How to facilitate physical skill development in Exertion Games

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Abstract
Throwing is an important physical skill that lays the foundation for the ability to participate in many physical activities and sports experiences. We aim to support the development of physical skills through exertion game design; our focus here is on the design of an exertion based throwing game that aims to help children improve their ability to throw. We discuss the results of some initial play testing, and how these observations can inform future game design to offer us insights into how technology can support the development of physical skills, important for physical health.

Keywords
Exertion Interface, interaction design, kinesthetic literacy, learning, gaming, whole body interaction

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation: Prototyping, User-centered design

Introduction
The virtuosos in any professional sport are those who started playing the sport at an early age and had positive experiences. For them, sport is a form of entertainment, an exertion activity that they're good at.

Children who are not physically well coordinated find such exertion activities strenuous, both physically and mentally. Miracle and Reese [3] cite instances where athletic participation can inhibit character formation. Negative youth sports experiences can erode motivations for participation, produce excessive stress, and destroy feelings of self-worth. Physically ill-coordinated children often find it hard to catch, throw and dribble, which are fundamental activities in many sports. This inability to catch and throw needs to be addressed at an early age to give the children a better chance of picking up or learning to play a sport in the future.

Given that today's average college student has spent over 10,000 hours playing video games [2], we propose to use this digital technology, coupled with exertion activities like throwing and catching, to encourage children to play more physical games, and gain kinesthetic literacy in the process. Would pairing a traditional sports game with interactive digital technologies help make it more fun for children to play? What would such a game look like and what aspects of game play would make children want to play it again and again? These are some of the questions we set out to answer. Specifically, we would like to understand the opportunities and challenges involved in using technology to make exertion games for children more engaging. We believe by making games more engaging, we can enhance opportunities for learning physical skills, which will contribute to further participation.

Embodied Interaction

Our work aims to make a unique contribution to embodied interaction as it asks the question how technology can facilitate kinesthetic literacy. As such, it points not to the common "learning through body skills" (e.g. gaining knowledge about tactics in football by playing football), but rather to "learning body skills" (learning how to throw by playing football), and asks the challenging question of how we can support the development of bodily skills [5]. We are interested in understanding how technology can help children who might have some knowledge about throwing (move your hand in a particular motion and release the object at the right time), to develop the skill required to throw through the practical experience of doing it and seeing the results [5]. We therefore propose to use an embodied interaction approach to investigate exertion games [1] to help develop the kinesthetic literacy beneficial to execute a throw.

By the "embodied interaction" approach we mean an approach that considers the aspects of bodily skills that are integral to the learning process, and in which the supporting technology facilitates gaming, learning, and bodily skills at once.

Sheridan et al. [6] suggest that kinesthetic literacy involves two major learning objectives, *learning to move* & *moving to learn. Learning to move* asks participants to focus on an understanding of the body in order to acquire the skills and techniques that are required to participate in physical activities. Doing so allows participants to take control of their body and to know its range and capacity for movement. Learning in this context often focuses on "fine-tuning" motor control and fundamental aspects of movement such as hand-eye coordination, coping with space, speed and distance. In *moving to learn,* the physical activity is the context for a means of learning. Sheridan et al. have

also used tangible exertion interfaces to explore this concept [4, 5]. Our game will explore the first of the two objectives, while also attempting to take it further. We would like to present the game so it seems less about learning to throw, and more like a game that children would like to play repeatedly. By abstracting the pedagogical aspect of the game and getting the children engaged in the act of throwing repeatedly through game play, we hope they will develop the kinesthetic literacy required to execute a throw.

Game Prototype

To ground our design decisions and lay the foundation for the game design, we developed a game prototype and informally play tested it. The goal was to ascertain what aspects of a throwing based exertion game would keep children engaged. The main components of the prototype were a baseball pitchback (5′ X 3′), a baseball/softball, a Wiimote, Processing code on a laptop, a projector and speakers.

Figure 1: Pitchback with Wiimote

Children threw the ball at images that were projected on the pitchback (Figure 1). The vibrations on the net of the pitchback varied based on the intensity of the throw. A Nintendo Wiimote was used to pickup the vibrations from the pitchback. The Wiimote was connected via Bluetooth to a laptop running Processing code. The code was written to pick up the vibration data being sent from the Wiimote and give appropriate visual/aural feedback, which we describe below.

Participants for this play test were two children aged 8, who were actively involved in a variety of sports. For the purposes of anonymity, the boy will be referred to as Jack and the girl as Jill. We first projected the image of a glass pane onto the pitchback. The harder one threw at the glass, the more it cracked. The sound of the breaking glass also changed based on the intensity of the throw.

The next set of images we used were those of the kids themselves and their family members. We used these to see if the kids would be willing to throw the ball at images of themselves, their dad, their sister and their dog. Different sounds were also played to match who was hit with the ball.

Results/Observations

The results were based on our observations and interviews with the kids, both during and after the game play. Some of the interesting results that came out were

- When asked to throw the baseball, Jack started off by taking a short run-up and throwing the ball with all his strength. When asked to throw with an imaginary ball, Jack just stood there and moved his hand, pretending to throw. While he believed his movements were identical, it was obvious to an outsider that the bodily actions were very different. This leads us to believe that having a real ball in the hand makes a difference to how kids would execute a throw.
- The kids enjoyed throwing the ball at images of the glass as well as their family. When asked which of the images came first in the sequence, the kids said their dad's; while actually, it was the images of the broken glass that were shown to them first, before the family pictures came up. The personal connection that the children shared with the images seemed to have influenced their engagement with the game.

- Jill was initially discouraged by the game as her throws did not produce any visible or audible feedback, i.e. the glass did not crack. This was because the program had been coded to provide feedback on higher levels of vibration received from the Wiimote and Jill's throws were not strong enough to produce these vibrations. Once the code was modified to pick up lower level vibrations as well, Jill enjoyed the game more. Having the ability to customize the game based on the player's ability might be a worthy feature.
- Jill was scared to catch the ball when it bounced back from the pitchback, while Jack, who played more and was more passionate about sports, was comfortable catching the baseball. A softer ball would have reduced the risk of injury and may have been ideal for Jill. A softer ball might also enable children of all ages and abilities to play the game.

Limitations

Our play test did give us insights into what children might like in a throwing game but we had only two participants, who were pretty excited about playing outdoors. Although our game does cater to this demographic, we would also need to test the game with children who don't enjoy or have not played much sport. We were not sure how much our participants learnt about throwing, if anything at all and were mostly concerned about engagement and to this extent, we believe the play test gave us some interesting ideas to explore.

Conclusion

We've presented here our approach to developing an exertion game that incorporates learning of body skills into game play. We did some initial testing which gave us interesting results about children and engagement in games. To take the game to completion, we're planning an iterative process of design, prototyping and play testing. This project is in its early stages, and we're looking forward to feedback from the workshop participants.

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