Abstract. This article describes how to design for ambient playful interactions in public spaces, using interactive technology. Ten explorative design cases are presented, all interactive installations with the goal to elicit playful active behavior from teenagers. Following this, we derive three design values, based on literature, user research and the insights from the design cases. These design values describe our best practices for eliciting intrinsically motivating playful interactions: eliciting and seducing passers-by to become players, designing for emergent play to create personalized and changing play, and resonating with users’ values, emotions and activities. In addition, insights gained from the cases and evaluations are discussed, and recommendations for implementing playful interactions in public spaces are given.

Keywords: Playful interactions, persuasive technology, design research, user evaluations, teenagers

1. Introduction

Recent studies indicate that teenagers in most western countries are not physically active enough [7,11,29]. Sedentary lifestyle seems to be a cause for this [23]; teenagers sit during classes, in their lunch break, and often at home behind a computer or television [7,33]. Many existing interventions try to tackle this problem, mostly by propagating a more physically active lifestyle, and by motivating sport participation [29].

In the PlayFit project [27,34], we aim to complement these existing interventions by reducing the number of sedentary moments throughout the day, especially in and around school. We attempt to do this by creating moments of social and physical play, with inherent moderate-intense physical activity (‘casual activity’). We focus on stimulating play: we believe that curious, enthusiastic players involved in enjoyable and explorative bodily play are physically active as an inherent side effect. We use interactive technology to elicit these playful moments that should happen day after day, throughout the day.

This technology has to fit in the context, should allow personalized and adapted play, and should invite and anticipate new playing styles. We call this ‘ambient play’.

In this article, we will present our insights on ‘how to design for ambient playful interactions in public spaces’. These insights are based on ten design cases, interactive installations that have been in situ evaluated with teenagers.

In order to stimulate ambient play, we combine best practices from fields such as human-computer interaction, serious gaming and psychology. We will now briefly define and describe these different fields; in the related work section, we will present our design vision based on examples from these fields.

Persuasive technology. Technology that is designed to change, reinforce or shape attitudes or behaviors of the users through persuasion and social influence, but not through coercion or deception [13,26]. Many interventions for changing behavior are developed and studied in this expertise area; principles, theories and best practices have informed our vision and designs.
Situated action Users’ actions are influenced by the situation, and will likely differ from situation to situation [35]. Mandatory to keep in mind when designing interventions, especially for semi-public spaces: the material and social conditions of a situation influence the user’s actions.

Serious games and exergames Serious games are games that have an explicit and carefully thought-through additional purpose [1], where entertainment is used to achieve goals such as training, education, or health. Exergames or exertion games are types of serious games with input mechanisms that use physical exertion, where the outcome of the game is determined by physical activity [24]. We focus on successful mechanisms and dynamics from games, and on success and failure factors for serious and exergames.

Playful interactions Interacting in a playful way in order to elicit explorative, social and enjoyable behavior [5]. Our research group is experienced in designing playful interactions: we focus on questions such as how can we invite users to act in a playful way, and how can we use this playfulness to achieve secondary goals?

Intrinsic and extrinsic motivation Intrinsic motivation refers to doing an activity for the inherent satisfaction of the activity itself, while extrinsic motivation refers to the performing of an activity in order to attain some separable outcome [30]. Theories like the Self-Determination Theory [30] help us to understand factors that influence these types of motivation.

1.1. Playful persuasion

We combine insights from these fields into playful persuasion: we persuade teenagers to participate in playful activities, using engaging elements from play and games. We envision a solution where teenagers play throughout the day, and where these playful moments of casual activity are part of their daily life, and even become part of their culture. Our ultimate design goal is to create a set of installations that motivate teenagers to play day after day; this goal is directly linked to our main research question of how to design for recurrent playful persuasion.

In order to answer our research question, we work in iterations. We start with a design vision for creating recurrent playful moments, based on related work and theory in the before-mentioned fields. Then, we explore how to design for this vision, by creating interactive prototypes. These prototypes are evaluated with users in school contexts; we then use the insights from these evaluations to improve our design vision, and the cycle starts again. Eventually, we formulate design values: core principles of designing for recurrent play.

Although our ultimate goal is to create recurrent play, we started by focusing on eliciting play on first encounters: after all, we need to succeed in eliciting playful activity on the first encounter, if we want to eventually achieve recurrent play. The type of play we design for, matches our design vision of recurrent play: so although we have not evaluated recurrent play extensively, we do evaluate if the play that occurred matches our design vision, and thus our expectations for recurrent motivation to play. In situ evaluations are necessary, as playful behavior is hard to predict due to the inherent personalized nature of play.

In this article we present our design strategy, based on theory and related work, followed by ten design cases where we explored the translation of this vision into prototypes. We derived three design values for playful persuasion from these case studies: powerful mechanisms that seem promising for designing for recurrent play. Finally, we will end with more general lessons and a discussion about playful persuasion.

2. Related work

Our goal is to create playful persuasion: persuading teenagers to participate in playful activities, using engaging elements from play and games. For this, we look at related work from various design and research fields. In this section, we present some well-known examples, the insights we gained from them, and explain our design vision for creating recurrent playful moments.

Starting at the persuasion side, with persuasive technology, we want to describe four examples for persuasive behavioral change. First, a pedometer; a small device that counts your steps, encouraging users to reach a certain amount of steps per day [45]. Second is an exercise bike that allows preset tracks or distances to be cycled, encouraging the user to prolong the exercise through these challenges. Third are applications such as nike+iPod, which allow users to track, visualize, and share their running results, motivating regular and increased exercising [3]. Last are websites like HealthMonth, which coaches users to reach their behavior or nutrition goals, by providing hints, reminders, daily rewards, and social comparison [18].
These examples give us three insights into persuasive technology that are especially useful for our approach. First of all, the pedometer and exercise bike let users focus on the goal of getting enough steps for that day, or on completing the next challenge while cycling, instead of on the larger and tedious goal of being physically active. Thus, they make the target behavior easier, help to restructure it in steps or segments, and transform the goal by shifting the user’s attention to other aspects. Fogg, in his analysis of how persuasive technologies can function, describes this type as tools [13,26]. A second type in his classification is media; persuasive technology can help users to keep moving towards their goal or target behavior through elements such as rewards, reminders, interactivity and narratives. A good example of this is HealthMonth, which reminds and triggers the users time after time to work on their goals. Third, Nike+iPod encourages users to share their accomplishments with friends, and helps them to compare at the same time. This kind of social support motivates users by leveraging social influence, such as normative influence, competition and comparison [26].

Persuasive technology focuses on motivation, ability and triggers. Even if a user is both motivated and has the ability to perform an action, then he/she still needs a trigger at the right moment to start the action [14]. In our case, the action and the trigger will occur in semi-public places: as described in the theory of situated action, the social and material conditions highly influence behavior [35]. We have seen in previous studies that teenagers behave totally different when for example a group of peers is watching [38]; it will therefore be necessary to control the social and material conditions through design, e.g. by creating a playful installation that allows and requires an audience to make the experience meaningful.

The main difference between our approach and persuasive technology is the presence or absence of a conscious goal or target behavior: most of the persuasive technology interventions are only effective when the user ‘cares’ for the target behavior or its benefits. If the user does not care about daily exercising, then the presented examples will hardly motivate. In our approach, we aim to design activities that are intrinsically motivating for the users, for example by making them enjoyable; once playing, the users will perform the targeted behavior (casual activity in our case) by accident. We motivate them to play, instead of motivating them to be physically active.

Our ultimate question is: how do we motivate users to play, time after time? For this, we look at games, serious games and playful interactions. Games are played all over the world, by many people: they are clearly motivating, time after time. Games are often played because they are enjoyable or fun. What makes things fun, or intrinsically motivating, has been studied extensively in the Self-Determination Theory [28,30]. Their research demonstrates that activities foster greater intrinsic motivation when they satisfy three fundamental human needs: the need for competence, autonomy, and relatedness. When we analyze successful games, we can indeed see many game elements that focus on competence and autonomy. Skills, challenges, and positive feedback are important for fulfilling the user’s need for competence, and to achieve a state of flow. Freedom of choice, different paths of progression and allowing individual experiences create autonomy and immersion. Cooperation, social bonds and social interaction are all contributors for the need of relatedness [9,28]. Fulfilling these needs through playing makes the game enjoyable: designing for competence, autonomy and relatedness can thus help us to create intrinsic motivation.

Serious games and in specific exergames seem to have a lot in common with our goal: these types of games are used to engage players in enjoyable play, while achieving a goal such as physical activity at the same time. Some examples are: exercise bikes such as High Cycle [4] or Cyber Exercycle [8] connect the activity of cycling to game actions – cycling forward results in going forward in the game; Dance Dance Revolution [10] is a game where players hit the arrows on a platform in a rhythmic sequence; in Just Dance [41] the players have to mimic the onscreen dancer’s movements using the Wii or Kinect, combined with their own dance moves; in Figure Running [12] the mobile phone’s GPS position is used to draw a shape on a city map while walking, cycling or running (see Fig. 1b).

Many exergames reward physical activity with points or badges, or require activity before a game can be played or continued: exerbikes are a clear example of ‘doing the activity, before you get a reward’. The focus in these types of exergames is almost solely on extrinsic motivation, which might be a reason why none of these games have become popular. Popular exergames do seem to make the activity itself intrinsically motivating: e.g. the skill development required for the challenges in Dance Dance Revolution, and the personal freedom between dance moves in Just Dance, fulfill the needs for competence and autonomy very well, and make dancing enjoyable for the players. Figure Running is another
good example that focuses on making the activity itself intrinsically motivating, instead of just the result: players can draw a shape on the map while moving through the real world, creating all sorts of enjoyable challenges during the exercise (e.g. what if you want to go left in your drawing, but there is a wall in the real world?). These examples show us the importance of designing an activity that is intrinsically motivating, focusing on competence, autonomy and relatedness.

2.1. Playful persuasion

Playful persuasion is a combination of persuasive technology and games. The Piano Stairs [37] is one of the best-known examples of playful persuasion: an interactive staircase that looks and sounds like a huge piano, which motivates commuters to take the stairs instead of the escalator (see Fig. 1a). Bogost’s persuasive games [6] approach this field from the side of games, while Hassenzahl [17] looks at it from a perspective of experience design. Gaver [16] uses principles such as ambiguity to create playful or open-ended design. In our own research group, we focus on playful interactions [5]: we design interactions that elicit explorative, social and enjoyable behavior in a playful way. The novelty in our work is the open-endedness: play is not governed by rules or win conditions, but the players themselves have to decide how to play. This again is closely related to Korhonen’s [21] framework of playful experiences, and Lucero’s work [22] of PLEX. In all these examples of playful persuasion we see the importance of making the activity intrinsically motivating: whether you want social play or physical play, the activity itself should be enjoyable – if you want to strongly motivate your users.

We believe that designing for intrinsically motivated play can lead to recurrent engagement with our installations. The above examples have given us first insights in how this could be done; in the remainder of this article, we describe our explorations and evaluations in designing for intrinsically motivated playful activities.

3. Design research process

In our design research, we want to know how to design for playful interactions in and around high-schools. We develop interactive installations that should elicit casual active behavior, and evaluate them in situ at high-schools. In our evaluations, we are primarily interested in a. whether our installations elicit the aimed-for behavior (casual active play) and b. how our design decisions elicit this behavior. Especially the second part is interesting but difficult to answer: since playful behavior at high schools is
caused and influenced by many factors, it is meaningless to look at one specific design element in isolation, since all design elements together create the interaction. Therefore, we use a holistic approach where we evaluate the design as a whole [32,44].

We follow a design research approach: iterations of prototypes are evaluated in context, which leads to rich, qualitative and situational insights [19]. By applying these insights to other prototypes, we try to formulate more general conclusions such as design guidelines and principles [20]. In our process, we work with iterations of prototypes and evaluations. Common to all these prototypes are design values, core principles of our design vision that are based on literature review, user research and design explorations. Through the evaluations, we try to gain a deeper understanding about designing for these design values.

Concretely, this means that we started designing interactive prototypes that fit into our design vision: we tried to elicit intrinsically motivated playful activity. We have evaluated these prototypes on first encounters: although our ultimate goal is to elicit recurrent play, we first need to know if we can create intrinsically motivated play on first encounters. Following this, we have evaluated all prototypes, focusing on the type of play that occurs, and the design elements that seemed to cause this. Finally, we have derived three design values from these evaluations: values that have proven powerful for eliciting intrinsically motivated play on first encounters, and that seem powerful for recurrent play as well, based on literature.

4. Design cases

In this section, we present ten design cases: interactive prototypes that have been developed in order to elicit intrinsically motivated playful activity. This is a just a selection of the explorations that we have done: in the past years, we have explored and studied our design space from different angles. We have supervised dozens of students in projects about playful persuasion for teenagers, over a hundred students have participated in game design competitions about public play, we have developed activity games for the swimming pool, and we have developed several installations ourselves [15,36].

Every design case has been evaluated in situ with teenagers; these evaluations were usually informal, and for a short duration – one-time only up to a full day. This sort of evaluations is necessary when designing for play: play is inherently personalized and social. It is impossible to predict how users will play with an installation, especially the kind of open installations that we design. Not only does evaluating them give us valuable insights about how the installation elicits play, it also teaches us many things about the type of play, social negotiations, and personalized activities that occur during exploration and playing. Last but not least, we need to know if an installation is enjoyable and achieves its goals, before we can successfully do a formal user evaluation. Summarized, the evaluations provide us with new inspiration and ideas, they allow us to evaluate the success of our installations, and they help to deepen our insights into playful behavior.

We describe the first two design cases in full detail; the other eight are summarized to save space while still providing a proper insight in the case.

4.1. Design case 1: Bomb It! [a] Figure 2

4.1.1. Scenario

Tom and Frank encounter a camera and a projector on the edge of the swimming pool. They quickly realize that the camera records their jumps into the water, and that the last four jumps are simultaneously projected on the wall. Tom jumps into the water, trying to create as large a splash as possible, immediately followed by Frank. Reviewing their jumps on the projection, they decide that it was a tie, and quickly climb out of the pool to try again. A bit later, Jose and Sandra join the boys; now, they try to make the perfect somersault – jumping, chatting and swimming in the same playful activity.

Physical activity: swimming, jumping, diving, climbing, walking

Fig. 2. Bomb It. Jumps, bombs and dives in the swimming pool can be reviewed on a large display.
**Playful activity:** competition, challenge, exploration, expression, personalization, cooperation, social interaction

4.1.2. **Design**

The installation consists of a camera and a projector on the edge of the swimming pool. The visibility of the camera and the repeating of previous jumps invites users to try it themselves. When users are already playing, the visibility of the action, the projection and the direct feedback creates social curiosity that seduces other users to join. The installation displays the last four jumps simultaneously; while a user could play individually, this comparison invites other players and social play. Players can compare their jumps, try to mimic each other and so on. Furthermore, the installation does not provide any further guidance, nor score, rules, requirements or levels. This stimulates creativity: players can explore and review different jumps, or they can negotiate goals and rules in order to create their own game(play). The playful interaction is open-ended: the players can decide while playing what the goals, rules and measurement of success are.

The installation allows users to record and review their own actions and those of others. It also enables spectators to watch the playful interaction without participating themselves. The public setting of the installation invites the giving of feedback on other user’s jumps, and stimulates discussion among the players and spectators. The installation elicits social interaction, exploration, expression and personalization: players can play, jump, act and chat as they wish.

4.1.3. **Evaluation**

In an informal user evaluation (n = 15) in the swimming pool, we observed and evaluated the playful behavior that occurred with the Bomb It installation. Three groups of teenagers were invited to play with the Bomb It installation for 10 minutes each, after which they continued to other prototypes. In general, the installation evoked playful, social and active behavior: teenagers hurried from pool to display to the diving spots, trying different jumps and watching themselves and peers, on the display and in reality.

Users were curious about the installation, once the first users started playing: they saw their friends jumping into the water, and were eager to try it themselves. Goals, rules and new ways of playing immediately emerged during the user evaluations: boys focused mostly on the biggest splash, while girls tried to make special jumps like pirouettes. These goals changed rapidly, creating new challenges and enjoyment throughout the playing sessions.

Social interaction between players and spectators, feedback, comments and expressive actions happened during and after the evaluation. Players for example repeatedly asked if the Bomb It recordings could be uploaded to Facebook or YouTube, indicating their interest in sharing the experience with peers.

4.2. **Design case 2: Magic Mirror [b] Figure 3**

4.2.1. **Scenario**

Mohammed, Sanne and Rens 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 recognize 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; Rens 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.

**Physical activity:** waving, walking, getting up from chair, jumping

**Playful activity:** exploration, expression, social interaction, sharing, broadcasting, observing

4.2.2. **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.

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 movements themselves.

4.2.3. 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 3 m of camera: 46). We installed the mirror early in the morning, and observed the hall for three subsequent breaks. 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 installation and the facilitated play resonated strongly with the user group. The playful activity revolved around watching each other and giving feedback, but also around the strong personalization, exploration, expression and social interaction that occurred. This all motivated the students to join and play in their own way.
4.3. Design case 3: Photo Vault [c] Figure 4

4.3.1. Design

The Photo Vault [40] 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 the 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 for the present day are displayed on an external display somewhere else in the school. The code and the video effect stay the same for one day, and change each day.

4.3.2. Evaluation

The Photo Vault was installed and evaluated at a high school during one full week. In those five days, around 1500 (not unique) players played with the Photo Vault, making roughly 2300 photos together. On all days, except the first day, 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.

Users were curious every day about the new secret code and video effect. Play revolved around creativity in posing, social interaction, and users trying to mimic each other’s poses. The users were mostly observing each other, showing off and giving feedback to each other.

4.4. Design case 4: Curious-action [d] Figure 5

4.4.1. Design

Curious-action [38] is an installation of five interactive speakers in a corridor, that detect the actions of passers-by, and respond with sound output: the way in which students walk through a corridor, and the actions they perform, trigger various sound samples from the speakers on the wall. Several interaction scenarios were implemented, all aiming to make the users curious and let them walk back through the corridor. In one implementation, the speakers responded with spoken numbers: when someone walked through the corridor, the first speaker would say ‘One!’, the second speaker ‘Two!’, and the third speaker ‘Four!’.

Fig. 4. The Vault. Players can take funny pictures of themselves if they successfully crack the secret code.
4.4.2. Evaluation

Curious-action was installed in a corridor in a vocational school, and evaluated for five subsequent days. On average, every day 25 students would pass the system 2–4 times. Users were curious on the first encounter, often walking back to explore what was happening. After this first encounter, we observed different types of playful and explorative behavior.

This study focused on curiosity: we implemented and studied different mechanisms for curiosity, such as mismatch of expectations and novelty. Limited play occurred, mostly social interaction while groups of users were playing with the installation.

4.5. Design case 5: Photo Drop [e] Figure 6

4.5.1. Design

Photo Drop 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.

4.5.2. Evaluation

Photo Drop, as well as the two games we describe next (Treasure Race and Waterdraw), were evaluated in several iterations with students from our ICT department. 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 Photo Drop 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.

4.6. Design case 6: Treasure Race [f] Figure 7

4.6.1. Design

Treasure Race is a game for the swimming pool, using floating objects, a display, and RFID readers. Players have to scan and find the object with the hidden treasure, and can compete in teams in a treasure hunt race.

4.6.2. Evaluation

In the evaluation, the gameplay mainly revolved around different strategies to win; competition and cooperation emerged in various shapes. Type 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 type of play varied between groups of players: some liked competition and speed, whereas others played in a slower pace.

4.7. Design case 7: Waterdraw [g] Figure 8

4.7.1. Design

Waterdraw is another game for the swimming pool, where players can virtually paint on a display. Players swim around with colored blocks, and are recorded via a top-side camera. Every object virtually paints with a specific color, and the system also responds to other colored 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 your color.

4.7.2. Evaluation

The observed play in the evaluation was creative and social: players used all sort of colored objects to draw, blocking each other or cooperating. Rules and goals were implemented, and changed, while playing. Players created drawings, and shared them with others.

4.8. Design case 8: Teaseat [h] Figure 9

4.8.1. Design

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. The goal of Teaseat was to elicit active social play during the lunch break, such as teasing and flirting between seated users.

4.8.2. Evaluation

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
connected to the users’ life: it fit into the users’ normal lunch break activities, and the users enjoyed the active sitting, teasing and the social interaction.

4.9. Design case 9: LightScribe [i] Figure 10

4.9.1. Design

LightScribe is a mobile application that allows users to scribe with light. The camera records with a slower shutter speed, resulting in a photo where only the movement of light sources are visible. Users can create forms, shapes and words by moving a light source around.

4.9.2. Evaluation

LightScribe was informally evaluated with five teenagers, and with 10–20 visitors at a student’s exhibition. Users enjoyed the freedom, creativity and self-expression. They engaged in different types of cooperative drawing. Play was very creative in this game, due to the freedom and expressive nature of the activity: users made their own goals while learning from each other. Discussing and showing off the results, and sharing this with others, were popular activities for the target group.

4.10. Design case 10: Whisperballs [j] Figure 11

4.10.1. Design

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.

4.10.2. Evaluation

The Whisperballs were informally evaluated in an office setting, and with five teenagers at a high school. Playing with the balls was not enjoyable according to the users. The objects were not visible and public enough: most users simply ignored the balls. In addition, when a recording was made, it contained insults or funny sounds most of the time. This medium or this implementation was apparently not suited for the teenagers’ interests.

5. Design values

After performing all design explorations and evaluations, we attempted to synthesize our design insights by analyzing all the cases. We found similar principles and mechanism across most of the cases; we then mapped these principles and mechanisms to findings from literature and user research, and eventually managed to derive three design values that are pivotal in designing for playful persuasion. The first design value is to elicit and seduce playful interactions. The second design value is based on designing for emergent play. The third design value focuses on creating playful activities that resonate with values, emotions and activities. These values are grouped ‘best practices’: our understanding, and our advice, of how to design for intrinsically motivated play. We
have only evaluated these values on short-term play, but we believe that they will also be useful for motivating long-term play. In future work, we will evaluate whether and how these values elicit recurrent playful behavior.

5.1. Design value: Elicit and seduce

This design value revolves around the quality that our installations elicit and seduce 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 comes from the Latin definition “drawn out by trickery or magic” [25]; seducing comes from Anderson’s seductive interaction design – “the process of deliberately enticing a person to engage in some sort of behavior” [2]. 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 [38]. Installing a novel installation in a school can already be a good starting point to elicit and seduce with. Scaffolding [43], gradually increasing the users’ knowledge or the interaction possibilities and ambiguity [16] in interaction 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 - 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 current players influences whether other passers-by start playing (e.g. if the ‘losers’ of the school are playing, then other students might decide not to join).

5.2. Design value: 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. An example from childhood play is a child playing with a stick: one minute, it is a sword, then a wand, or a walking stick. The play emerges in the interaction with the object and the other players; the players decide how and what to play.

Emergent play is “play that is not defined beforehand, but that evolves as a result of interaction” [42]. 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 [5]. The playful activities we 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’s “system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome” [31]. Instead, we design open-ended playful interactions, where players themselves can create rules and win conditions, if any. Related to this is our focus on social interaction; the playful activities get value, 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.
5.3. Design value: 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: for Dutch teenagers for example, it is unacceptable to look sweaty in public. Designing a playful installation that requires intense physical activity would therefore be a misfit, and would likely be unsuccessful 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 [39]: exploration, social interaction, personalization and expression. This can be seen in popular products 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 these 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’; this sitting and watching could be made to resonate by creating interactive seating elements that allow teasing and flirting through physical actions.

6. Valuable lessons

We have learned valuable lessons about playful persuasion, the design values, implementation and public play in our design explorations and evaluations. While these lessons apply mostly to our context and target group, they are also generalizable to other settings. In addition, although our evaluations have only focused on short-term play, we think that these lessons will also be useful for longer-term engagement: they help to create intrinsically motivating play, which is important for recurrent play. In this section, we will briefly discuss those lessons and insights.

6.1. Elicit & 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 will likely share this with others. A different way of launching is letting the users encounter and explore the installation by themselves. This allows the users to give their meaning to the installation, and lets action and interaction emerge. Advantage here is that the exploration phase is prolonged, and that users can develop their personalized way of interacting with the installation. A risk is that users might never discover the proper way of interacting.

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.

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 elicited 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.
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.

6.2. Emergent play

It is vital to design for pure open-ended gameplay, if the goal is 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 behavior. Incorporating rewards in the installation, such as giving a score, is destructive to this creative behavior: it restricts play to competition, invites rigid rules and limits exploration beyond getting the rewards.

**Design for social play, social rules, social goals and social negotiation.** If social play should emerge, 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 grieving (e.g. players who intentionally harass other players) and socially unacceptable behavior should be limited by reducing the duration of the result of a user’s action.

**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.

6.3. Resonate with values, emotions and activities

**Connect to normal behavior,** 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 behavior, 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 behavior for one step, doing one tiny interaction, or letting them make one change to the installation’s state. In addition, user’s normal behavior 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 behavior, and let it resonate.

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.

7. Discussion

Through our playful installations, we attempt to reduce the amount of sedentary moments. We realize that we will not solve the lack of physical activity problem with this solution alone, nor do we aim to: we want to complement existing interventions. In addition, our insights into motivation, persuasion and play can aid other interventions.

Our primary goal is to gain a better understanding of playful persuasion, on both a design and research level. Our choice for a specific behavioral target and user group allows us to reach depth, but also gives us results on different layers of generalizability. Some of our insights are target group and context specific, such as the importance of self-expression. Other insights, such as the design values, can be applied to
other cases; in fact, we have been advocating and applying our design values in projects about elderly, office employees, festivals, and so on.

The strength of this work is that all our prototypes and installations are evaluated in situ: users do not know that they are participating in a user evaluation; they just encounter something new and start exploring. This allows us to evaluate first encounters and explorations. More important, this often causes social exploration: passers-by start talking and discussing while exploring the installation, which leads to social interaction and emergent play. A downside of this type of evaluations is that we have to be more creative in our research methods; for example, as soon as we interview users, the knowledge that the installation is part of a study rapidly spreads through the community, influencing the exploration and playing styles.

In addition, this sort of research involves an ethical issue: one can argue that it is unethical to let teenagers participate in a study without them knowing it, or their permission. We are aware of this, and partly agree, but also face a trade-off: if we tell the users in advance what we are looking for, then we can no longer study the ‘real’ behavior. We solve this issue in three ways: first of all, we always inform the parents and the teenagers that a study and video observation are being performed, but we do not tell them the full details of our focus. For example, we communicate that we are evaluating a new playful installation, in order to see if it remains functional and if teenagers enjoy playing with it. This way, teenagers and parents can decide whether or not to play with the installation, and thus if they want to participate in the study. After the study, we inform all teenagers and parents about the secondary goals of the study, and the findings; teenagers and parents can always indicate if they want to be removed from the results. Second, the study protocol is discussed on beforehand with the teachers and managers of the school, and executed under supervision of the school’s staff. Thirdly, our studies have a low intrusive level: we place an enjoyable installation in the school, and teenagers themselves can decide whether to play or not. Our methods mostly consist of covert observations and group interviews with teenagers.

We feel that this setup covers the ethical issues for this kind of research, and we have until now only received agreement from the parents and teachers of six different high schools.

In our project, we still face a major challenge: our installations seem to be effective for a day or two, but how do they fare in the longer term, both on a design and evaluation level. Design-wise, we envision two possible approaches. We could design a (group of) installations that remains enjoyable over a longer period of time – be it through personalization, progression, complexity, and so on. Another approach would be to implement many installations and variations that are only interesting for a few days or a week; after this period, they would be replaced by others, introducing another novel installation in the school context. We see advantages and downsides to both approaches; in the coming year, we will try them both. We predict that our final solution will be somewhere in-between the two approaches. Evaluation-wise, we face the question of how to evaluate and measure: when is our approach successful? When the majority of the students are playing during their lunch break? When they burn enough calories? When there is no more obesity? And, how do we measure those effects? Or, should we be satisfied with design insights from observations, without long-term effects? These questions need to be answered, through design, just as much as the design questions themselves.

Playful persuasion is an approach that utilizes insights and methods from many expertise fields. This multi-disciplinary quality makes it hard to define, but also gives it its strength: the combination of all those insights, integrated in a coherent design process, allow us to maximize the success of our installations. We feel that cooperation between disciplines such as gaming, social sciences and technology is mandatory if we want to tackle the problems and opportunities of the modern age.

8. Conclusion

We have presented our vision of playful persuasion on how to design for playful interactions that influence behavior. A combination of best practices from fields such as persuasive technology, serious gaming and psychology have been combined in this design vision; ten design explorations, proof-of-concepts and in situ user evaluations have been used to translate this vision into design values and insights for implementation. We have given examples and reflect upon evaluations of these implementations in a specific context.

The combination of designing for ‘elicit & seduce’, ‘emergent play’ and ‘resonate with values, emotions and activities’ has proven to be successful on the
short term: we have elicited playful ‘casual active’ behavior in and around the school, on several occasions, on first encounters. We have not yet evaluated the longer-term attraction of our installations; however, the creative and intrinsically motivated play that occurred with our installations is promising. We are currently evaluating interactive installations, designed with our design values, in periods up to six weeks; eventually, we want to seduce school youth to adapt a playful, casual active lifestyle.

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[c] Developed by first author.