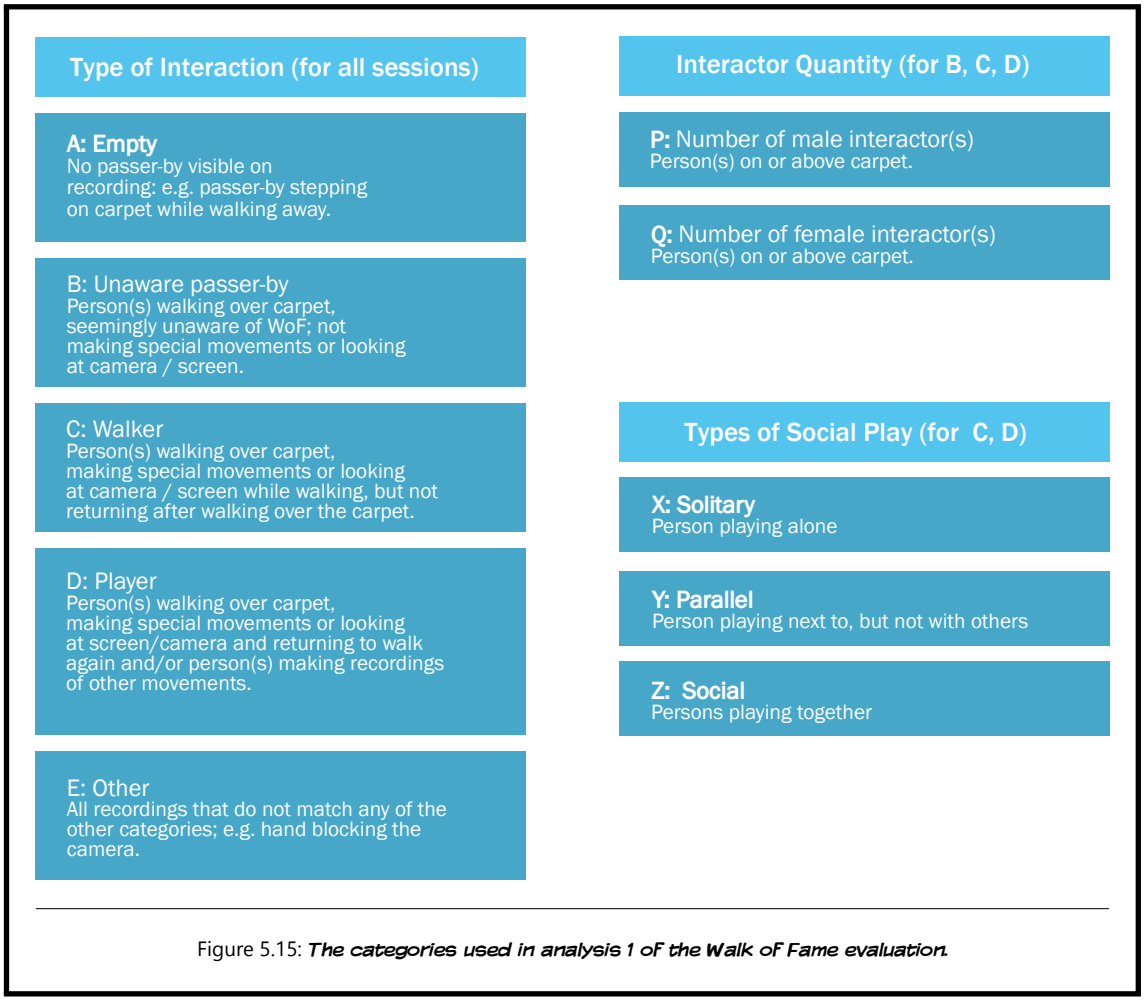


Figure 5.15: *The categories used in analysis 1 of the Walk of Fame evaluation.*

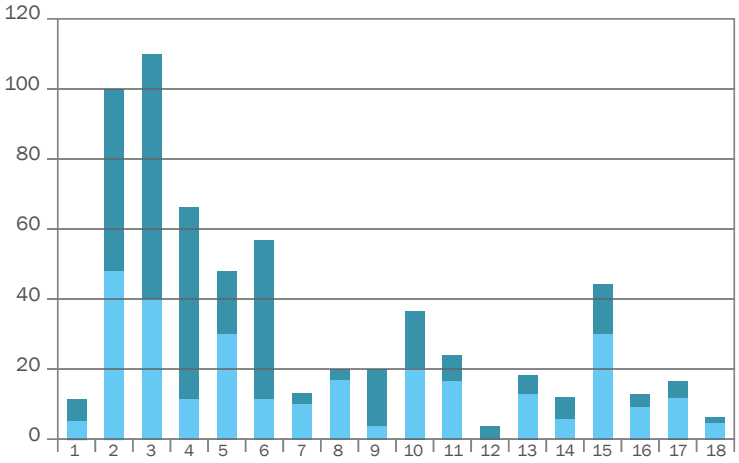


Figure 5.16: ***Players interacting with the Walk of Fame per day, by gender.***

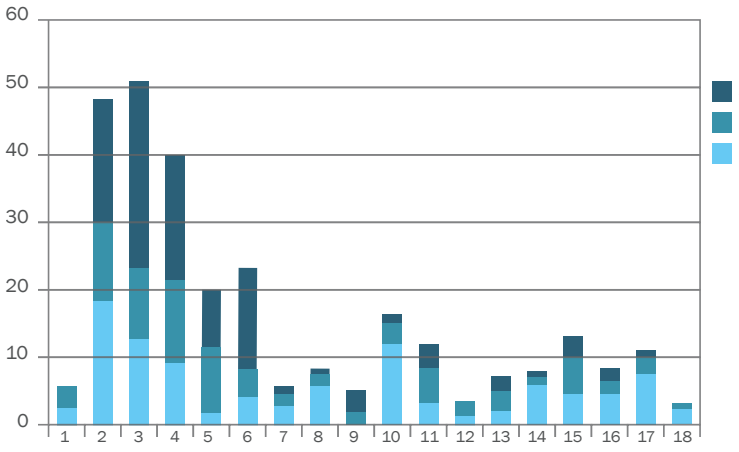


Figure 5.17: ***Types of social play with the Walk of Fame per day.***

followed by a new player. The recordings were not watched by the players or spectators; instead, the players immediately moved on to record a new action. Interviews confirmed this: doing funny things together and laughing about it with others was more enjoyable and important than watching the result of one's actions in the projection. In these situations, the Walk of Fame system only served as a kick-off for a social play experience of performance and social interaction.

A typical use scenario was:
Wouter and Luuk approach the corridor with the Walk of Fame, and see that two classmates are walking in a funny way over a red carpet. They watch for a minute, realising that you can apparently record yourself by walking over the carpet. Wouter decides to try it himself, and runs over the carpet; Luuk follows, adding his upper body to Luuk's running legs. After having created several compositions, and becoming more experienced with creating perfect combinations, Wouter and Luuk walk on to their class.

In this evaluation, we realised that it was impossible to try and understand what elements of the installation caused certain play actions; behaviour was influenced by many factors, and the design of an installation was only a tiny aspect in this. This can be summarised by an adapted version of Lewin's equation (Lewin, 1943); he states that behaviour is a function of a person and his/her environment, B = f (P,E), where B is behaviour, P is person and E is environment. This can be extended by adding D for design, so the behaviour of a person playing with an interactive installation in a public space becomes B = f (P, E, D), a combination of person, environment with all its social conditions, and the design. The exact influence of these three factors is impossible to predict in complex settings; it is the combination of the three that determines the user's behaviour.

In other words, designing for a playful experience is trying to guide or influence the users, in parallel to all those other factors. All a designer can do, is turn the knobs by changing certain design elements, and see if this changes the emerged behaviour (Rijnbout et al., 2013).

Analysis 2: understanding the types of play that occurred

The goal of this design research project was to elicit and study free play. In previous design research cycles, we have observed diverse types of play as elicited by our installations; but we had not yet studied this free play in detail.

The goal of this analysis was to identify and describe the process and types of play that occurred with the Walk of Fame installation. This was an explorative yet in-depth study: we wanted to analyse the elicited playful behaviour in depth, to explore and present the scope of free play and some of its varieties.

A group analysis session was setup, in which we qualitatively analysed the video recordings of teenagers playing with the Walk of Fame installation. The setup was based on the Interaction Analysis method (Jordan & Henderson, 1995), in which a group of researchers analyses video recordings without predetermined analytic categories. Through

the analysis and group interaction, categories that order the observed interaction emerge, and hypotheses about the activity on the tape are given. These assertions are then iteratively grounded and improved in the video materials (Jordan & Henderson, 1995). The observations, hypotheses and categories are recorded during the session, for later further analysis by the key researcher.

In interaction analysis, researchers watch the same video material repeatedly, to analyse it in depth and to ground their hypotheses. In our case, we decided to watch new material on every iteration, to analyse a larger set of play experiences with the Walk of Fame. In our session, researchers watched a series of recordings from the Walk of Fame (±12 minutes) and described the type and process of play they observed on post-it notes. All descriptions were then sorted and discussed as a group, until categories and models of the observed play emerged. These findings were then used as a starting point for a second round of video analysis, in which the categories and model were expanded, improved and updated, based on the new material.

Six design researchers participated in the group analysis session, all with backgrounds in play design and research; of those six, two researchers were directly involved in the Walk of Fame project.

The session started with an introduction, in which the Walk of Fame installation and the evaluation were presented. Then, the video material was analysed in three rounds of 50 minutes (see Fig. 5.18).

A selection of the available Walk of Fame video material was made in advance, as there was too much data to analyse in a single group session. All sessions of one minute or longer were included, from two days per week, resulting in 37 sessions (see Fig. 5.19).

An overview of the results from the session can be found in Fig. 5.18, 5.20 and 5.21. These results have been further analysed and grounded in theory and previous work; both the types of play, and the model of play, have been extended with descriptions and examples. The final results are presented in Section 5.5.

5.4.3 Conclusions

The Walk of Fame case mainly focused on (1) successfully eliciting free play on recurrent encounters, and on (2) identifying and describing the types of free play that occurred.

The Walk of Fame was successful in eliciting free play: the installation attracted attention from passers-by, invited them to walk over the red carpet, and consequently activated cycles of walking, observing and commenting. Teenagers played in a creative and autonomous way, discussing and defining new goals while playing, in a socially driven process.

The playful interactions that occurred during the four-week evaluation period are a good example of free play: the play was creative and autonomous, without predetermined structure or meaning, that continually evolved through the actions and interactions of the players.

In an initial analysis of the types of free play that occurred in this case, five types of play were identified: explorative play, performative play, active play, negotiative play and communicative play. In addition, a process of play model has been sketched, describing

Setup and results of group analysis session for the Walk of Fame evaluation	
Round 1	1. Watch WoF recordings and individually describe observed types of play 2. In group: sort and categorise all described types of play 3. Result: social interactions are present in all types of play; four types of play: exploration, physical, communicating, performing (see Fig. 5.5)
Round 2	1. Watch new WoF recordings and individually describe process of play experience 2. In group: discuss and create one model for process of play 3. Result: encounter > decision > play > memory process; different play actions in circle (watching, types of play) (see Fig. 5.6)
Round 3	1. Watch new WoF recordings and individually categorise in types of play from round 1 2. Discuss and compare; added new type (negotiative play) and created definitions for every type of play 3. Result: 5 types of play: Explorative Play, Performative Play, Active Play, Negotiative Play and Communicative Play (presented in Section 5.6.1)

Figure 5.18: ***Setup and results of group analysis session for the Walk of Fame evaluation.***

Selection process for video recordings in analysis session	
From each week	Day 1: day with external recording device (Wednesday) Day 2: day with most WoF activations (excluding Wednesday)
From each selected day	All sessions with duration of 60 seconds or longer
Total selection	37 sessions, duration between 60 and 330 seconds

Figure 5.19: ***Selection process for video recordings in analysis session.***

Figure 5.20: ***The four types of play as defined in round 1 of the group analysis session.***

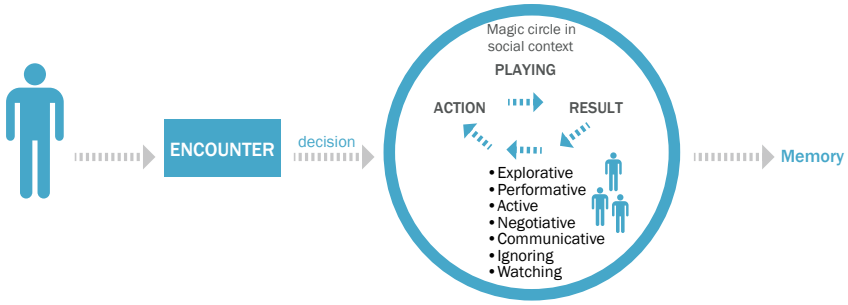


Figure 5.21: ***Initial process of play model, as created in round 2 of the group analysis session.***

the encounter, decision, play action and memory of an encounter with a playful installation. These types of play, the model, and the insights from other design cases are used as input for the analysis and results in Section 5.5.

5.5 Synthesis: bridging concepts frameworks

The synthesis section of this last design research cycle is larger than in other cycles. This section synthesises all insights and design knowledge from the four design research cycles, resulting in two frameworks of design knowledge.

We first present *five types of free play*: major types of play that 'worked well' in our designs, based on the analysis of the Walk of Fame case combined with insights from other design cases. These types of free play can be used to guide designers, and as a tool for analysis and evaluation.

The types of free play also return in the second framework in this chapter: the *layers of free play*. This framework presents three perspectives or lenses for designing a free play experience in a public context. Every layer discusses important design parameters, design recommendations and applied examples from a different perspective: the *encounter*, *attention* and *commitment* layer.

This framework combines the design knowledge from all four design research cycles. It can be used as guidance in a design process, as tool for analysis and evaluation, and as reading guide for this thesis.

We end this chapter with a short conclusion and reflection. An extensive discussion of the results, and a reflection on the design research project, can be found in the final chapter of this thesis.

5.6 Types of Free Play

In this section, we present five types of free play in a format inspired by bridging concepts (Dalsgaard & Dindler, 2014). Bridging concepts are a type of intermediary knowledge, used to facilitate exchange between theory and practice (see Section 1.1.1 for a discussion about intermediary knowledge in design research).

Following the format of bridging concepts, every type of play we present starts with a definition followed by a theoretical grounding in which the relation to theory about similar types of play is explained. Then, a series of design articulations is presented, parameters that shape this type of play. We end by exemplifying how these types of play, and the design articulations, are critical to the design of an interactive installation.

The types of free play are based on the analysis of the Walk of Fame case (Section 5.4), combined with insights from Wiggle the Eye (Section 5.3) and previous cycles. These five types are not totally new, nor do they describe every possible type of play: they describe the major types of play that 'worked well' in our designs, accompanied by important parameters and examples for designing for such play.

These five types of play are not mutually exclusive; it is very well possible for a play session to contain all five types of play. In addition, social interaction such as cooperating or commenting can occur in every type of play: free play is after all driven by the interactions

of the players. Social interaction is therefore not repeated in every type of play, as it occurs throughout all types of play in a free play session.

This omission of social interaction is not meant to lessen its importance: the social actions, interaction and context are vital, as they allow free play to blossom. As also reported by Stenros, Waern and Montola (2011), the actions and interactions due to the social environment are often more important than the designed aspects. In addition, the social interaction while playing together creates, to a large extent, the enjoyment of playing (De Kort & IJsselsteijn, 2008).

This social interaction, however, emerges while players are interacting in a social context. As such, it cannot be designed, but only designed for, and designers should be aware of the power of social interaction throughout the design process.

The types of free play are based on insights from all design research cycles. In this section however, we only use the Walk of Fame case in the examples, to simplify and to shorten the required explanations.

At the end of this section, we will explain how these types of play can be used in a design process, both as guidance when designing and as tool for analysis and evaluation. We will illustrate the generalisability of these types of play by using them to analyse the Wiggle the Eye case.

In Fig. 5.22 we present the five types of free play. Fig. 5.23 shows these same types with the related terms they are grounded on, and the design articulations.

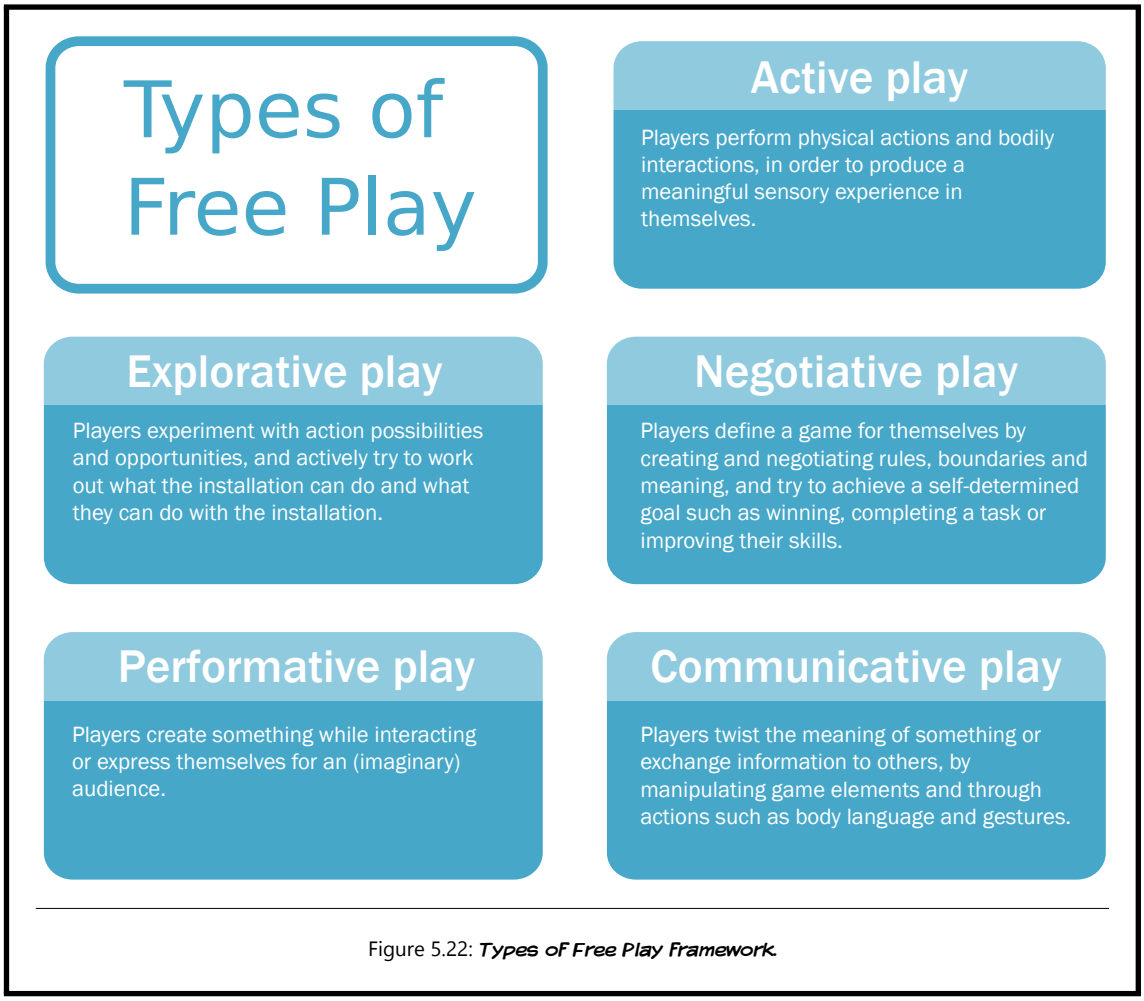


Figure 5.22: *Types of Free Play Framework.*

Type of free play	Theoretical grounding	Design articulations
Explorative play Players experiment with action possibilities and opportunities, and actively try to work out what the installation can do, and what they can do with the installation.	Exploration and discovery (Costello et al. 2007; Korhonen et al. 2009) Speculative play (Morrison et al. 2011) Investigative and diverse exploration (Hutt 1966) Exploration (Valk et al. 2012) Playful exploration (Nielsen et al. 2009) Curiosity (Tieben 2011)	Curiosity Balance between the known and the unknown Appropriate complexity and challenge Honeypot driven
Performative play Players create something while interacting or express themselves for an (imaginary) audience.	Simulation or mimicry (Caillois 1961) Socio-dramatic play (Smilansky 1968) Simulation, expression and fantasy (Korhonen et al. 2009) Designing or creating something new (Csikszentmihalyi 1975; Costello et al. 2007) Performative play (Montola 2009)	Self expression Autonomy Freedom in possibilities Relation between interactors, spectators and audience
Active play Players perform physical actions and bodily interactions, in order to produce a meaningful sensory experience in themselves.	Ilinx (Caillois 1961) Sensation (Costello et al. 2007; Korhonen et al. 2009) Body games (Márquez Seguar 2013) Embodied play (Morrison et al. 2011))	Social interaction Intimacy Space and place
Negotiative play Players define a game for themselves by creating and negotiating rules, boundaries and meaning, and try to achieve a self-determined goal such as winning, completing a task or improving their skills.	Agôn and ludus (Caillios 1961) Competition, challenges and completion (Costello et al. 2007; Korhonen et al. 2009) Creation of rules, open-ended play and emergent play (Bekker and Sturm, 2009; Tieben 2014) Players decide how to play (Frasca 2001)	Self-determined goals and rules Replayability Free competition
Communicative play Players twist the meaning of something or exchange information to others, by manipulating game elements and through actions such as body language and gestures.	Griefing (Wiktionary 2014) Subversion (Costello et al. 2007; Korhonen et al. 2009)	Public visibility Play history Social control

Figure 5.23: ***The five types of free play with the related terms they are grounded in, and the design articulations.***

5.6.1 Explorative Play

Players experiment with action possibilities and opportunities, and actively try to work out what the installation can do and what they can do with the installation.

Theoretical grounding

This type of play is described by Costello and Edmonds (2007) and later by Korhonen, Montola and Arrasvuori (2009) as *exploration* and *discovery*, the pleasure and experience participants get from exploring and making a discovery. Morrison, Viller and Mitchell (2011) call this *speculative play*: participants that actively figure out how something works. Hutt (1966) discusses a differentiation between *investigative* and *diverse exploration*; users trying to work out what the object can do versus users trying to work out what they can do with the object. Valk et al. (2012) define *exploration* as the second stage of play, closely related to the *playful exploration* of Nielsen, Fritsch, Halskov and Brynskov (2009). Naturally, this type of play is largely driven by curiosity, as studied in design research cycle 2 (see Chapter 3).

Design articulations

Curiosity: curiosity is the strong intrinsic desire to know or learn something (based on Merian-Webster (2010)), and the driving force behind explorative play. Five principles can be used to make users curious: novelty, partial exposure, complexity, uncertainty and conflict (see Section 3.2.4).

Balance between the known and the unknown: the gap between what users know and not know should be exactly right. If an installation is too complex or unrelated to previous experiences, then the users could get confused; if the installation hardly makes users curious, then they might decide to continue with their normal behaviour, instead of starting to explore (as seen in Section 5.3).

Appropriate complexity and challenge: an installation that is easy to understand can be rewarding for first-time users, but could quickly lose its appeal for returning visitors. Vice-versa, a complex rich installation could scare new users. An appropriate complexity and challenge is required to elicit explorative play, especially in public spaces with both new and returning visitors (as seen e.g. in Section 5.4). Scaffolding, gradual knowledge construction by adding or changing aspects on subsequent encounters (Verenikina, 2003), is a mechanism that can be used, in combination with designing for skill development and socially driven play.

Honeypot driven: a public installation exists in a social situation. Groups of players interacting with the installation will attract other users, leading to cycles of social exploration and interaction (Müller, Walter, Bailly, Nischt & Alt, 2012). Behaviour is mimicked by others; users will explore in groups; and users will be told about the installation by previous users (see Section 4.2.6). The installation has to be designed with this honeypot-situation in mind.

Examples

Explorative play with the Walk of Fame occurred both as *what does this installation do* and as *what can I do with this installation*. The Walk of Fame *elicited curiosity* through the red carpet and the projection on the wall. The red carpet afforded a *known action*; players realised that they could walk over the red carpet, and were surprised by the - at first- *unknown* results of seeing themselves on the wall. The installation had an *appropriate complexity and challenge*: everybody could easily create a funny composition by walking over the carpet, but creating a perfect or original result required practice and group coordination. The interaction with the installation was *honeypot driven*: actions and new compositions were created by the players themselves, and the most enjoyable compositions were only possible through coordinated exploration and by cooperation of players and spectators.

5.6.2 Performative Play

Players create something while interacting or express themselves for an (imaginary) audience.

Theoretical grounding

Performative play encompasses several types of creative and expressive play. Caillois (1961) described *simulation* or *mimicry*, a type of play where the player becomes an illusory character and behaves so; Smilansky (1968) discussed *dramatic play* and the additional component of social interaction in *socio-dramatic play*. Korhonen, Montola and Arrasvuori (2009) covered this type of play in *simulation*, *expression* and *fantasy*. Performative play is also about creation through interaction; both Csikszentmihalyi (1975) and Costello and Edmonds (2007) discuss the pleasure of *designing* or *creating something new while interacting*. This creation is intended to be observed by the players themselves, and possibly by an audience, hence it is part of performative play in this categorisation. Montola, Stenros and Waern (2009) discuss *performative play* where players are performing for the benefit of other players, and they discuss the dynamics of spectators, especially in their case of pervasive games.

Design articulations

Self expression: for performative play, players should be allowed and encouraged to play a role or make a statement through their actions. If players can express themselves, their identity or opinion, then this can invite richer and more diverse play (as seen in Section 3.4.2).

Autonomy: users should be able to play in their own personalised ways, driving the play session as they see fit. In performative play, players should be encouraged to create something through interaction via their own means and path. Spectators will be able to see the results and the different play possibilities, which can lead to chains of interaction between players and spectators-who-become-players (see Section 5.4).

Freedom in possibilities: to elicit autonomous play, users should be allowed to be creative with the rules. Limiting play possibilities, either by design or by constraints such as competition or a sign explaining the 'proper way to play' can hamper the creativity and freedom of players (as seen in Section 4.2.3).

Relation between interactors, spectators and audience: the relation between interactors, spectators and audience is a tedious balance. The presence of peers that are watching and commenting often motivates players to perform 'funny' or 'silly' actions; however, an audience that is too daunting (e.g. the entire school is watching), can restrict the performative play.

Broadcasting poses a similar balance: players often want to share their actions, be it on a large display or by making recordings with their mobile phone. However,

broadcasting of every player action can lead to negative social behaviour such as obscene gestures or bullying (as seen in Section 3.4.2).

Examples

Performative play with the Walk of Fame occurred both in players creating compositions and in players performing or acting for their peers. *Self expression* showed in actions of players, such as sexy dancing or mimicking famous persons. Players were creative and performed *autonomous* play, creating compositions with groups of people or by using props from the environment. The *freedom in possibilities*, goals and rules allowed different performances to occur, such as dancing on music or recording who is the fastest runner. Finally, the location of the installation and the fact that replays could be erased by making a new recording, created a good *relation between interactors, spectators and audience*, resulting in strong interaction between those parties.

5.6.3 Active Play

Players perform physical actions and bodily interactions, in order to produce a meaningful sensory experience in themselves.

Theoretical grounding

This type of play revolves around actively using one's body for a sensory experience. Caillois (1961) describes this as *ilinx*, play such as swinging where one produces in oneself a state of dizziness and disorder. Costello and Edmonds (2007) and Korhonen, Montola and Arrasvuori (2009) call this *sensation*, the pleasurable and meaningful experience that players get from the feeling of physical action. Márquez Segura, Waern, Moen and Johansson (2013) describe *body games*, games in which the body is brought to focus and becomes the main source of enjoyment.

Active play can be richer than ilinx or sensation, as it often happens in a social situation. Morrison, Viller and Mitchell (2011) discuss *embodied play*, bodily interaction with others through gestures, body poses and moving around others. This intimacy can be part of active play.

Design articulations

Social interaction: social interaction can stimulate active play, as users playing together can be triggered to perform physical actions such as comparing strength and skills, or helping each other. In addition, social interaction can lower the threshold for active play: users are more likely to perform out-of-context bodily actions when peers are doing the same (as seen in Section 5.4).

Intimacy: designing for bodily or even intimate play can help to break social norms and can facilitate novel types of playful interaction. For example, if an installation requires participants to touch each other, then an intimate bodily experience is more likely to emerge (as seen in Section 5.3).

Space and place: both the space and the place should allow for active play (see Section 3.3). The physical place should offer enough free space and possibilities for users to perform physical movements and bodily interaction. The required play actions should fit in the space; e.g. people should not be required to perform intense physical activity in a public context, as they will not want to get sweaty in public.

Examples

Active play with the Walk of Fame occurred in activities such as walking on hands, jumping around, and balancing. *Social interaction* led to bodily interaction and even *intimate* play such as players hugging or carrying each other. The *space and place* of the corridor allowed people to perform creative active play in novel compositions, such as doing pull-ups from the ceiling or bringing in a table to lay down on.

5.6.4 Negotiative Play

Players define a game for themselves by creating and negotiating rules, boundaries and meaning, and try to achieve a self-determined goal such as winning, completing a task or improving their skills.

Theoretical grounding

Negotiative play concerns games, competition and skills. Caillois (1961) describes *agôn*, games of competitive nature, and the difference between *ludus* and *paidia*: structured activities with rules and boundaries, as opposed to unstructured activities. Negotiative play leans more towards ludus than the other four types of free play, which are closer to paidia. *Competition*, *challenges* and *completion* are related pleasures as discussed by both Costello and Edmonds (2007) and Korhonen, Montola and Arrasvuori (2009).

Negotiative play also includes the *creation of rules* by players, the creativity and social negotiation. Bekker and Sturm (2009) and others call this *open-ended play*, play without predefined (game) rules, where the players create and play with rules, meaning and interpretation. This is similar to our *emergent play*, as described in Section 4.4: play that is not defined beforehand, but that evolves as a result of interaction. Negotiative play is also similar to Frasca's (2001) notion that the player and not the designer decides how to use a toy or game, and that the designer can only give suggestions for the players.

Design articulations

Self-determined goals and rules: negotiative play is free play with goals and rules created by the players. Allowing and encouraging challenges, completion or competition can facilitate the emergence of negotiative play (as seen in Section 5.4).

Replayability: a playful activity has to be repeatable and comparable to allow negotiative play. Players should be encouraged to play again, to try and improve their skills or results and to compare the outcomes (as seen in Section 5.4).

Free competition: there is a thin line between allowing and forcing competition. If competition is too prominent, which can happen through the inclusion of high scores for example, then the players will solely focus on competition. To facilitate (free) negotiative play, competition should be allowed but not to the exclusion of other types of free play (see Section 4.2.2).

Examples

Negotiative play occurred in the Walk of Fame when players tried to make the best fitting composition, or orchestrated other players' actions to receive better results. *Self-determined goals and rules* were created and negotiated during play sessions and in between sessions, leading to different aims and actions while playing. *Replayability* was important for this, as it allowed players to retry to achieve their goals.

The *free competition* allowed different types of competition, challenges and orchestration, depending on the preferences and creativity of the players; e.g. a player trying to connect exactly to another player's recording, while simultaneously making it more difficult for the next one.

5.6.5 Communicative Play

Players twist the meaning of something or exchange information to others, by manipulating game elements and through actions such as body language and gestures.

Theoretical grounding

Communicative play is about *communicating while* or *through playing*; it can be e.g. body language, gestures or play with words. Making hearts or sending kisses are examples of communicative play, and so is *griefing* (deliberately harassing, annoying or causing grief to other players ('grief', 2014)). Costello and Edmonds (2007) and Korhonen, Montola and Arrasvuori (2009) discuss *subversion*, the breaking of social roles, rules and norms, which can be part of communicative play as well.

Design articulations

Public visibility: the fact that a player's action is visible or even broadcasted to others, makes it rewarding to communicate through play actions. This can also be 'abused' through negative communication such as obscene gestures (see Section 3.4.2).

Play history: the play history, the time that actions or results remain visible, highly influences communicative play. The history allows players to review their actions, and the audience to see the results as well; simultaneously, the history influences the visibility of unwanted or negative play actions (as seen in Section 3.4.2).

Social control: social control, through norms or rules, is a stimulator and a constraint. The presence of an audience can facilitate communicative play and prevent unwanted behaviour, e.g. the presence of a teacher and peers (as seen in Section 3.4.2). At the same time, social control can hamper the play actions that occur, because people feel a certain action is out-of-context.

Examples

Communicative play with the Walk of Fame happened in players making obscene gestures, blocking the camera, or jumping in the camera field while someone else was recording. It also happened in positive ways: groups of players making letters with their body, sensual dancing, and written notes that were recorded and broadcasted.

The *public visibility* of the projection allowed teenagers to stop playing to watch or film a specific composition. The *play history* was long enough to allow this reviewing, but caused negative recordings to disappear rapidly (after three new recordings). The installation was located in a calm area of the school, which allowed free play, but the nearby presence of a teacher served as *social control*.

5.6.6 Using the types of free play in a design research process

The five types of play can be used as tool in different phases of a design research process. They can be used for guidance when designing, inspiring and informing design decisions, and they can be used as framework for analysis and to evaluate an existing design. Ideally, they are used in an iterative process of design and evaluation, as inspiration, information and evaluation of a well-designed product or system that elicits free play.

The five types of free play can be used for guidance in a design process, by helping to focus the intended free play experience: do we want to design for explorative active play, or more for performative communicative play? The design articulations can serve as important design elements that need to be considered or even incorporated in the design. The many examples in this thesis can serve as inspiration and exemplify how these insights can be applied to interactive systems.

As tool for analysis, the five types can be used in several ways. First of all, as lenses for observation and analysis: what types of free play are elicited by a design in a certain context, and to what extent and in what combinations do they occur? The design articulations can be used to identify opportunities for improvement, both to strengthen already observed types of play, and to activate types of free play that are not yet present in the evaluated situation.

The five types of free play have been used in a myriad of situations, both as guidance and for analysis. In design research, teaching, workshops, presentations and consultancy they have proved to be a valuable tool. The validation and extension of this tool goes beyond the scope of this design research project.

Analysing Wiggle the Eye

In this section, we will analyse the Wiggle the Eye case (see Section 5.3) using the five types of free play. This way, we will illustrate how the types of play can be used as tool for analysis, and we will show the generalisability of the types of play.

For every type of free play, we will evaluate if it occurred with Wiggle the Eye, and consider if we (hypothetically) want to strengthen or include it. Then, we will use the design articulations to analyse how this specific type of play could be elicited more strongly.

Explorative play players experimented with the installation in every evaluation session. This explorative play, however, was not as strong as we had aimed for. We had overlooked the strength of the *honeypot effect*: exploration occurred with twenty players simultaneously, who all tried something and mimicked each other, resulting in chaos instead of exploration. The *curiosity* and *balance between the known and unknown* seemed appropriate, but the *complexity and challenge* was not: the chaos caused by mass-exploration prevented most users from understanding the deeper levels and possibilities of interaction.

To improve the installation, the interaction should be redesigned with mass-interaction in mind, and offer better guidance from simple exploration to more complex play possib-

ilities. The Simple Direct Me interaction scenario was a first step in this direction, but did not offer enough challenge and complexity for longer play sessions or returning users.

Performative play this type of play hardly occurred in the Wiggle the Eye installation. Some players performed for others, by dancing on the benches or showing off how powerful they could wiggle a bench. The installation did not offer many possibilities for performative play, nor was it intended: we chose to focus on the other types of play.

Active play physical actions to produce meaningful sensory experiences were a prominent activity in the Wiggle the Eye case. Players would balance, hang, wiggle or jump on the benches, playing with the springs, gravity and their equilibrium. They would also do this together, e.g. holding hands while balancing to opposite sides, or sitting on a friend's lap to be able to wiggle more strongly.

The strong *social interaction* between teenagers stimulated active play, including bodily contact and more *intimate* behaviour than normal at a schoolyard. The *space and place* of a schoolyard allowed and elicited hanging and sitting: teenagers sat at normal benches or at the wiggle benches, while talking to friends and enjoying their break. This way, the installation became a part of their normal break ritual, while eliciting social and active play.

The strong preference for balancing and wiggling could be used more strongly in the interaction with the installation. Instead of measuring 'is a bench being wiggled', we could measure the depth of wiggling, or the simultaneous balancing to one side of the benches. This way, the users' preferred and natural behaviour would be used as input, and could be used as starting point for more rich play interactions.

Negotiative play the interactions with the Wiggle the Eye installation were designed with negotiative play in mind. Ideally, players would have created their own goals and rules for playing with the different interaction scenarios. This hardly occurred, due to the chaos of mass-interaction; only the Hey, Who Woke Me and the Energize Me interaction scenarios saw the creation of goals by groups of players, in the form of "let's try to make it as wild as possible!".

We still see a lot of opportunities for negotiative play using the installation; however, for this the installation should be redesigned for mass-interaction, proper explorative play, and *replayability*. Only then can *self-determined goals and rules* emerge, and eventually *free competition*.

Communicative play the Wiggle the Eye installation, the actions it afforded and the output it gave, were used to communicate in various ways. The fact that a player could cause other benches to vibrate was used to tease, annoy or flirt with peers. Performing certain actions, such as wiggling wildly, was used to joke about oneself or others. The *public visibility* of the installation elicited social interaction; the *play history* was short since both input and output were abstract; and the presence of peers and teachers in the schoolyard provided a good level of *social control*.

The installation could be redesigned to elicit more communicative play: players could be enabled to put a certain bench in the spotlight, or to make one chair vibrate continuously. This way, more prominent feedback can be caused by a player's actions, resulting in more opportunities for communicative play.

5.7 Layers of Free Play

In this section, we present a framework that describes a free play experience in a public space. This framework is based on the analysis of the Walk of Fame case (Section 5.4), combined with insights from Wiggle the Eye (Section 5.3) and previous design research cycles. It combines the design knowledge from all four design research cycles.

The framework looks at free play experiences in public spaces from three layers or perspectives; from a birds-eye perspective of the context to the in-depth play experience itself (see Fig. 5.24). It aims to help the design researcher to look from different perspectives at an experience, while introducing important design parameters in every layer. Design recommendations suggest vital considerations for each layer, accompanied by examples that show how the recommendations can be applied.

The framework can be used when designing for free play experiences in public spaces, and when evaluating or analysing such a setting. At the end of this section, we explain how these layers of free play can be used in a design research process. The model is also an overview or reading guide of this thesis: it links to important conclusions in the four design research cycles.

An overview of the framework can be found in Figure 5.24.

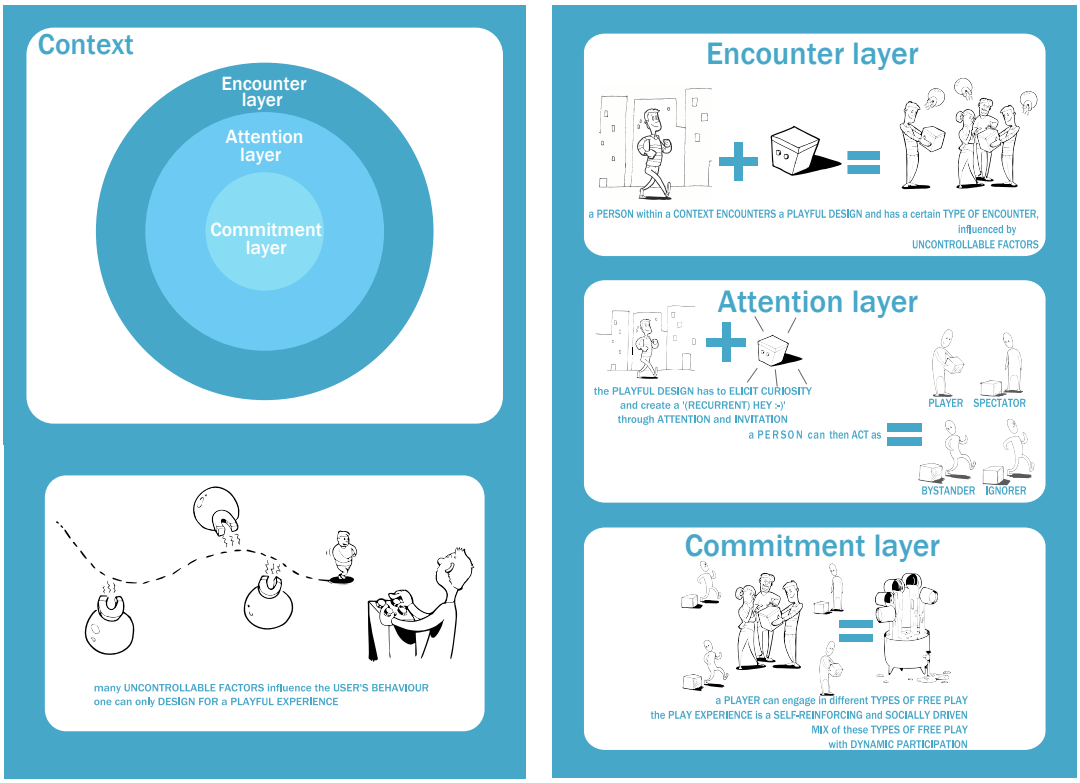


Figure 5.24: ***Layers of Free Play Framework.***

5.7.1 Encounter layer

In the encounter layer, the focus is on a global level, namely the type of encounter and the context. What type of encounter are you designing for? Globally, what type of play, actions and activity should the public installation elicit from the users, and how long and how intense should they play?

The encounter takes place in a context: a specific place and space, with many different users and social conditions. The encounter has to fit in this context, and in the visitor flow: in some encounters all users are first-time visitors, in other contexts most visitors are returning users.

It is also vital to realise that there are many factors that influence the users' behaviour, and that a designer can only control a few of these factors. You design for certain actions, and try to seduce the users to break from their normal behaviour and to eventually perform the intended (playful) behaviour.

Based on

This layer is based on insights and experiences developed in the four design research cycles; in specific on the following sections:

- Section 3.2: Designing for curiosity
- Section 3.2.4: Curious-action framework
- Section 3.3: Designing for public contexts
- Section 3.3.5: Challenges in design and research for public interactions
- Section 4.4: Synthesis: design values framework
- Section 5.6: Types of Free Play

Important parameters

user(s): users that encounter the public installation all have their own character traits, mindset, busy-ness, group composition, etc.

context: the space, place and social characteristics wherein an encounter with the playful installation takes place.

type of encounter: the type of play, actions and activity that the installation should ideally elicit.

uncontrollable factors: all the factors that influence a user's behaviour in a public context.

Design recommendations

Resonate with context and users: the type of play, actions and activity should fit and connect to the context and the users' interest and mindset. A playful installation in a train station for example should not require intensive actions that make users sweat, as that would create a mismatch between users, context and action.

In addition, the threshold to start exploring and playing should be low. The required actions should be easy and normal to perform in the context. Try to seduce users while playing to perform more wild or creative actions; start small, and try to create resonance with the users and the context.

Concentrate on the core concept: design for one simple type of playful behaviour that will be the core activity of the playful experience. This core concept can be e.g. 'playing with reflections' or 'wiggling while sitting'.

The entire design should focus on facilitating this core concept. Once the core experience is successfully elicited, extra features can be added such as sharing or changes over time; but they are extras, they should not hamper or overshadow the core concept.

Create possibilities instead of coercion: allow users to play in their preferred way. Even if the design has an 'optimal way of use', allow and encourage rich interaction and different play possibilities. Constraining users, or even coercing them to play in a fixed way, can severely limit free play.

Example: Walk of Fame at a youth center and a high school

The Walk of Fame installation was evaluated at various locations, including a youth center during a break-dance festival, and a high school. These different locations illustrate the *encounter layer*, as the *users, contexts* and *uncontrollable factors* differed greatly between the locations. In the first location, break-dancers encountered the installation in a party atmosphere, accompanied by loud music; in the second, students encountered the installation every day on their way to class in their lunch break. This naturally resulted in totally different *types of encounter* and play: break-dancing versus coordinated walking.

Walk of Fame *resonates with the context and users*, as it allows simple actions such as walking by and posing, but users are invited while playing to start moving or even dancing in creative ways. The design of the installation *concentrates on the core concept*: playing with the reflection of your body and actions is the only activity that the installation encourages.

Finally, Walk of Fame *creates possibilities instead of coercion*: the setup does not explain how to play with the installation, but users can and have to discover that themselves, either by exploring or by mimicking previous users and actions.

5.7.2 Attention layer

This layer revolves around how the design will convince users to break from their normal behaviour and start exploring and playing. A "hey :-)" moment (playful surprise) is the moment when a user notices the installation, becomes curious and decides to start exploring. This moment can be created in different ways, but the goal is always to grab the attention of the users, and seduce them to change their normal behaviour.

Users can perform the role of ignorer, bystander, spectator or player in these situations; and they can switch these roles during the encounter.

Based on

This layer is based on insights and experiences developed in the four design research cycles; in specific on the following sections:

- Section 3.2: Designing for curiosity
- Section 3.2.4: Curious-action framework
- Section 3.3: Designing for public contexts
- Section 3.3.5: Challenges in design and research for public interactions
- Section 4.4: Synthesis: design values framework
- Section 4.4.4: Lessons learned

Important parameters

attention and invitation: the design has to grab the attention of passers-by, make them curious, invite them to come closer, and seduce them start playing.

different roles: users can have different roles during an encounter. These roles are ignorer, bystander, spectator and player.

recurrent "hey :-)": on recurrent encounters, passers-by already know what to expect and what a design can do. The initial curiosity has likely worn off, so recurrent "hey :-)" moments are needed to renew their curiosity (recurrent playful surprise).

Design recommendations

Create recurrent curiosity using the curiosity principles: make passers-by curious on every encounter, using novelty, partial exposure, complexity, uncertainty, conflict and social curiosity. After the initial curiosity wears off, passers-by need to notice that something has changed on recurrent encounters: they need a new "hey :-)" moment to rekindle their curiosity.

Elicit playful exploration, by connecting to the target group's interests and emotions: passers-by should be triggered to start exploring and playing as soon as they notice

the design. Tailoring the design by connecting to the target group's interests and emotions can help to create this strong desire for exploration.

Entertain different and fluent interactor roles: people differ in explorative actions; e.g. some people start exploring right away, while others prefer to first watch from a distance. Designing for, and rewarding these different roles is important; not only does this attract and please different types of 'players', it also enriches the playful interactions, as spectators and bystanders serve as an audience, give suggestions and encouragement, and can become future players themselves.

Example: The Photo Vault at a high school

The Photo Vault created strong "hey :-)" moments in a relatively simple way. It facilitated *attention and invitation* by being clearly out of place in the school context, being an old cabinet with big lit buttons. When interacting, *different roles* were encouraged and even necessary: spectators commented on the created pictures, and often a spectator started controlling the buttons while a player was posing in a specific way.

Recurrent "hey :-)" was created by changing the photo effects and secret code; every day, when passing by, teenagers would notice that the photo effect had changed, and had to crack the code again in order to play.

The Photo Vault *created recurrent curiosity using the curiosity principles*: at first, novelty and complexity were used to create curiosity. On recurrent encounters, social curiosity and complexity were used to renew the attention and invitation.

The activities of taking pictures, sharing, commenting and broadcasting *connected to the target group's interests and emotions*, creating motivation for *playful exploration*.

The Photo Vault *entertained different and fluent interactor roles*, as the interaction between audience and players was a vital part of the playful experience.

5.7.3 Commitment layer

This layer covers the actual play experience, when passers-by are successfully seduced to start playing. This experience is determined by factors from all three layers, by design decisions and most of all by the actions of the players(s) and audience.

Different types of free play can occur simultaneously in a play moment, such as explorative play, performative play, active play, negotiative play and communicative play. The play experience and its types of play will be different in every play session, as there are many factors that influence it.

Based on

This layer is based on insights and experiences developed in the four design research cycles; in specific on the following sections:

- Section 2.5: Synthesis
- Section 3.3: Designing for public contexts
- Section 4.4: Synthesis: design values framework
- Section 5.6: Types of Free Play

Important parameters

Free play: free play is creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players. Free play fosters competency, autonomy and relatedness, and helps to create intrinsic motivation.

Self-reinforcing & socially driven: in free play, the activity and playful experience are driven by the actions and social interaction of the players. Ideally, the design and technology disappear in the background of the playful experience.

Blend of different types of free play: different types of free play can and should happen. Encouraging various types of play stimulates the change of play over time, and allows players to have different experiences with the same design.

Five common types of free play are explorative play, performative play, active play, negotiative play and communicative play.

Dynamic participation: play sessions in public spaces vary in time due to factors of the space and place. The visitor flow and urgency for example will cause play sessions with different duration. Fluent, episodic or always-on encounters can be used to accommodate dynamic participation.

Design recommendations

Design for intrinsically motivating activities: design for activities that elicit and foster exploration and development, freedom and self-expression, and social interaction. By stimulating activities that are intrinsically motivating for the target group, users can start playing for the enjoyment of the activity itself, and not for rewards or other extrinsic motivators.

Stimulate free play that evolves through the actions and interactions of the players: allow and encourage socially driven free play. The five types of free play we described above have proven to be successful for teenagers in public spaces.

Make play experiences different every time: make sure that play experiences are different in every encounter, either as result from player actions or by changing the system state. This way, players are triggered to play in a creative and autonomous way on every encounter, as they have to give meaning to the situation.

Example: Walk of Fame for teenagers in a public space

The Walk of Fame installation elicited rich *free play*, true to the definition of free play. The goal of a play session, e.g. creating a perfect composition or dancing together, was *socially driven and self-reinforcing*: goals changed over time through the actions of the players, and through the social interaction between them. A *blend of different types of free play* occurred, varying from explorative negotiative play, to communicative performing play, and many other combinations. The school context required *dynamic participation*: some players only interacted when walking by, while others purposely came to the area in their break and played for a long period of time.

Walk of Fame was *designed for intrinsically motivating activities*. The installation allowed players to decide what, how and why they played and focused on social interaction, observing-being observed-broadcasting and self-expression. *Free play that evolves through the actions and interactions of the players was stimulated* through the publicly visible replaying of the recorded movies. Groups of spectators and bystanders commented on the results and gave suggestions for the next recording, and as a result roles and goals changed fluently during a play session.

Walk of Fame was designed for different types of free play; the installation only focused on 'playing with your reflection', inviting players to decide while playing what their goals and actions would be. The *play experiences were different every time*, as the players decided what to record and do.

5.7.4 Using the layers of free play in a design research process

The three layers of free play can be used as tool in different phases of a design research process. They can be used for guidance when designing, inspiring and informing design decisions, and they can be used as framework for analysis, to evaluate an existing design. Ideally, they are used in an iterative process of design and evaluation, as inspiration, information and evaluation of a well-designed product or system that elicits play.

The three layers of free play look at free play experiences in public contexts from three layers or perspectives. Each layer is accompanied by design parameters, design recommendations and applied examples.

The *encounter layer* discusses a playful moment from an encounter perspective, focusing on the users, context and type of encounter. This layer contains our insights about public spaces (3.3), resonating with context and users (4.4.3) and the many uncontrollable factors (3.2).

The *attention layer* zooms in, showing how users can be seduced and elicited to start exploring and playing. The curiosity principles (3.2.4) and elicit & seduce design value (4.4.1) can be used to create recurrent "hey :-)" moments, with different roles (3.3) for players, bystanders and spectators.

The *commitment layer* elaborates on the playful activity itself. It revolves around eliciting free play (2.5 & all design research cycles) in a social context, and presents five types of free play (5.6) that can be specifically designed for: explorative play, performative play, active play, negotiative play and communicative play.

A designer can use this information as guide when designing, to make sure that no important aspects are overlooked. The examples can serve as inspiration, and can exemplify how the information from the layers can be applied to interactive systems.

As a tool for analysis, the layers can be used as lenses for observation and analysis: what type of behaviour is elicited at a certain layer, what seems to be causing this, and how can we analyse it. The design parameters and recommendations can be used to identify opportunities for improvement.

Ideally, the layers of play are used in an iterative design research process, informing the design and research activities through their conceptual, applied and methodological design knowledge.

The layers of free play can also be used as a summary of, or a reading guide to, the design knowledge in this thesis. Every layer links to work from earlier design research cycles. In a way, the layers combine all our insights in one framework and tool.

This tool is far from complete: it is a first framework that attempts to chart and share the design knowledge about free play that we have developed so far. Future work by us, and by others, is required before this framework can approach completion; but we feel that the framework in its current state can already be helpful to designers and researchers in the fields of play, teenagers and public spaces.

5.8 Conclusions, design knowledge and reflection

This final design research cycle focused on recurrently eliciting free play. The main question for this cycle was: *how can we design for and study recurrent free play in public contexts?* This cycle had three main aims: (1) successfully eliciting free play for longer periods, (2) evaluating and studying the installation and the playful activities, and (3) identifying and describing the types of free play that occur.

To achieve this, two high-fidelity prototypes were developed, and evaluated at high schools for periods of a month: Wiggle the Eye, interactive seats for physical and social play at a schoolyard, and the Walk of Fame, an installation for moving through a corridor in a performative way. The evaluation results, in combination with design knowledge from previous design research cycles, resulted in two frameworks of designing for free play: five types and three layers of free play.

Designing for these types of play allows players to continually evolve the playful activity through their actions and social interactions, helping to create recurrent curiosity and ever-changing playful experiences. The model of three layers of free play helps to design for free play by looking from different perspectives: it combines insights and design knowledge from all cycles into one model.

The types and layers of free play can be used generatively when designing, for inspiration and to guide to design process. In addition, they can be used to evaluate and analyse a design that elicits play. Ideally, they are used in an iterative design research process, in both the design and evaluation phase. This way, the results inform and verify design decisions throughout the process.

The answer to the design research question for this cycle can be found in the layers and types of free play, in combination with the design examples. By using this conceptual and applied design knowledge, we successfully elicited free play on recurrent encounters - and expect that other design researchers can do the same.

5.8.1 Design knowledge

This cycle has generated the following design knowledge:

layers of free play a model that looks at free play experiences in public contexts from three layers or perspectives, accompanied by design parameters, design recommendations and applied examples.

types of free play five concrete types of free play that were recurrently observed in our evaluations, and that can be used to specifically design for. Design articulations and applied examples explain how one can design for these types in more detail.

proofs-of-concept two high-fidelity interactive installations that were successful in eliciting free play on recurrent encounters.

5.8.2 Reflection

In this design research cycle, we have successfully elicited recurrent free play. Teenagers played with our installations in a creative and autonomous way, without predetermined structure or meaning, and the play continually evolved through the actions and interactions of the players. The players kept the playful experience continuously novel and motivating; the system and technology faded into the background during a play session, as the playful and social interaction took precedence.

These experiences show that we can elicit free play for a period of weeks; it is a good first step of designing for recurrent free play that becomes part of teenagers' daily life and culture. However, there are still many challenges to be tackled in the design research space of free play, teenagers and public spaces. In the next chapter, we reflect on and discuss the four design research cycles, try to answer the design research questions, and share our strategies for design research about free play, teenagers and public spaces.

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Chapter 6

Conclusions and Discussion

This chapter reflects on the entire body of design and research conducted in the four design research cycles. We start with conclusions, and answer the three design research questions of this thesis (Sect. 6.1). This is followed by a discussion section (Sect. 6.2) where we discuss the contributions (Sect. 6.2.1), reflect on our design research process (Sect. 6.2.2) and present our insights and strategies for evaluating free play with teenagers in public spaces (Sect. 6.2.3). We conclude this chapter with a reflection and by looking forward to future work (Sect. 6.2.4).

6.1 Conclusions

In this section we answer the three design research questions of this thesis and briefly discuss the frameworks that were developed in the four design research cycles.

6.1.1 What type of social and active play is enjoyable for teenagers in daily life?

Design explorations, user research and literature review in the design research cycles resulted in a design vision of free play that resonates with teenagers' interests, activities and contexts (see *free play vision*, Sect. 2.5.2). Free play is the answer to the first design research question of this thesis.

Through iterations we developed building blocks of designing for free play, starting with the importance of designing for intrinsic motivation. For teenagers, this means designing for activities that elicit and foster exploration and development, freedom and self-expression, and social interaction (see *qualities for motivating teenagers*, Sect. 2.5.1). In Section 2.5.2 we framed this type of intrinsically motivating activities as *free play*: *creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players*.

The user confrontations and evaluations in the design research cycles showed us the importance of resonating with teenagers' interests, activities and contexts. Playful activities should fit into teenagers' daily life and connect to or even pivot around their drives and

interests. Self-expression and sharing with peers are for example important to teenagers, so an activity should support or even stimulate this.

To iteratively develop the free play design vision, parts of the vision were grounded in chunks of design-relevant knowledge, and many prototypes were designed, implemented and evaluated with teenagers in public spaces. The resulting moments of free play show the rich variety in which free play can be embodied, e.g. the social playful swimming in the Swimgames, the creative posing with the Photo Vault, or the performative play in the Walk of Fame.

Summarised, the design vision, interactive installations and user evaluations explain and illustrate what enjoyable social and active play for teenagers in daily life is: *free play that resonates with teenagers' interests, activities and contexts*. This design vision can inspire and guide designers and researchers in a myriad of design challenges.

6.1.2 How can we recurrently elicit this type of playful activities through interactive installations in public spaces?

The *layers of free play framework* and the accompanying *types of free play framework* explain how to design for free play from a conceptual perspective. The interactive installations that were designed in this project show how this design knowledge can be applied in concrete interactive systems, and the evaluations of the designs serve as examples and proofs-of-concept. Together, the frameworks, designed installations and evaluated moments of play answer the second design research question of this thesis: we can recurrently elicit free play through interactive installations in public spaces by *designing for five types of free play from an encounter, attention and commitment perspective*.

Our goal was to recurrently elicit free play through interactive installations in public spaces. Designing for free play, teenagers and public spaces is complex, as there are numerous factors that influence the behaviour of the users; as such, a design research process was used with many iterations of design, evaluation and analysis.

Four design research cycles were executed in this project, each building on the results of the previous cycles. In these cycles, many prototypes were designed, implemented and evaluated with teenagers in public spaces, and the free play design vision was iteratively developed and grounded in building blocks of design-relevant knowledge.

The first three design research cycles focused on exploring, activating and designing for free play in public spaces, and resulted in a series of intermediary frameworks, design explorations and proofs-of-concept. The fourth and last design research cycle focused on free play for longer periods, and on developing and synthesising all our design knowledge in a summative framework.

Wiggle the Eye and Walk of Fame are high-fidelity prototypes developed in cycle four that were evaluated for periods of a month, with hundreds and respectively thousands of players. By studying these installations and the behaviour they elicited, we were able to articulate the implicit design knowledge from the design research cycles, which manifested in the *layers and types of free play frameworks*.

The *layers of free play framework* (Sect. 5.7) presents the design of free play experiences in public contexts from three layers or perspectives, accompanied by design parameters, design recommendations and applied examples.

The *encounter layer* discusses a playful moment from an encounter perspective, focusing on the users, context and type of encounter. This layer contains our insights about public spaces (3.3), resonating with context and users (4.4.3) and the many uncontrollable factors (3.2).

The *attention layer* zooms in, showing how users can be seduced and elicited to start exploring and playing. The curiosity principles (3.2.4) and elicit & seduce design value (4.4.1) can be used to create recurrent "hey :-)" moments, with different roles (3.3) for players, bystanders and spectators.

The *commitment layer* elaborates on the playful activity itself. It revolves around eliciting free play in a social context (2.5 & all design research cycles). This layer incorporates the *types of free play framework* (5.6), five types of free play that can be specifically designed for: explorative play, performative play, active play, negotiative play and communicative play.

These frameworks show, together with the designed installations and evaluated moments of play, how we can recurrently elicit free play through interactive installations in public spaces: by *designing for five types of free play from an encounter, attention and commitment perspective*. The frameworks explain how to design for free play, teenagers and public spaces, and the designs illustrate how this conceptual design knowledge can be applied to interactive installations in real life contexts.

6.1.3 How can we conduct design research about such playful activities for teenagers in public spaces?

The approach described in this thesis, combined with the evaluation discussion later in this chapter (see Sect. 6.2.3), answer the third design research question of this thesis.

Designing and studying playful activities for teenagers in public spaces is complex: there are numerous factors that influence the actions and experience of the players, and most of these factors are outside the designer's control. In these complex situations, one can only design *for* a specific experience: the actual experience emerges from the interaction of the players with the installation, the context, other players, etc. As a designer, one can tweak certain design elements, place the installation in the real world, and see what happens: the combination of the design, users and all the situational factors create the specific experience.

Only by *iteratively* exploring, experimenting and studying many designs and evaluations *from a holistic perspective* can one gather intermediary design knowledge, which can inform future design iterations and can eventually lead to new theory. With holistic we mean by reference to the whole, as the parts of an experience are intimately interconnected ('holistic', 2015) and cannot be evaluated individually.

A combination of design exploration, implementation and evaluation in several iterations is required in order to understand the complex design and research space.

Evaluation methods and approaches have to be adapted for teenagers, public spaces and playful experiences - and especially for the combination of these three fields (see Sect. 6.2.3). Evaluation methods for teenagers can neither be too childish nor too complex, need to fit into their daily life, and the disruption and intrusion the study will cause must be taken into account. Evaluating in public spaces means dealing with many (uncontrollable) influential factors, that make every experience unique. Evaluating free play requires freedom in the play environment, which can complicate evaluation setups.

The contributions in this thesis can help to inspire and guide design research projects about free play for teenagers in public spaces. They can be used as best practices in the planning and execution of a related design project. However, actually performing many iterations of design and evaluation remains the most important action. In the end, design research for these playful activities requires *iterative design research from a holistic perspective*, with teenagers in real-world contexts.

6.2 Discussion

In this section we discuss the results of this thesis and its relation to related work. We discuss the contributions (6.2.1), reflect on our design research process (6.2.2) and present our insights and strategies for evaluating free play with teenagers in public spaces (6.2.3). We conclude this chapter with a reflection and by looking forward to future work (6.2.4).

6.2.1 Design research contributions for free play, teenagers & public spaces

This thesis focused on design research about *free play*, *teenagers* and *public spaces*. In this section, we present an overview of the contributions of this thesis, and discuss how they can be used by design researchers in related fields.

The contributions are categorised in conceptual, applied and methodological contributions (inspired by Ljungblad (2008)), see Fig. 6.1.

Conceptual and applied contributions

The *conceptual contributions* in this thesis show why designing for free play, teenagers and public spaces is useful or even necessary, and what type of mindset and design vision can be used when designing for these fields. The *applied contributions* show how this conceptual design knowledge can be applied to designs: the applied contributions transform the values, vision and design concepts into concrete and functional systems that can be evaluated and consequently inform future iterations.

The design explorations and studies presented in this thesis all show in an embodied way how free play can be elicited in public spaces; they are both examples and proofs-of-concept of our vision. The designs reveal the issues we think are important, and our beliefs about the right way to address these issues (Gaver, 2012). They are the embodiment of all the implicit and explicit design decisions, based on the theoretical and practical insights from the frameworks.

In this section we discuss the main conceptual and applied contributions from this thesis per individual topic. The strength of the contributions is both on the individual topics and on the combination of free play, teenagers and public spaces.

Free play design vision, frameworks and designs

The free play design vision, frameworks and designs are the main contributions of this thesis. The free play definition and design vision explain what free play is, and why designing for free play is useful and important (Sect. 2.5.2).

The types of free play framework (Sect. 5.6) shows what types of play can be successfully elicited by interactive installations, and the layers of free play framework (Sect. 5.7) explains how to design for a free play encounter in a public space. Designing for different types of free play allows players to continually evolve the playful activity through their actions

	Conceptual contributions	Applied contributions	Methodological contributions
C1	Free play vision Teenager interest areas Qualities for motivating teenagers	Design explorations Proofs-of-concept	
C2	Curiosity principles Curious-action framework Insights designing for public spaces	Design explorations Proofs-of-concept Curious-action speakers Magic Mirror	Curious-action framework
C3	Framework design values: Invite & Elicit Emergent Play Resonate	Design explorations Proofs-of-concept Photo Vault	Framework design values: Invite & Elicit Emergent Play Resonate
C4	Bridging concepts framework: types & layers of free play, design recommendations	Wiggle the Eye Walk of Fame	Bridging concepts framework: types & layers of free play, design recommendations
C&D	Conceptual design knowledge	Applied design knowledge	Methodological design knowledge Reflection on design research process Strategies for design research about teenagers, public spaces and free play
	Answer des res question 1 Answer des res question 2	Answer des res question 1 Answer des res question 2	Answer des res question 2 Answer des res question 3

Figure 6.1: ***Contributions of this thesis, sorted by conceptual, applied and methodological contributions (same as Fig. 1.5).***

and social interactions, helping to create recurrent curiosity and ever-changing playful experiences. The three layers of free play help to design for free play by elucidating from different perspectives: they synthesise insights and design knowledge from all design research cycles into one model, and present it from an encounter, attention and commitment perspective.

These frameworks are a type of intermediary knowledge, inspired by design examples as well as theory, and facilitate an exchange between theory and practice (Dalsgaard & Dindler, 2014). As such, the frameworks are intended to serve an intermediary role: they connect, combine and reflect on our designs, implemented theories, debates and the design process. They are meant as both inspiration and guidance to designers and researchers.

The design explorations and studies presented in this thesis show how this conceptual design knowledge can be applied. They show examples of free play in public contexts, with all the rich diversity and emergent interactions. They embody all the implicit and explicit design decisions, and serve as examples and proofs-of-concept.

Using the design knowledge:

The free play design vision and frameworks can be used as tool in different phases of a design research process. They can be used for *guidance* when designing, inspiring and informing design decisions, and they can be used as tool for *analysis* to evaluate an existing design. Ideally, the frameworks are used in an iterative process of design and evaluation, as inspiration, information and evaluation of a well-designed product or system that elicits free play.

The frameworks can be used for guidance in a design process by helping to shape and focus the intended free play experience. The design articulations and recommendations are important building blocks for design that need to be considered or even incorporated in a design. The examples in this thesis can serve as inspiration and exemplify how these insights can be applied to interactive systems.

The designs can be used by other designers and researchers as inspiration, as best practices, and as proofs-of-concept - in various stages of a design process. Since they are applied design knowledge, they contain many implicit and explicit design decisions. As such, they are useful when designing for free play, but also for related contexts, target groups or design goals.

As tool for analysis, the frameworks can be used in several ways. First of all, as lenses for observation and analysis: what types of free play are elicited by a design in a certain context, and what factors can be identified from each layer perspective? The design articulations and recommendations can be used to identify opportunities for improvement, both to strengthen already observed types of free play, and to activate types of free play that are not yet present in the evaluated situation, from different layers or perspectives.

The free play frameworks have been used in a myriad of situations, both as guidance and for analysis. We have applied them in design research, teaching, workshops, presentations and consultancy in order to communicate our design knowledge and experiences.

Contribution to related work:
This thesis focused on free play and on developing design knowledge about free play. The expertise area of free play is extensive and loosely defined, and overlaps with expertise areas such as open-ended play (Bekker, Sturm & Eggen, 2010; Valk et al., 2012), ludic design (Gaver, 2009), pervasive games (Montola, Stenros & Waern, 2009), playful art installations (Costello, 2009) and free-play (Morrison, Viller & Mitchell, 2011).

Our free play design vision, the frameworks and the designs contribute to the further development of this broad field: we chart the dimensions of this 'playful' field, and define parts and building blocks of it. In this thesis, we described and illustrated one approach for designing for free play, and discussed different forms of free play and interactive installations that elicit such play. Our contributions develop this field one step further and can inspire and guide designers and researchers working in this expertise area.

Besides contributing to free play on a general level, our work also contributes by extending the design knowledge about free play to new target groups and situations, as requested by Morrison, Viller and Mitchell (2011). Existing literature about free play mostly focuses on children and its benefits for child development (e.g. Smith and Pellegrini, 2008; Bekker, Sturm and Eggen, 2010; Goldstein, 2012; Moreno, Delden, Poppe and Reidsma, 2013). We extended this to other target groups (teenagers) and recurrent encounters by specifically designing for and evaluating free play with teenagers in public spaces. We show that it is possible to design for free play, teenagers and public spaces, and elucidate how to do this.

Our frameworks and designs can aid designers, researchers and other practitioners both inside and outside the HCI community by inspiring and guiding the design and evaluation of free play activities, in the ways described before ('using the design knowledge').

Curiosity principles and curious-action framework
An important step in designing for free play is activating play. In this project, we used curiosity to do that: we made passers-by curious in public spaces, and invited them to come to the interactive installation and to start exploring and playing.

The curiosity principles and curious-action framework (Sect. 3.2 and 3.2.4) explain how to make people curious in public spaces using interactive technology. They show, on a conceptual and applied level, how play can be activated in public spaces.

The curiosity principles, framework and the 'elicit & seduce' design value (Sect. 4.4.1) are forms of intermediary design knowledge. This design knowledge returns in the layers of free play framework (Sect. 5.7), and is applied in many of the proofs-of-concept.

Using the design knowledge:
The curiosity principles and curious-action framework can be used as inspiration and guidance in a design process: one can specifically design for curiosity by focusing on one or more of the curiosity principles.

In presentations, teaching and consultancy we have experienced that people appreciate the simplicity of a few concrete elements to focus on, when designing for curiosity. The

principles have been used as input for design research in various situations, e.g. Valk et al. (2012) and Hobye (2014).

Contribution to related work:
The design knowledge about curiosity is grounded in literature from psychology (e.g. Berlyne (1960), Loewenstein (1994), Kashdan, Rose and Fincham (2004)), marketing (e.g. Cialdini (1993)) and popular science (e.g. Vorst, 2007). This existing work about curiosity was extensive, abstract and it discussed curiosity from various perspectives; as such, it was hard to relate to design.

In this thesis, we made this knowledge available in an easy-to-use format, by translating the insights from these sources into design-relevant knowledge. We developed design knowledge by exploring and designing with these curiosity principles, resulting in concepts and proofs-of-concept that show how to apply this design knowledge to design.

The five curiosity principles are an example of this design-relevant knowledge, and they have been used in the design of various installations. In the Photo Vault for example, the influence of the principles is directly visible in the final design: we created an old odd cabinet to elicit curiosity (novelty), we changed the code on a daily base to create uncertainty and conflict, etc.

Through the work in this thesis we also contributed to the discourse about designing for exploration and curiosity in the HCI community. The work of Hobye (2014) for example used our curiosity insights as starting point for his discussion about Homo Explorens.

Designing for (motivating) teenagers
This project focused on motivating teenagers to play in a social and active way; as such, the target group teenagers was an important factor in our design research.

Our contributions in design research for teenagers are the qualities for motivating teenagers (Sect.2.5.1), based on teenager interest areas and the insights from psychology about motivation (Self-Determination Theory, Sect. 2.2). This is complemented by insights and best practices of how to design for and evaluate with teenagers, throughout the design research cycles.

The design explorations and studies are applied contributions: examples and proofs-of-concept of how one can design for teenagers, using the conceptual design knowledge. They illustrate how the conceptual insights can be translated into applied designs, and communicate design decisions that were successful for our situation.

Using the design knowledge:
The teenager interest areas and qualities for motivating teenagers (Sect. 2.3 & 2.5.1) can be used as starting point in a design process. We experienced that when designing for teenagers, it is important to focus or at least include the three qualities we defined. These qualities, the best practices and the applied examples in the proofs-of-concept can inspire and influence design decisions.

This teenager-specific design knowledge does also apply to other contexts, technologies or design goals.

Contribution to related work:
Our design knowledge about teenagers is grounded in literature from developmental and motivational psychology. We complemented this with user research (observations, focus groups, etc) and through design explorations.

We translated these existing psychological insights into design-relevant information, and by applying them to design we created conceptual and applied design knowledge.

An example are the teenager interest areas (exploration, personalisation, self-expression and social interaction): four groups of interests or activities for teenagers that we defined, based on literature and user research. These four items have been valuable in the early phases of several design processes, as they provide inspiration and user focus when designing for teenagers. The Walk of Fame installation for example was specifically designed to allow and encourage exploration, personalisation, self-expression and social interaction.

The design knowledge about teenagers contributes to the small-but-growing field of designing for teenagers in the HCI community. Our insights contribute to the body of knowledge about motivating, designing for and evaluating with teenagers, in line with the work of Fitton, Read and Horton (2013). We aid in creating solutions for the many challenges in design research with teenagers, as requested by Read, Horton, Iversen, Fitton and Little (2013). Our work contributes on a conceptual level with the teenager interest areas and qualities for motivating teenagers, and on an applied level with the proofs-of-concepts and experiences in designing for teenagers.

Designing for public spaces
In this project, we have designed for specific public contexts such as school environments. In the design research cycles, we have presented insights and best practices for design research in public spaces (Sect. 3.3.5): we discussed how to design for public spaces, and what factors and design elements are important in these contexts. Both the 'resonate design value' and the layers of free play framework (Sect. 4.4.3 & 5.7) explain the importance of connecting to and resonating with a specific context.

The design explorations and studies show how this conceptual design knowledge can be applied: the designs embody design decisions and best practices for designing in public spaces.

Using the design knowledge:
The insights about designing for public spaces, the design value and the layers of free play framework can be used to inspire and inform a design process. When designing for public spaces, it is important to keep this information in mind. However, this will not automatically lead to a good design: there are many more factors that influence a design in a public context. Iterations of design and evaluation are required in these situations, in order to

understand a context and to create a suitable design.

Contribution to related work:
Designing for public spaces is a popular topic in the HCI community. Researchers have studied the design of public installations, evaluation methods and best practices for conducting design research in public spaces (e.g. Brignull and Rogers, 2003; Finke, Tang, Leung and Blackstock, 2008; Montola, Stenros and Waern, 2009; Fischer and Hornecker, 2012; Müller, Walter, Bailly, Nischt and Alt, 2012; Akpan, Marshall, Bird and Harrison, 2013). However, many of these studies focused on interactive displays in city environments; in addition, the focus was often on first-time users. Our project focused on recurrent encounters with public installations in schools and other semi-public environments.

The work in this thesis covers designing for both public spaces and public or pervasive games, and contributes to both fields. The layers of free play framework for example can be used when designing for pervasive games (Montola, Stenros & Waern, 2009), it connects to the discussion about roles in public interaction (Brignull & Rogers, 2003; Fischer & Hornecker, 2012), and offers an alternative viewpoint on interaction processes and models (Nielsen, Fritsch, Halskov & Brynskov, 2009; Müller, Alt, Michelis & Schmidt, 2010, 2012).

The design knowledge in the frameworks about public spaces is applicable to all sorts of semi-public contexts such as schools, city halls, swimming pools or stations - and can be used by practitioners in a range of fields, as inspiration and guidance in a design project.

Methodological contributions

The *methodological contributions* in this thesis support other designers and researchers that face similar challenges, or that want to apply the insights from this thesis to other design goals, user groups or contexts. The process and strategies described in this thesis, and discussed later in this thesis (Sect. 6.2.2), discuss important decisions or considerations when designing for this design research space: the importance of iterations of exploration, design and in situ evaluation; the necessity of an holistic perspective and analysis; and the acceptance that this kind of design research leads to exemplary results and proofs-of-concept, and not to truths or general theories.

Evaluating free play brings specific challenges, and requires adaptations to evaluation methods; so does evaluating with teenagers or in public spaces. The combination of the three poses even more complexities. In section 6.2.3 we discuss these challenges, and our insights and best practices for evaluating free play with teenagers in public spaces.

Together, these insights about design and evaluation are the methodological contributions of this thesis.

Using the design knowledge:
The methodological design knowledge is especially relevant for design researchers who are working with free play, teenagers and public spaces. The main strength is in the combination of these three fields, but the contributions are also useful for people working in just one of the fields.

The lessons learned about the design process and about evaluating free play with teenagers in public spaces can be used as inspiration and guidance. Our contributions can help to guide decisions in both the planning and the execution of a design project, and they can help to prevent some of the less successful decisions that we have made.

Contribution to related work:
Our methodological design knowledge contributes to the expertise fields of design research about free play, teenagers and public contexts.

Our insights and experiences about design research for free play help to develop this field, as was also requested by Morrison, Viller and Mitchell (2011). In addition, we extend the available methodological knowledge about free play and children to recurrent encounters, and with other target groups and contexts.

Regarding teenagers, we contribute to the limited existing work of design research and evaluation with teenagers. We provide insights, experiences and best practices for design research with teenagers, in line with the work of Fitton, Read and Horton (2013), and help to solve the challenges posed by Read, Horton, Iversen, Fitton and Little (2013).

In relation to public spaces, our methodological contributions add to the existing knowledge about evaluating in public spaces, and broaden the current focus on interactive displays in city environments with our evaluations of recurrent encounters with public installations in schools and other semi-public environments.

Last but not least, we contribute to ongoing design research projects in our universities and communities. First of all in our own design research group, where research on the topics of free play, teenagers and public spaces continues through student projects and several ongoing PhD projects. Second, we connect to the ongoing discourse in international conferences, such as the teenagers workshops in the IDC (2014) and CHI (2014) conferences, and the (open) play discussion in game-related conferences like DIGRA (2014).

Literature: synthesise, apply and develop

In this section, we discuss the relation of our contributions to the literature presented in this thesis, and discuss the way in which our work extends existing literature.

In this thesis, we have extended existing literature on three levels. First, we have *synthesised* existing literature and enriched these syntheses with our insights from theory and practice. This way, the design-relevant parts of existing literature have become easier to grasp and use for ourselves and others.

Second, we have *applied* these literature syntheses to design, showing how to use the insights to inform design decisions, and we provided examples and proof-of-concepts. This extends the existing literature by translating the theory to applicable and applied design knowledge.

Third, we have *developed* new conceptual, applied and methodological design knowledge which is grounded in existing literature and in insights from design explorations and studies. This new design knowledge extends the existing literature, and can serve as starting point and foundation for future design-related studies.

The literature discussed in this thesis has been extended on various levels. The more abstract literature has 'merely' been synthesised and applied, while literature closer to the core of this work has been extensively developed into new design knowledge.

6.2.2 Reflecting on our playful explorative process

The goal of this project was to learn how to design for free play for teenagers in public spaces, through a design research approach - and simultaneously, to learn how to conduct design research about these same subjects.

Looking back, we can conclude that our design research process itself had a playful explorative nature. Our focus was from the start on designs and frameworks. The design research space was complex with many uncontrollable factors. Therefore, literature and discussions could only help us to a certain extent; only by deciding and implementing designs, and by placing them in a real user context, could we begin to grasp the most important factors in our design research space.

We decided relatively early in the project that our focus would be on exemplary designs, and not on in-depth evaluations or validated guidelines. We believed and believe that the richness and complexity of free play installations can best be explored and communicated through designs, accompanied by frameworks that attempt to articulate the implicit and explicit design decisions, design knowledge and implemented theories.

Our core goal and value in this project was designing, or as Gaver (2012) describes: "exploring and speculating, particularising and diversifying, and - especially - its ability to manifest the results in the form of new, conceptually rich artefacts".

This focus on designs influenced our process and results in various way. Most notably, it meant that the outcomes of our design research would be rich qualitative insights instead of facts or truths. We focused on rich results, on exploring the field of free play and on showing how designing can be done for this design research space.

Second, it meant that we had to develop many interactive installations and evaluate them in in situ contexts, to evaluate the dynamic behaviour and rich interaction that emerge in such situations.

In such open situations, there are numerous factors that influence the actions and experience of the players and audience; most of these factors are outside the designer's control. A designer can only tweak certain design elements, place the installation in the real world, and observe what happens: the combination of the design, users and all the situational factors create the actual experience.

Events such as a group of older-year students walking by, or a class that suddenly has a spare hour, create situations and opportunities for new play experiences; through these uncontrolled factors, rich and truly free play can blossom. In every play session, these factors are different, and thus the emerging play is different - which is the strength of the free play experiences.

Holistic analysis instead of comparing

Often, we - researchers - try to show or prove that a certain factor or design decision causes certain behaviour; in our case for example, one could argue that it is valuable to know what design decisions are required before an installation elicits free play.

Comparing two designs with each other, in order to prove that a certain design element promotes or hampers free play, is however of limited to no use. Gaver (2012) summarises this: "the problem is in determining how to construct such a systems to be 'comparable'. Simply tweaking an unambiguous system to be ambiguous might address the assertion in a narrow sense, but it would be unrepresentative of the ways designers harness untheorised factors of a design to support its intended effects. In other words, the synthetic nature of design is incompatible with the controlled experiments useful for theory testing."

To clarify this point, imagine a second version of the Walk of Fame, where recordings would only be saved when a perfect match was made between lower and upper body. This system would probably elicit less free play, since players would focus on creating the perfect recording. As a result, the total play experience would change: play would be centred around timing, speed and focus. Some players would become more skilled than others, changing the social interactions; many types of play, such as hanging from the ceiling or displaying a note, would no longer be possible; and so onwards. By changing one design element, the entire play experience would radically change - without telling us more about 'what exactly causes this change', as the changed play experience could also be caused by factors such as the creativity of the players, the social situation, or different group compositions.

To solve this 'problem' while still allowing us to gain rich in-depth insights from in situ user evaluations, we developed the installations iteratively and evaluated them in an holistic way. By tweaking certain design elements, and evaluating a combination of new and old design decisions, we eventually achieved designs that successfully elicit free play. It is hard to identify which specific change between iterations made the design suddenly 'work'; it is impossible to pinpoint one variable that can be changed so that designs can be compared, without totally altering or destroying the play experience. However, that does not matter, as the final successful design is the result and the insight; it is a proof-of-concept that proves that our implemented theories and design knowledge lead to (a) good design.

Design-it-yourself

To conduct design research in complex situations such as ours, one needs to follow an iterative process and analyse from a holistic perspective, over a series of exemplary design cases. The frameworks presented in this thesis, combined with the designs, can aid this process: the layers of free play framework, for example, provides three perspectives that can be used in design and analysis.

However, actually performing iterations of design and evaluation will provide the best aid. Successfully designing for free play is a case that is highly dependent on the envir-

onment, players and other factors, and can therefore not be fully predicted or planned. Frameworks can certainly help, but they cannot replace or generate the design.

6.2.3 Evaluating free play with teenagers in public spaces

Evaluating free play brings specific challenges, and requires adaptations to evaluation methods; so does evaluating with teenagers or in public spaces. The combination of the three poses even more complexities. In this project, we have learned many lessons about conducting design research about free play with teenagers in public spaces. In the design research cycles, we mainly discussed the design side; in this section, we will focus on the evaluation side of this design research space.

We will discuss this combination of teenagers, free play and public spaces from three perspectives, going from evaluating with teenagers to public spaces and eventually to free play.

Teenagers

Teenagers are neither adults nor children; evaluation methods should have the correct level of complexity and maturity for their age and education level, and fit in with their daily life.

In this project, we have tried several evaluation methods with teenagers that were originally developed for children or adults, as there were no methods available that were specific for teenagers. This posed us with several challenges.

The smileyometer developed by Read and MacFarlane (2006) for example was considered as childish by our target group, and invited jokes and sometimes plain refusal. Questionnaires for adults, on the other hand, used too abstract or reflective questions, and were too complex for the target group's language skills and age. This is similar to challenges posed by Read, Horton, Iversen, Fitton and Little (2013).

The MemoLine is an UX-curve adapted for children by Vissers, De Bot and Zaman (2013), that has been successfully used with children by the authors. Our target group, however, did not understand the tool, even after explanation and practice, which resulted in inconsistent and 'incorrect' entries. Possibly, the teenagers interpreted the curve on a deeper level than the children, resulting in confusion. Another reason for the incorrect entries could be that the users did not want to fill in the forms seriously, for social related reasons.

A method should also fit in with the school context and the teenagers' daily life; we found that the daily activities and priorities of our users often interfered with evaluations. In a diary study we conducted, similar to the study by Romero, Baren, Markopoulos and Ruyter (2003), users had to fill in their diary at the end of each school day. This task kept them from their free afternoon, so this resulted in a large amount of random and quick-and-dirty entries.

Activity monitors posed a similar challenge: some teenagers proudly showed the monitors to everyone they encountered, shaking and explaining how the monitor functioned. Other teenagers refused to wear the monitors because they were "uncool", and kept them in their locker or bag. Both the enthusiasm and refusal resulted in unusable data. This is

a type of evaluation apprehension (O'Hara, Glancy & Robertshaw, 2008), where users fear that their behaviour is judged by others. This fear, or at least awareness of others' opinion is especially strong with teenagers, as social identity is important to them. In future evaluations, a strategy could be to make teenagers part of the research team, so that evaluations can connect to their interests and life style, and maybe even become part of their daily life.

Social factors strongly influence teenagers' behaviour, and this should be considered in evaluation setups. Many social factors can influence the results and success of an evaluation study, as also observed in Fitton, Read and Horton (2013) and Read, Horton, Iversen, Fitton and Little (2013). First of all, a proper bond is required between researcher and users. In our experience, an interview that is performed one-on-one was too intrusive for the teen participants; on the other hand, large groups of teenagers (5+) in focus groups resulted in too much joking, group pressure or even chaos. The location influenced the study results as well: a session in the teacher room overwhelmed the users, while a session in the break area resulted in too much freedom and interference.

Groups of two to three teenagers per researcher showed to be the optimal group size, with semi-structured interviews in a quiet corner of a social area. In addition, building a good but serious bond with the users helped, as did giving a reward for successful completion of the study (water-skiing in our case).

It is also important to be sensitive to social factors, even with small groups of participants: we tried the video-cued recall method (Lyle, 2003) for example, where participants could watch themselves playing with the Walk of Fame. This resulted in so much giggling, joking and yelling that normal conversations or interviews were almost impossible. In another interview, participants were so ashamed of their socially unacceptable behaviour in the recording (sexual dancing), that they refused to talk about it, and continued giggling for 20 minutes. Both the users' age and the discussed subject probably caused the strong effect of the social factors.

Last but not least, we found that following a fixed group of students for a period of time can be valuable. These students often took the role of ambassador upon themselves: they shared their experiences with peers, inviting them to come and play with the interactive installation as well. In many cases, these ambassadors also acted as emergent leaders, coming up with new ways of playing while interacting in groups, in line with the findings of O'Hara, Glancy and Robertshaw (2008). Following this select group in depth gave us good insights into their play experiences over time, similar to the studies about play experiences in pervasive games by Montola, Stenros and Waern (2009).

Teenagers & public spaces

Running an evaluation study in a public context means intruding and disrupting the normal behaviour in these spaces. We observed that this is especially true when working with teenagers. Teenagers are conscious about (changes in) 'their environment': the school area is their area, and every new person or object is clearly not-normal, and will either be scrutinized or consciously ignored.

The fact that 'research is going on' spreads through the school rapidly: the presence of a new object, strange people walking through the school, or a message in the newsletter can all make students fully aware that research is happening.

We noticed that normal behaviour will change immediately, especially in the presence of peers. We observed on numerous occasions that teenagers started dancing, jumping, waving or shouting just because they thought that they were being observed or recorded. Behaviour of teenagers will change when a study starts, independent of the influence of the newly placed interactive design; this can be seen as a variant on the Hawthorne effect (Macefield, 2007).

In addition to this, the influence of the observer or researcher on the users (variant of the observer's paradox (Labov, 1972)) is extra strong for teenagers, because social interaction and identity plays such an important role. We have noticed huge differences in responses, attitudes and behaviour of teenagers depending on the researcher. The gender, age and even style of clothing of the researcher influenced the results: a 39-year old researcher got different responses than a 27-year old one (the former "might be a teacher!"), and semi-formal clothing resulted in us being ignored, while shorts invited shouts about "you don't belong here! what are you doing here?".

There is not much to be done about these two effects: teenagers will gossip and come up with (imaginative) explanations for changes in the school, teachers will joke about a study and tell a made-up story, and so on. We accepted that teenager behaviour was influenced by our study and ourselves, and tried to keep everything constant: we told everybody the same, both through the school's website and in response to questions, the same researchers were present every week, the same type of clothes, etc. To us, the value of evaluating in a real-life school environment was more important than fully controlled evaluation conditions.

Ethical issues must be discussed and approved before evaluating with teenagers in public spaces. This type of research involves an ethical issue: one can argue that it is unethical to let teenagers participate in a study without them knowing it beforehand, or without their permission. We were aware of this, but also faced a trade-off: if we told the users in advance what we were looking for, then we could no longer study the initial explorative behaviour.

We have solved this issue in three ways: first of all, we have always informed the parents and teenagers that a study and video observation were being performed, but we did not tell them the full details of our evaluation goals. For example, we communicated that we were evaluating a new playful installation in order to see if it remained functional and if teenagers enjoyed playing with it. This way, teenagers and parents could decide whether or not to play with the installation, and thus if they wanted to participate in the study.

Second, the study protocols were always discussed beforehand with the teachers and managers of the schools, and executed under direct supervision of the schools' staff.

Thirdly, our studies had a low intrusive level: we placed an enjoyable installation in a school, and teenagers themselves could decide whether to play or not. This is similar to

the solution of Montola, Stenros and Waern (2009) in pervasive games in public spaces: if a situation can be easily identified as play, then it should be easy enough for bystanders to accept or refuse an invitation to play. Stenros, Waern and Montola (2011) present several sources that discuss this ethical challenge as well, stressing the importance of carefully considering the bystander experience and the ethics of social expansion in public play.

For covert observations, we informed the students and parents using the channels explained above; for all other methods, such as interviews or diary studies, normal permission of the parents and teenagers was requested using consent forms.

We feel that this setup covered the ethical issues for this kind of research, and we have received agreement from the parents, teachers and management of seven different high schools.

Teenagers in a school environment are subject to many external factors that will influence their behaviour and the encounter experience. This can be the weather, upcoming holidays, a recent television show, hypes like 'Gangnam style', but also events like soccer tournaments or fights in the school.

All these factors can and will change the behaviour of teenagers on a certain day. To perform design research with teenagers, one has to accept that teenagers will be influenced by these external factors and that these influences will change over time. Evaluation and analysis can better be done from a holistic perspective, instead of trying to compare behaviour or evaluations in a traditional way.

Public spaces

An issue that is especially prominent in public spaces is safety. Running a study in a public space, whether it is an informal exploration or a long-term evaluation, means dealing with stakeholder safety issues. *Safety, both direct and because of the changes a design causes, should always be the most important consideration*.

In the Wiggle the Eye case for example, the installation naturally had to be safe to use for all sorts of players and actions. Apart from this, the school managers were worried that a modern-looking lamp at their schoolyard might attract vandals, that an installation might cause delays and blockades, and so on: all sort of safety issues that have to be considered before evaluating in public spaces.

Montola, Stenros and Waern (2009) discuss similar safety issues for evaluating pervasive games and the extreme case of a joyful art installation that was interpreted as a terrorist attack by officials.

Besides protecting the users and the evaluation environment, it is important to protect the installation and study equipment from intended and unintended damaging actions by users, without constraining the freedom of play too much.

The strategy we used to handle these public context issues was through communication and iteration. In every situation, we communicated extensively with all stakeholders before, during and after an evaluation. Wherever possible, we worked in iterations, starting with a short and small evaluation to explore all possible hindrances, conflicts and stakeholders.

Public spaces & free play

It can be difficult to evaluate new designs in public spaces, since public spaces require more robust prototypes. A strategy we used to solve this was to *evaluate an early version of a prototype at an exhibition or event*, such as the Dutch Technology Week or the University's open house. While not a formal study, such evaluations allow single-day setups that bring hundreds or thousands of players, in varying social contexts. This results in many first-time encounters and different types of exploration, interaction and play. Users can be informally interviewed, and also listening to what players tell their peers can give good insights in their experiences. This approach is similar to the approach of the ChiCi group ('Child Computer Interaction Group', 2014), the evaluations at Roskilde by Hobye (2014), and work by other scholars in the HCI community.

Evaluations should allow for the open nature of free play. Free play is creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players. As such, it is hard to predict what type of play will occur in an evaluation; and constraining play sessions will hamper or at least alter the free play experience.

This freedom can present challenges for evaluation: the duration of play sessions could vary between a few seconds to several minutes depending on the actions of the players, sessions can merge while players change, and so on.

An example is a study, executed by psychologists from another university (University of Amsterdam) that used the Walk of Fame installation. In this study, teenagers were asked to play for exactly five minutes in a secluded area, in an attempt to control most of the conditions. The play that occurred in this situation was different than free play in public contexts, as the flow of play and participants was constrained. As a result, by changing the play setting to improve the evaluation conditions, another type of play was elicited and consequently evaluated. This is not always bad, but it should be taken into account when setting up an evaluation, as it does strongly influence the results.

This challenge does concur with two central challenges for the evaluation of pervasive games, as posed by Stenros, Waern and Montola (2011): "the play activity is governed by more than just rules and goals" and "studying games on the move is difficult". They too discuss the challenges and importance of evaluating play that can and should evolve through a play session.

Give suitable instructions, if any, to participants when evaluating free play. A challenge is the assignment that is given to participants when evaluating free play in a controlled setup. Should participants receive the assignment to play, or to discover what they can do with the installation? Every assignment will influence the exploration process, and thus the play experience; picking a suitable assignment can be a difficult task, as we also experienced in a previous study on social play during festivals (Boerdonk, Tieben, Klooster & Hoven, 2009).

Instructions or tasks can force participants to focus solely on one aspect of a design to the exclusion of playful exploration, as also observed by Barendregt, Bekker and Speerstra (2003). No instructions at all, on the other hand, can lead to shallow exploration when the users never discover the 'right' way of interacting, as we saw in the Wiggle the Eye case.

Conclusion

In this section, we explained that evaluation methods and approaches have to be adapted for teenagers, public spaces and playful experiences - and especially for the combination of these three fields. Evaluation methods for teenagers can neither be too childish nor too complex, need to fit into their daily life, and the disruption and intrusion a study will cause must be taken into account. Evaluating in public spaces means dealing with many (uncontrollable) influential factors, that make every experience unique. Evaluating free play requires freedom in the play environment, which can complicate evaluation setups.

This methodological design knowledge is especially relevant for design researchers who are also working with free play, teenagers and public spaces. The lessons learned, however, are also useful for everyone who evaluates either free play, teenagers or in public spaces, as the lessons and strategies can help to prevent some of the less successful decisions that we made.

6.2.4 Reflection and future work

In this section we want to briefly reflect on the results at the end of the four design research cycles and this thesis. Throughout this project, we have successfully elicited free play, with many users, in many contexts, and with many manifestations of free play. We have seen free play that continually evolved through the actions of the players, spectators and bystanders, creating ever changing play experiences.

These moments of play have occurred many times, throughout the day and over a period of several weeks. A future challenge, however, is the continuation of these playful interactions. How do we design for play that occurs day after day for months or even years? Do we even want that in the first place, or should we aim to stimulate different types of playful behaviour? Can we stimulate people to adapt a more playful and creative lifestyle?

To solve these kind of challenges, more design and research is needed in multi-disciplinary solution spaces. Solutions could be found in the domain of pervasive games for example, and in the design for ambient play: play that can happen at every moment, and every location, as part of the lifestyle and culture of the players. Another possibility could be moving towards endless cycles of co-design between teenagers, schools and designers, so that the users themselves can create solutions that keep motivating them time after time. One can even imagine an ambient playful city, where the environment actively elicits social and active play, driven by the actions of the citizens.

Explorations in this area are happening around the world, but there are still many questions to be answered - through iterations of design and evaluation.

We are currently applying the design knowledge from this thesis to new projects on academic and commercial levels, and exploring future design research directions simultaneously. One example is a commercial project about motivating sport participation: we are using the layers of play framework to design public interventions that motivate teenagers to start participating in several sports.

The design knowledge in the frameworks is useful in this kind of projects, to inspire and guide the design process and design decisions. The format and contents of the frameworks can still be further developed to optimally support these commercial or industrial audiences (e.g. entrepreneurs or sport associations), and other target groups, goals and contexts.

Another project we are working on combines design research and commercial goals, and we aim to launch a spin-off company for the swimgames projects, while simultaneously studying how to improve the swim experience on an educational, sport and recreational level. For this, we use the free play design vision, the frameworks and the many interactive examples. This commercial context brings a whole new set of challenges, varying from communication of the benefits of free play to validating the durability of this type of solutions over time.

Last but not least, the insights, examples and frameworks from this thesis have been used by us as tools in workshops, presentations, coaching and consultancy about a range of topics, in both the academic and commercial world.

Overall, we feel we have made a good first step in developing and sharing our free play design vision. Several schools, swimming pools and museums have been immersed in our vision; many designers, researchers and other stakeholders have learned about our approach; hundreds of students have designed using our principles, insights and vision; and last but not least, thousands of teenagers have been seduced to start playing in a creative and autonomous way, driven by their own actions and interactions - and have enjoyed a little moment of play during their day, with a smile on their face.

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Summary

Activating Play
a design research study on how to elicit playful interaction from teenagers

Playing is beneficial to people of all ages: through playful activities, people can e.g. develop skills, engage in physical activity, or improve cooperation and social interaction. The valuable qualities of play are often inherent to the playful activity; people enjoy themselves, while inherently developing skills and being physically and socially active.

The main goal of this design research project was *activating play*: learning and showing how we can stimulate physical and social play for teenagers using interactive technology in public spaces. Stimulating teenagers to engage in moments of physically and socially active play throughout the day can have many benefits, such as decreasing sedentary behaviour while increasing social interaction, creativity and autonomy.

To achieve this goal, a *design research* process has been used: an iterative process of design, evaluation and analysis. Four design research cycles were executed in this project, each building on the results of the previous cycles. In these cycles, many prototypes were designed, implemented and evaluated with teenagers in public spaces.

Three design research questions were answered through the design research cycles in this thesis:

1. *What type of social and active play is enjoyable for teenagers in daily life?*
2. *How can we recurrently elicit this type of playful activities through interactive installations in public spaces?*
3. *How can we conduct design research about such playful activities for teenagers in public spaces?*

Through the iterations, a design vision of social and active play for teenagers in daily life was developed and grounded in building blocks of design-relevant knowledge. This design vision is about *free play* that resonates with teenager's interests, activities and contexts. Free play is creative and autonomous play, without predetermined structure or meaning, that continually evolves through the actions and interactions of the players. The free play design vision, together with the interactive installations and user evaluations, answer the

first design research question.

The first three design research cycles focused on exploring, activating and designing for free play in public spaces, and resulted in a series of intermediary frameworks, design explorations and proofs-of-concept. The fourth and last design research cycle focused on free play for longer periods, and on developing and synthesising the design knowledge in a summative framework. Wiggle the Eye and Walk of Fame are high-fidelity prototypes developed in cycle four that were evaluated for periods of a month, with hundreds and respectively thousands of players. By studying these installations and the behaviour they elicited, we were able to articulate the implicit and explicit design knowledge from the design research cycles, which manifested in the *layers* and *types of free play frameworks*.

These frameworks show, together with the designed installations and evaluated moments of play, how we can recurrently elicit free play through interactive installations in public spaces: by designing for five types of free play from an encounter, attention and commitment perspective. This is the answer to design research question two. The frameworks explain how to design for free play, teenagers and public spaces, and the designs illustrate how this conceptual design knowledge can be applied to interactive installations in real life contexts.

The design research approach described in this thesis, and the methodological discussion in the last chapter, answer the third design research question.

Designing and studying playful activities for teenagers in public spaces is complex: there are numerous factors that influence the actions and experience of the players, and most of these factors are outside the designer's control. In these complex situations, one can only design for a specific experience: the actual experience emerges from the interaction of the players with the installation, the context, other players, etc.

Only by iteratively exploring, experimenting and studying many designs and evaluations from a holistic perspective can one gather intermediary design knowledge, which can inform future design iterations and can eventually lead to new theory. Evaluation methods and approaches have to be adapted for teenagers, public spaces and playful experiences - and especially for the combination of these three fields.

Many prototypes were designed, developed and evaluated in this design research project. The *Swimgames* projects for example are interactive games in the swimming pool that show how active and negotiative play can be elicited. *The Photo Vault* is an interactive photo cabinet where funny pictures can be taken if players find the secret code, stimulating communicative and explorative play. *Wiggle the Eye* transforms a schoolyard into a social and active sitting area through interactive seats and a streetlight. *Walk of Fame* elicits performative and communicative play by projecting and recomposing expressive actions in a corridor of a school. These designs are an integral part of this thesis: they illustrate and embody the design knowledge of the frameworks, communicate the free play design vision, and serve as proofs-of-concept.

The combination of the designs and design knowledge is the main contribution of this thesis. Together, they explain and illustrate how we can stimulate physical and social play for teenagers using interactive technology in public spaces.

Addendum: the website playfulll.com hosts a 'gallery of playful moments', which presents sixteen designs in depth through photos, videos and annotations.

List of publications

The following articles have been published during this design research project.

Journal articles

Tieben, R., Sturm, J., Bekker, M.M., and Schouten, B.A.M. (2014). 'Playful Persuasion: designing for ambient playful interactions in public spaces'. In: *Journal of Ambient Intelligence and Smart Environments*, 6.4, pp. 341-357.

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Workshop papers, demos and abstracts

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Tieben, R., Sluis-Thiescheffer, W., Sturm, J., Bekker, M.M. and Schouten, B.A.M. (2014). 'Playful (inter)action: teenagers, high schools and six playful designs'. Demo paper for *IDC 2014*.

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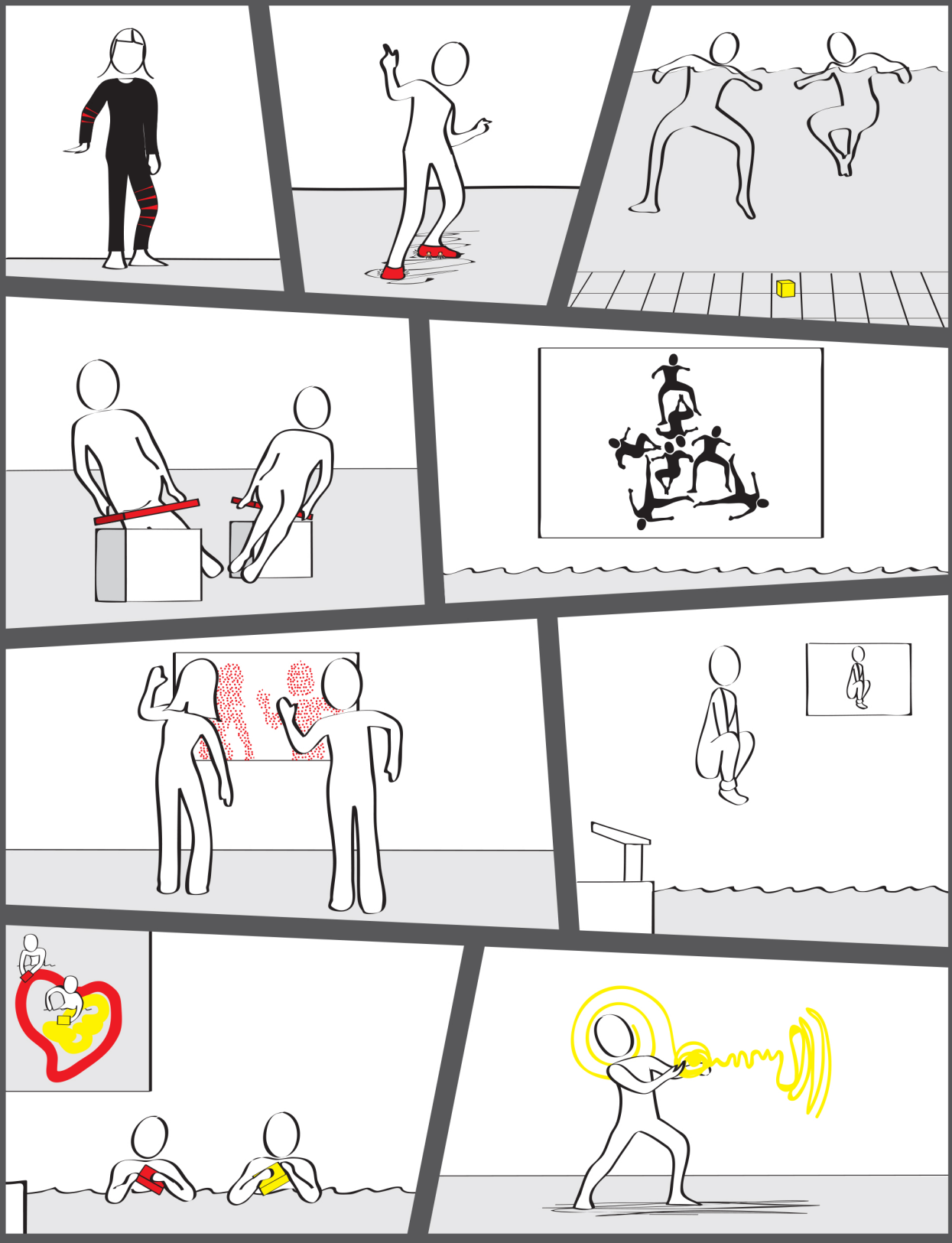
Biography

Rob Tieben (1986) creates playful interactions in the fields of design, research and innovation. In both his education as M.Sc. in Industrial Design, and his PhD, Rob focused on activating play through interactive technology. He uses curiosity, play and social interaction to elicit people to change their behaviour for the better, while they play and enjoy themselves.

Rob's interactive systems activate play in public contexts for various target groups. His designs have been used by thousands of teenagers, children, sporters and curious people in schools, museums, cities, festivals, sport centres and swimming pools. Various scientific publications explain the theories and frameworks behind the designs, to ground his design vision and to help fellow designers and researchers.



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