PlayFit: Designing playful activity interventions for teenagers

Janienke Sturm[1,2], Rob Tieben[1,2], Menno Deen[1,2], Tilde Bekker[1], Ben Schouten[1,2]

Fontys University of Appied Sciences, dept. ICT
P.O.Box 347
5600AH Eindhoven
The Netherlands

Eindhoven University of Technology, dept. Industrial Design
P.O.Box 513
5600MB Eindhoven
The Netherlands

{j.sturm, menno.deen, ben.schouten}@fontys.nl
{r.tieben, m.m.bekker}@tue.nl

ABSTRACT
Young people spend a large part of their day sedentary, both at school and at home. The aim of the PlayFit project is to persuade teenagers to lead a more active lifestyle by using digital as well as non-digital games and play. In this position paper, we describe in detail the three key principles of our vision concerning the design of game-based interventions for stimulating physical activity: playful persuasion, ambient action and play profiles. In our vision teenagers take part in playful activities and games throughout the day. In these activities, casual action is inherent to the fun experience, thus reducing teenagers' sedentary behavior. Relevant information about their activities and preferences is stored in a personal play profile, which affects the games they play and through which they can communicate to their peers. We illustrate this vision by means of several innovative game concepts.

Keywords
Design, activity interventions, playful persuasion, ambient gaming, play profiles

INTRODUCTION
Various statistics indicate that many teenagers do not meet the norms for healthy physical activity (Hildebrandt et al., 2008). This is caused by a complex mix of factors, among which are changes in society (Biddle et al., 2007). Changes in mobility are one of these important changes: improvements in public transport cause people to cycle less often than they did 25 years ago. Another societal change affecting the amount of physical activity is the increased availability and popularity of television and computer games. Young people spend a large part of their day sedentary, both at school and at home. According to

Proceedings of DiGRA 2011 Conference: Think Design Play.

Hendriksen et al. (2010), Dutch youth spends on average three hours of their leisure time sedentary, which is more than most elderly people (75+) do. The Dutch norm for sedentary behaviour says that people spend at most 2 hours per day sedentary (TNO, 2009).

The PlayFit project (http://www.playfitproject.nl) is a large Dutch research and development project aimed at reducing teenagers' sedentary behavior. The project focuses on providing games and other playful activities in which movement is inherent to fun, so that physical activity becomes an inherent part of the teenagers' daily life. Play and games are an essential element of our approach.

At the start of the PlayFit project we carried out several explorative studies aimed at defining the context and research questions, getting to know our prospected users and collecting best practices for activity interventions. A literature review was conducted on youth, youth behaviour, lifespan development, and leisure activities, all focused on Dutch secondary school youth. This review was complemented by several focus groups on high schools, in which daily activities and interests were discussed. Finally, an inventory was made of existing activity interventions and interactive activity games, leading to the definition of best practices. This explorative research led to several interesting insights, which shaped our view on the design of an activity intervention on the basis of gaming. First of all, many activity interventions for this age group focus on providing information and creating awareness (Ooms and Veenhof, 2008; De Meester et al., 2009). The lack of *successful* interventions seems to indicate that this may not be the right approach (Ooms and Veenhof, 2008). Research has also shown that this type of interventions may increase physical activity for a while, but fail to be effective on the long term and that the effects of these interventions fail to transfer outside the school environments outside school (De Meester et al., 2009). We believe that learning by doing is the right approach for this target group. Therefore, we would like to engage teenagers in fun activities in which movement is inherent to the activity, in such a way that the boundaries between physical activity, play and fun disappear and children move because it is part of the fun. Since play and games play such an important role in the lives of many teenagers, the use of (aspects of) gaming is a vital element of our approach. Furthermore, we intend to reduce the amount of time teenagers spend sedentary, by engaging them in playful activities throughout the day rather than at a specific time and place. Finally, we found that our target group is a very heterogeneous group representing a diversity of interests and values and showing huge differences between age groups. Therefore, for an intervention to be successful, it is crucial that it offers something interesting for each individual and that it can be personalized to match individual preferences.

Our vision on how to persuade teenagers to be more physically active – as described above - can be summarized by means of the following three principles: *playful persuasion*, *ambient action*, and *play profiles*. In this position paper, we describe and motivate these three key principles concerning the design of game-based interventions for stimulating physical activity in more detail, relating them to existing theories and research. We illustrate our vision by means of three concepts that have been conceived in the context of the PlayFit project and that are representative of our design vision.

RELATED WORK

In the context of promoting physical activity by means of gaming, one of the most obvious categories of related work is the research on *exergaming*, i.e. video games that require some form of exercise in order to be played. Exergames, or exertion interfaces, and their effects on social and physical health, have been extensively studied (e.g. Bogost, 2005). Daley (2007) and Graves et al. (2009) studied to what extent exergames can help increase activity levels for youngsters, while Mueller and colleagues carried out design research with various forms of exertion interfaces, such as *Table tennis for three* (Mueller et al., 2009b) and *Remote impact* (Mueller et al., 2009a), combining exertion games with social interaction over a distance. The work that we describe in this paper is different from these studies on exergaming, because although we intend to use gaming to promote an active lifestyle, we try to avoid centralized solutions which require a traditional screen connected with some form of controller, such as dance mat games (such as *Dance Dance Revolution*), interactive exercise bikes, the *Nintendo Wii* and the *Xbox Kinect* (in which the human body itself is the controller). Instead, we focus on games that can be played anywhere and anytime, using multiple devices or even sensors that are embedded in the environment.

Another related body of research focuses on computer games that are immersed in the daily life of the players, so called *pervasive games* (Lindley, 2004; Magerkurth, 2005). Pervasive gaming is an umbrella term for various game genres, such as mobile games (where changing relative or absolute position/location is taken into account in the game rules), location-based games (that take relative or absolute but static position/location into account in the game rules) and alternate-reality games (in which the virtual and the real world are interwoven in the gameplay). Well-known examples of pervasive games are *Uncle Roy all around you* (Benford et al, 2004), *Can you see me now* (Flintham et al., 2003) and *Pirates!* (Björk, 2001). What pervasive games such as those mentioned above have in common is that they expand the traditional definition of a game - in which play is restricted to a specified time and place and separated from ordinary life (Huizinga, 1955) – in a spatial, temporal or social sense (Montola, 2005). Games that expand in a spatial sense are quite common, e.g. alternate-reality games or mobile games; games that expand in a temporal sense, i.e. games that are seamlessly integrated with daily activities such as those envisaged in the PlayFit project, are much less common.

Finally, there is a vast number of studies addressing games that promote physical activity, for diverse user groups, e.g. children and elderly. *Ambient Wood*, for example, is a pervasive educational game for children, in which they can explore a technology-enhanced wood (Rogers and Price, 2004). *DanceAlong* is an augmented dancing environment that allows elderly to dance along with selected dance sequences from well-known movies (Keyani et al., 2005). In the PlayFit project we focus on teenagers (both boys and girls) between 12 and 16 years of age, who have a strong need to define and develop their own identity and relate to others. This group is very heterogeneous because of rapid changes on a physical, cognitive, emotional and social level (Berk, 2006). To our knowledge, there are no studies related to the design of games that promote physical activity for this specific target group.

PLAYFIT VISION

As mentioned in the introduction, explorative research carried out at the start of the PlayFit project shaped our vision on how to design interventions that stimulate physical activity for teenagers based on play and gaming. We carried out a literature study, held

several focus groups with our target group and discussed our ideas with experts from various disciplines such as sports motivation and gaming. From this research we derived three key principles: playful persuasion, ambient action and play profiles. In the subsequent sections, we describe these three key principles in more detail and put them in context by referring to our main sources of inspiration.

Principle 1: Playful Persuasion

Research in persuasiveness explores the role of technology to change users' attitudes and behaviors through persuasion and social influence (Fogg, 2002). Persuasive technology has been used for various purposes, ranging from digital health coaching and computer games that help reduce children's dentist anxiety, to technologies that influence the buying behavior of consumers on e-commerce websites. Interactive activity interventions that stimulate young people to be more physically active are yet another application of persuasive technology.

Our intention to use elements of play and (digital) games leads to a specific type of persuasion, which we call *playful persuasion*. The differences and similarities between play, games and playfulness have been topic of discussion in many research papers, such as Schouten et al. (2011), Korhonen et al., (2009) and Bundy (1997). For the purpose of this paper, it suffices to define playful, namely as an adjective that is attached to something that elicits play, or in a more concrete and workable definition as "a mood of frolicsomeness, lightheartedness, and wit" (Sutton-Smith, 1997). Playful persuasion thus refers to applying persuasive principles in a playful way in order to influence people's attitudes or behaviors. Interesting examples of concepts in which playful persuasion is applied are the *Playful Toothbrush*, which uses a tooth brushing game in which children brush their own virtual teeth to train children to brush their teeth adequately (Chang et al., 2008) and the *Activator* concept in which social interaction and physical activity are used as mutual motivators to persuade elderly to get out of their room (Romero et al., 2010). The underlying assumption in this type of applications is that playful mechanisms, such as discovery, captivation or fellowship (Korhonen et al., 2009) can be used to persuade people to perform certain behavior, by appealing to intrinsically motivating strategies. In the context of the PlayFit project, we apply playful persuasion principles to get teenagers to be physically active because they think it is great fun, not primarily because it is good for their health or because they are forced to do so. This type of playful activities can be labeled *persuasive games (*Bogost, 2007). By engaging in fun and playful activities, children are intrinsically motivated to move rather than extrinsically, which has a positive effect on the effectiveness of the intervention. In line with theories of intrinsic motivation (Ryan & Deci, 2000) we found that intrinsic motivation for this age group is strongly related to their need for autonomy, their self-esteem and their relation with others, which are elements that we will incorporate in our designs.

Principle 2: Ambient Action

Our aim is to make teenagers more active throughout the day. We explicitly do not intend to stimulate physical activity by making sports more fun. The reason for this is that the children who need more physical activity the most are the children who have the least interest in sports-related activities (this is known as the Matthew effect in sociology). These children will not be motivated by interventions that try to make sports more fun. Instead, we aim to reduce teenagers´ sedentary behavior, by stimulating *casual action*: moments of playful behaviour, with low-impact physical activity, connected to the children's daily activities and interests. Because it is casual and low-impact, casual action may appeal to those who would not normally be interested in activities related to sports

and exercise. Moreover, because the activity is spread out during the day, the risk that people will compensate for the additional physical activity at other moments during the day is avoided.

To facilitate casual action and lower the threshold for taking part in activities, we intend to design for activities that are seamlessly integrated with daily life; opportunities to be active should be everywhere and always, for instance on the way to school, during the school breaks, and during after school activities. We call this *ambient action*. In a literal sense, ambient is defined as "existing, or surrounding on all sides"; a definition which clearly reflects our intention to provide teenagers with playful activities throughout the day, which are seamlessly integrated with their daily life, in such a way that there is no longer a clear distinction between physical activity and play.

In a technological sense, the concept of 'ambient action' is strongly related to the vision of ambient intelligence (Aarts & Marzano, 2003). Ambient intelligence means being surrounded by smartness. In an ambient intelligence environment, one is surrounded by intelligent computers that are able to sense *who* is present, *where* they are, *what* they are doing *when* and *how* they are doing it. An ambient intelligence environment can adapt to this knowledge, react to it and anticipate. According to Aarts and Marzano (2003), key principles in the ambient intelligence vision are: embeddedness, context-awareness, personalization, adaptation, and anticipation. To achieve ambient action we will make use of ambient intelligence technology, which means that we intend to use different kinds of sensors (e.g. activity meters, location sensors, person identification sensors) that are embedded in all kinds of objects, also in ordinary objects such as clothes, walls and toys and gadgets.

On a conceptual level, there is also a strong resemblance with the concepts of pervasive games, such as those mentioned in previously, and *ambient gaming*; a term that has gained popularity in recent games and is used to denote games that make use of ambient intelligence technology to provide an enhanced gaming experience, see for example Eyles & Eglin (2008) or Schouten (2008). However, we would like to point out that in the PlayFit project we do not focus on gaming as such, but on the broader concept of play and playful activities (which may include computer games).

Principle 3: Play Profiles

Despite the narrow age range of our target group (12-16 years of age), these teenagers form a very heterogeneous group which is caused by rapid changes on a physical, cognitive, emotional and social level (Berk, 2006). It is impossible to design a 'one-size-fits-all' solution for such a heterogeneous target group. Therefore, in order to meet the wishes and requirements of every individual, we intend to provide a collection of games and activities that can be played at various occasions throughout the day (ref. ambient activity). Each player has a personal *play profile* which is used for personalization and adaptation. A play profile may contain various categories of static as well as dynamic information, such as:

- Demographics (e.g. name, age, gender, weight)
- Interests (e.g. sports, reading, shopping)
- Player type (e.g. casual gamer, achiever, socializer)
- Social network
- Log of recent physical activity
- List of achievements, points, games played, etc.

The personal play profile may two purposes. First of all, information in the play profile could influence the games and activities that the user takes part in, in several ways. For

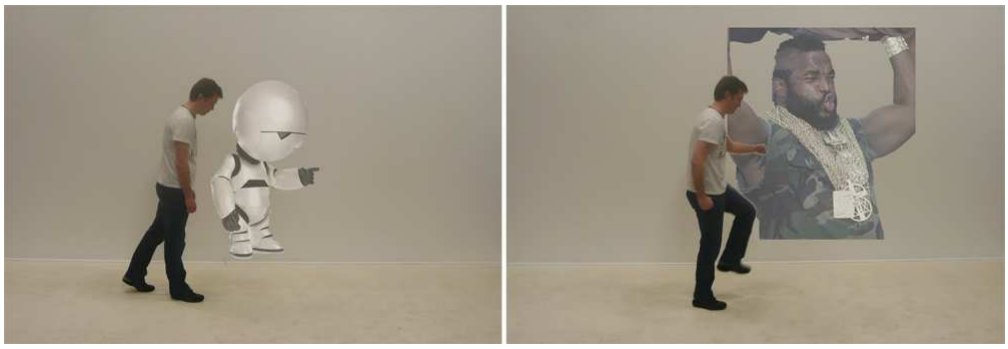
example, a player's interests could determine which games and activities are activated or offered by the system. Also, information from the profile, for example information about the amount of physical he or she has had recently may influence the player's character in the game: its looks, its power, etc. Finally, the play profile supports connectedness between various game contexts; it makes it possible to transport game characters and achievements between different games and activities within the intervention. Although this type of mechanisms supports the heterogeneity of the target group, current social games, for example on Facebook, do not yet apply these mechanisms.
Second, by sharing information in the play profile with others, either personally between friends or publicly on a message board, players are able to express who they are and what they stand for with their peers. In this way, the play profile provides teenagers with a playful way to construct and communicate their identity, for example by showing the activity achievements they collected while taking part in playful activities, sharing the games that they play, or personalizing the appearance of their avatar. It also enables game sharing, a process in which several players team up to control one avatar, thus sharing their complementary qualities and skills for better performance. In this way play profiles support the teenagers' needs related to self-esteem, autonomy, and relatedness (Berk, 2006). By combining playful physical activities with ways to fulfill these needs we expect to increase teenagers' motivation to take part in physical activity. This is in line with Moreno et al. (2008), who found that meeting the needs for relatedness positively predicted self-determined motivation, which also positively predicted the enjoyment exercisers had during the activity.

CONCEPTS

In the PlayFit vision, which was sketched in the previous sections, teenagers take part in playful activities and games throughout the day. In these activities, casual action is inherent to the fun experience, thus reducing teenagers' sedentary behaviour. Relevant information about their activities and preferences is stored in a personal play profile, which affects the games they play and through which they can communicate to their peers. In this section, we present three concepts of playful activities that have been conceived within the PlayFit project and which could become part of the collection of activities and games that our intervention comprises. Each concept implements one or more of our key principles. Although these three examples have not been fully developed yet, they have been all been evaluated in informal user tests, showing that these concepts are fun, feasible, and promising.

Concept 1: Walk-of-Fame

Walk-of-Fame is a playful installation in a corridor, consisting of a group of connected cameras and a display that covers the span of the wall. The system films teenagers walking through the corridor and analyzes their way of walking. A digital avatar is visualized on the display, walking alongside the passer-by; which avatar is shown depends on the person's way of walking.



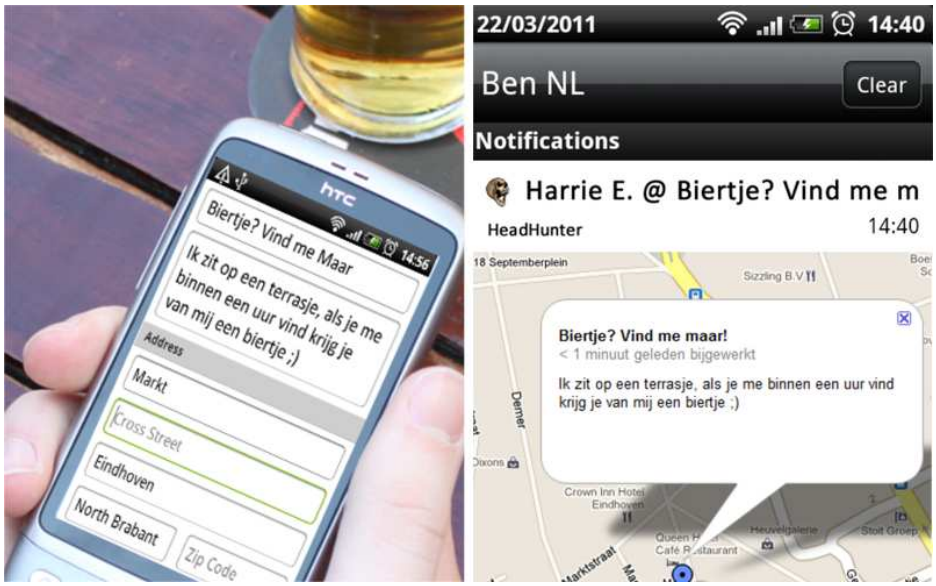
John walks slug and slowly through a corridor in his school, bored with his upcoming mathematics class. On his left, he sees a flicker of movement, and suddenly Marvin the Paranoid Robot walks alongside him through the corridor. Curious, Marvin retraces his steps and starts walking through the corridor with exaggerated heavy movements. Now B.A. Baracus of the A-team appears! Laughing, he enters the main hall, showing B.A. to his classmates who are watching. Over time, groups of friends start walking in their specific way, always activating their preferred characters. At certain moments, the system records a movie of the passers-by and their avatars, and uploads it to Facebook; this way, the interplay of watching, walking, and being watched broadens to the network sites.

Figure 1 Pictures and scenario of the Walk-of-Fame concept

The Walk-of-Fame scenario provides a playful activity, in which students can walk in different ways in order to activate various famous characters. This explorative, enjoyable activity elicits physical activity in an inherent way: Students become curious how the interaction works, and will explore what happens. Curiosity and exploration are two important playful principles (Korhonen et al., 2009). They will walk back and forth through the corridor trying out different ways of walking in order to explore the different characters they can make appear, using several sorts of exaggerated movements. It playfully invites them to walk in a different way, to walk back and forth through the corridor several times in a row, and it invites the onlookers to stand up and try it for themselves. In this way it supports ambient action throughout the school day. Although this scenario does not yet incorporate the play profiles principle, it offers various opportunities for doing so. For example, if the system would be able to recognize the passers-by, their virtual characters on the screen could easily be enriched with information or achievements gained in previous activities, friends in their network, etc.

Concept 2: Headhunters

Headhunters is a mobile social game that can be played using a smartphone. It facilitates the creation of assignments: challenges in which a collection of photographs must be taken within a certain amount of time. Every picture taken is uploaded and shared, and the player's friends determine if the assignment is fulfilled or not.



Catherine walks through the shopping street, when she receives a notification from the Headhunters app. It tells her that her friend Agnes has created a challenge: "Headhunt twenty people wearing something red". Quickly, Catherine walks to the bus stop, taking pictures of several people wearing red clothes. For the last picture, she quickly enters a shop, puts on a red hat, and photographs herself. The Headhunter app shows her progress and pictures compared to her friends, and she smiles when receiving the achievement reward from Agnes.

Figure 2 Pictures and scenario for the Headhunters concept

The Headhunters scenario simply creates a game, which is initiated and specified by the players themselves. Movement, e.g. the search for the objectives, is an inherent part of the enjoyable activity. The Headhunters scenario creates a perfect ambient gaming atmosphere: at any time of the day, at any location, one can start or join a game with friends, or simply choose to ignore the challenge. The game provides opportunities to create challenges for others. Challenge is one of the commonly applied playful principles as described by Korhonen et al. (2009). The Headhunters game is coupled to the player's digital profile which can easily be connected to and integrated with other playful activities and play profiles. In addition, since the player's friends create the challenges, the content is always personalized and specific for that peer-group of friends.

Concept 3: Sway-it

Sway-it is an interactive multifunctional play object that stimulates youngsters to reinvent playing. Sway-it tries to spark the curiosity in youngsters by giving them something to explore and interact with during their breaks at school, or after school with friends. With Sway-it youngsters can play and customize their environment, while it also has the possibilities to be used in more complex games.

Lunch break, finally! Jesse and his friends walk outside to relax a bit and get some fresh air. They gather around the Sway-it objects, leaning against them, some sitting on them. The Sway-its light up, in different colors. Jane climbs onto one of them, changing its color to her favorite color: red. But, hey, it turns green again. She then hears Jesse laugh and sees him aiming his Sway-it to another one, shouting: "Green takes over the world!". They end up in a 'fight' in which they each try to conquer all the other Sway-it objects.

Figure 3 Pictures and scenario for the Sway-it concept

Sway-it can be used as a table or something to lean against, but also to sit or stand on during their school breaks or when hanging out in public space. Sway-it invites users to explore the object by reacting to the presence of people by means of light. Teenagers can change the color and the brightness of lights that are incorporated right beneath the seat, by bending the Sway-it into a particular direction. By pulling back the top part, they can "shoot" their color to another Sway-it in the vicinity like a catapult. These objects invite people who sit on them to casually active in a playful way, without really interrupting or interfering with the teenagers' activities, as such it fits the ambient activity principle very well. Moreover, the open-ended nature of the interaction implies that teenagers can make their own games and play with it in many different ways. In this way creativity and activity are stimulated and rewarded.

DISCUSSION

We presented three concepts of playful activities intended to stimulate casual activity among teenagers. First informal user tests have pointed out that these concepts have potential. However, in order for our intervention to be successful there are a number of issues that should be further explored.

First of all, we need to find out whether the concepts that we design and build have the desired effect, i.e. whether they indeed result in more physical activity. Although we firmly believe that that is the case, we will carry out observation studies and studies using activity meters to verify this assumption. Another, related question is what happens on the long run? Are the concepts still fun after a couple of weeks, or are they already abandoned by then? If the Walk-of-Fame would show the same avatars every time you walk past it, teenagers may be bored with it after a few days already. For this reason, the system behavior may need to change now and then. Also, creating your own games with Sway-it may be a lot of fun, but since the interaction possibilities are limited, it may not take very long before the Sway-its are used in this way only occasionally. Fortunately, what is left is a set of outdoor furniture which requires active sitting. We will perform longitudinal studies to find out what is left of our concepts when the novelty has worn off, and what can be done to make the concepts as much fun as possible for as long as possible.

Another issue that needs to be taken into account concerns privacy. Some of the concepts make use of personal information stored in the teenagers' personal play profile. For example, the Walk-of-Fame scenario describes that pictures or movies are taken of the avatars shown on the wall and regularly uploaded to network sites. For many children this may be a nice way to show off, but not all teenagers will be happy to share this information, even though the network may be restricted to the school's intranet, for example children with a different cultural background or children with low self-esteem.

User tests should also point out whether these concepts will be accepted and used within a school context. In this respect, both the teenagers themselves and their teachers are concerned. For example, public displays such as the Walk-of-Fame may be misused by children making obscene gestures or showing abusive language, as we observed in previous user tests. Supervision is then required to prevent this type of misuse. For some schools the Headhunters concept may not be acceptable because it requires the use of a mobile phone, which is not allowed at some schools, even during breaks. Other reasons for schools to be reluctant to apply our intervention may relate to privacy, safety or required investments. We have had close collaboration with several schools (staff as well as students) during our design process and we will continue consulting them for future designs and evaluations.

CONCLUSION AND FUTURE WORK

In the previous sections we described the three key principles of our approach to stimulate teenagers to be more physically active throughout the day, viz. playful persuasion, ambient action and play profiles. To illustrate our vision, we presented three concepts of games and playful activities - Walk-of-fame, Headhunters and Sway-it - each representing one or more of these principles, and discussed issues that should be taken into account when further developing these concepts.

In the near future, we will use these (and other) concepts in studies aimed at answering relevant research questions, such as:

- Which are motivating factors for teenagers, and how can these aspects be translated into persuasive playful activities incorporating casual action?
- How can ambient principles such as personalisation and anticipation be translated to gaming and play?

- What information should be included in a personal profile and in what way can a play profile affect games and play?

We will apply a research-through-design approach in which prototypes are evaluated in the *in situ* context, leading to rich, qualitative and situational insights that are, in turn, applied in other prototypes and contexts, in order to derive general design guidelines. Because the school is a very important element in the daily life of our target group (teenagers spend up to eight hours at school every day), we intend to investigate in which way the school, the teachers and subject material can play an active role in the intervention. For example by designing a game that can be played in the swimming pool to teach students principles of physics, such as gravity and resistance, by experience. Or by developing a pervasive game that is played throughout the city in which children are taught about historical events and buildings. Another topic that we intend to explore is the use of social media for stimulating sports, play and movement. Social media, such as Facebook, Twitter and social gaming, are immensely popular among teenagers, they have a wide, even international scope, and they are 'always on'. These characteristics make for social media to be a promising means for activity interventions throughout the day.
Ultimately, our aim is to develop a fun and exciting activity intervention which comprises various games and activities incorporating our three key principles and which has proved to be effective also on the long run. In addition, we intend to generate general guidelines for the design and implementation of interactive activity interventions on the basis of gaming.

BIBLIOGRAPHY

Aarts, E., Marzano, S. (2003) The new everyday: Visions of ambient intelligence. 010 Publishers, Rotterdam.

Benford, S. , Magerkurth , C., Ljungstrand, P. (2005) Bridging the physical and digital in pervasive gaming. Communications of the ACM, 48(3).

Berk, L.E. (2006) Development through the lifespan, 4th Int. ed., Pearson Education (US), 2006, pp. 360-427.

Biddle, S.J.H., Gorely, T., Stensel D.J. (2007) Health-enhancing physical activity and sedentary behaviour in children and adolescents. Journal of Sports Sciences, 22(8), 2007.

Björk, S., Falk, J., Hansson, R., and Ljungstrand, P. (2001) Pirates! - Using the physical world as a game board. In Proceedings of Interact 2001, IFIP TC.13 Conference On Human-Computer Interaction (Tokyo, July 2001).

Bogost, I. (2005) The rhetoric of exergaming. In: Proceedings of the Digital Arts and Cultures (DAC) Conference 2005.

Bogost, I. (2007) Persuasive Games: The Expressive Power of Videogames. The MIT Press, 2007.

Bundy, A.C. (1997) Play and playfulness: What to look for. In Play in Occupational Therapy for Children, L. D. Parham, L. S. Fazio, MO: Mosby, 1997.

Chang, Y-C., Lo, J-L., Huang, C-J., Hsu, N-Y., Chu, H-H., Wang, H-Y., Chi, P-Y., and Hsieh, Y-L. (2008) Playful toothbrush: ubicomp technology for teaching tooth brushing to kindergarten children. In Proceeding of the twenty-sixth annual SIGCHI conference on Human factors in computing systems (CHI '08). ACM, New York, NY, USA, 363-372.

Daley, A.J. (2009) Can exergaming contribute to improving physical activity levels and health outcomes in children? Pediatrics (journal),124(2), pp. 763-771.

De Meester, F., Van Lenthe, F.J., Spittaels, H., Lien, N. and De Bourdeaudhuij, I. (2009) Interventions for promoting physical activity among European teenagers: a systematic review. International Journal of Behavioral Nutrition and Physical Activity, 6(82).

Eyles, M. and Eglin, R. (2008) Ambient games, revealing a route to a world where work is play? International Journal of Computer Games Technology (2008).

Flintham, M., Benford, S., Anastasi, R., Hemmings, T., Crabtree, A., Greenhalgh, C., Tandavanitj, N., Adams, M., Row-Farr, J. (2003) Where on-line meets on the streets: experiences with mobile mixed reality games, Proceedings of the SIGCHI conference on Human factors in computing systems, April 05-10, 2003, Ft. Lauderdale, Florida, USA

Fogg, B. (2002) Persuasive technology: Using computers to change what we think and do. Morgan Kaufmann, 2002.

Graves, L., Stratton, G., Ridgers, N.D., and Cable, N.T. (2007) Comparison of energy expenditure in adolescents when playing new generation and sedentary computer games: cross sectional study. BMJ 335 (7633): 1282–4.

Hendriksen, I., Bernaards, C., Hildebrandt, V.H. (2010) Lichamelijke inactiviteit en sedentair gedrag in de Nederlandse bevolking. In: Hildebrandt, V.H., Chorus, A.M.J., Stubbe, J.H. Trendrapport Bewegen en Gezondheid 2008/2009, TNO Kwaliteit van Leven, Leiden, 2010, 39-56.

Huizinga, J. (1955) Homo Ludens. A study of play element in culture. Boston, Beacon Press.

IJsselsteijn, W., de Kort, Y.A. W., Westerink, J., de Jager, M., & Bonants, R (2006) Virtual Fitness: Stimulating exercise behaviour through media technology. Presence: Teleoperators and Virtual Environments vol. 15, 688-698

Keyani, P., Hsieh, G., Mutlu, B., Easterday, M., and Forlizzi, J. (2005) DanceAlong: Supporting positive social exchange and exercise for the elderly through dance. In Extended Abstracts of the Conference on Human Factors in Computing Systems (CHI'05), April 2005, Portland, OR, USA.

Korhonen, H., Montola, M., Arrasvuori, J. (2009) Understanding playful experiences through digital games. In: Proceedings of the 4th International Conference on Designing Pleasurable Products and Interfaces. DPPI, pp. 274–285.

Lindley, C. (2004) Trans-Reality Gaming. Proceedings of the Second Annual International Workshop in Computer Game Design and Technology.

Magerkurth, C., Cheok, A.D., Mandryk, R.L., and Nilsen, T. (2005) Pervasive games: bringing computer entertainment back to the real world. Comput. Entertain. 3, 3 (July 2005), 4-4.

Montola, M. (2005) Exploring the edge of the magic circle. Defining pervasive games. Proc. Of Digital Experience: Design, Aestethics, Practice conference, Copenhagen, 2005.

Moreno-Murcia, J.A., Lopez de San Roman, M., Martinez-Galindo, C., Alonso, N. and Gonzalez-Cutre, D. (2008) Peers' influence on exercise enjoyment: A self-determination theory approach. Journal of Sports Science and Medicine, 7, 23-31

Mueller, F., Agamanolis, S., Gibbs, M. and Vetere, F. (2009a) Remote Impact: Shadowboxing over a distance. CHI'09: Proceedings of the 27th International Conference on Human Factors in Computing Systems, Extended Abstracts. Boston, MA, USA. ACM, New York, NY, USA, 3531-3532.

Mueller, F., Gibbs, M., and Vetere, F. (2009b) An exploration of exertion in mixed reality systems via the "Table Tennis for Three" game. The Engineering of Mixed Reality Systems, Human-Computer Interaction Series, 2010, Part 1, 165-182

Ooms, L. and Veenhof, C. (2008) Evaluatie van kansrijke interventies om lichaamsbeweging in de bevolking te bevorderen. NASB report (in Dutch). Retrieved from: http://www.nasb.nl/downloadpool/pmed040-14_08_2008-rapport-evaluatie-kansrijke-interventies-lichaamsbeweging.pdf.

Rogers, Y. and Price, S. (2004) Extending and augmenting scientific enquiry through pervasive learning environments: children. Youth Environ 14(2):67–83

Romero, N., Sturm, J., Bekker, T., Valk, L. de, and Kruitwagen, S. (2010) Playful persuasion to support older adults' social and physical activities. Interact. Comput. 22, 6 (November 2010), 485-495.

Ryan, R.M., and Deci, E.L. (2000) Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55, 68-78

Schouten, B. (2008) Play as Source for Ambient Culture. Inaugural speech Professor of Serious Gaming, Fontys University of Applied Science.

Sutton-Smith, B. (1997) The ambiguity of play. Cambridge, Mass.: Harvard University Press.