Stimulating Children's Physical Play through Interactive Games: Two Exploratory Case Studies

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ABSTRACT
Children are really intrigued by television and computers. However, the interaction with these products hardly requires any form of body movement. This paper presents two case studies of product designs that provide more opportunities for children to enjoy physical play activities.

Author Keywords
Children, interaction design, case study, physical play, playgrounds.

ACM Classification Keywords
H.5.2 [**User Interfaces**]: Interaction styles (e.g., commands, menus, forms, direct manipulation), User-centered design.

INTRODUCTION
The daily activities of children have changed tremendously over the last decade, e.g. sitting in front of screens instead of playing outside. At the same time new technologies provide possibilities for new products that could stimulate movement. This paper is the result of a 16-week project by two second-year design teams of Industrial Design at the Eindhoven University of Technology. The teams applied a user-centered design approach, the user being 8- to 10-year-old children.

CHILDREN AND PHYSICAL PLAY
Previous work on the role of physical movement and play in computer and tangible games has led to initial requirements for such applications, such as robustness, responsiveness, intuitiveness and physical appropriateness [2]. While the designs focus on supporting physical play, they will also try to appeal to other aspects of development such as social and cognitive development. For example, 8- to 10-year-old children start exploring the importance of rules and roles [1]. They enjoy realistic fantasies and sport-like activities that require physical dexterity, balance, coordination and strength [1]. At this age they can understand more complex rules as part of a game. The use of their imagination in a fantasy world is a reason why children find computer games appealing [3]. This knowledge can also be used in physical games. Finally, exploring the possibility to design for open-ended play will allow more flexibility in interacting with games.

The first case study we present is a solution to be placed in a playground. The second one is a mobile solution of a vehicle remotely controlled by children's physical activity.

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CASE STUDY 1: FLASH-POLES
Flash-Poles is a design of a stimulating and safe outdoor environment that motivates children to play and perform physical activities while being socially active. The intended location is a playground in a residential area.

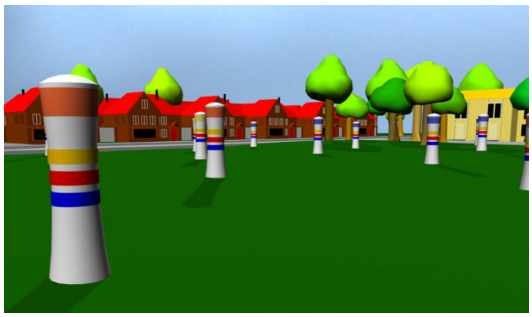

Figure 1. Artist impression of the Flash-Poles.

Concept
The Flash-Poles concept consists of a number of poles which are setup on a field at approximately 3.5 meters distance from each other (see Fig. 1). Each pole has three colored rings (blue, red and yellow) that can rotate and be pressed; each pole has an integrated lamp that can light up in the same color as the color of the button that is pressed / rotated.

Imagine a child that presses or rotates one of the three rings of a pole. Pressing the ring only switches the color of the light, rotating it will switch the color *and* set an additional timer depending on how much the ring was rotated. This disabled the three rings, no one could change the color for a while, indicated by a blinking light. Using this functionality children can play games: e.g. one group tries to get all poles to light up blue and another group tries to get all poles to light up red.

User involvement
In different stages of the development of the Flash-Poles primary school children were involved. The Flash-Poles concept was evaluated with the intended user-group. Dummy poles were created to test size, distance, interaction and colors of the poles. The Wizard of Oz method was used (Fig 2 left side) to find usability problems. These results were used in the

final design. The final user test (Fig 2 right side) showed that children like the Flash-Poles and competition in games.

Figure 2. Early prototypes and final demonstrators of the Flash-Poles concept.

The children were eager to play and came up with several possibilities for competitive games. They did not have any problems finding out about the functionality of the colored rings. The timer feedback (light's blinking rate) was difficult to find out, but once explained it did not pose any problems.

Conclusion

User tests performed with the early prototype as well as with the final demonstrator show that the goal of initiating physical exercise while being socially active is met. The reactions of the children made it plausible that in a real "in the field" implementation these Flash-Poles will create a long-term stimulus for social and physical activities.

CASE STUDY 2: BATTLE-BOTS

The Battle-bots case study developed a physical game in which children's body movements are used to remotely control battle-tank toys, physical props for outdoors.

In the analysis phase the game interests of the target group was studied by means of interviews and observations. Based on these findings initial design ideas were generated: a hide and seek robot, a physical game controller, a musical playground and a physically controlled tank. The tank best met the requirements, including user skills, challenges and feasibility, and thus was selected for further development.

Concept

The Battle-bot tank (see Fig. 3) can be controlled by the child's own body movements, creating a whole new experience of interaction. It incorporates activities that appeal to this age group [1] such as: hunting, hiding, fighting, aiming and shooting. The activities related to fighting are probably more appealing to boys, while other activities required for the game, such as controlling the tank and negotiating strategies, are probably more appealing to girls. There are three types of Battle-bots, each with specific advantages and disadvantages in terms of speed, firepower and maneuverability. Children can even compete on self-created obstacle courses.

Two sensors are needed to control the tank: one positioned in a vest on the chest and one in a glove on the hand. When a child walks forward, the tank will also move forward and if the child turns the tank will turn in the same direction. To shoot, a button is implemented in the glove. Each tank only has so many shots and the child needs to make a lot of movements to reload. The sensor determines whether sufficient movements have been made. One type of Battle-bot can also lift and lower its body, which is done by jumping and crouching.

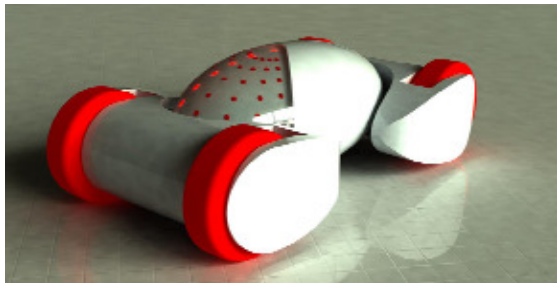

Figure 3. The design of the battle-tank: with LEDs providing feedback about the aiming direction.

User involvement

A total of 12 children participated in two user tests. The user tests examined whether children understood how to control the tank and whether the movements for controlling the tank were appealing. The children were able to find out how to control the tank without any explanation. Some of the more complicated maneuvers, such as reloading, took more practice. This learning curve fits a general design requirement of games: easy to learn and hard to master. Both girls and boys liked the global concept, but boys preferred the battle fantasy component of the design. Children, who did not control the tanks themselves, enjoyed providing advice to the players. Overall, the children were enthusiastic about controlling the tank with their body movements.

DISCUSSION AND CONCLUSION

The two designs illustrate possible solutions to stimulate physical play of children. These concepts were tested to assess whether they actually stimulate body movement. Future research needs to examine the longer term appeal of the concepts and the behaviour of the children. Another issue is the added value of the technology when designing playful solutions for physical play. Are children not better off with more basic products? In future case studies we hope to take the development and evaluation of the concepts one step further.

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