An Ecological Approach to Children's Playground Props

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ABSTRACT
This paper describes an ecological approach to designing children's play props. By studying the world with the help of intermediary objects, children learn about the physical and "mythical" characteristics of their three-dimensional surroundings through physically active play. Starting from the universal pull-along toy as inspiration, a new category of space explorer emerges that interacts with children as they engage their outdoor play environment. Early design experiences are described and directions for future research are given.

Keywords
Outdoor play, props for play, theories of play.

ACM Classification Keywords
K4.m. Computers and Society: Miscellaneous.

INTRODUCTION

This paper discusses an attempt to develop props that support young children's play in outdoor settings, usually the playground. How can digital technologies add to the rich relationships that already exist among children, their play props and their play spaces?

AN ECOLOGICAL APPROACH TO PLAY PROPS

Play presents a key means of "learning about the world" available to children. Piaget, the famous child psychologist, was very interested in these dynamic aspects of children's play which he saw "as a biological model of interaction between child and environment" [9,15]. In other words, children are able to learn about themselves and subsequently the world through hands-on interactions which researchers, educators and grown-ups call play.

During play, objects act as mediating elements between children and their surroundings because they connect the two. Garvey describes the role of objects: "They provide a means by which a child can represent or express his feelings, concerns, or preoccupying interests. (…) Further, for the child an unfamiliar object tends to set up a chain of exploration, familiarization, and eventual understanding: an often-repeated sequence that will eventually lead to more mature conceptions of the properties (shape, texture, size) of the physical world" [6]. Figure 1 shows the three essential elements of the play scenario Garvey describes, children ↔ objects ↔ play setting. Though Garvey does not limit herself to outdoor spaces, they are the setting studied in this paper.

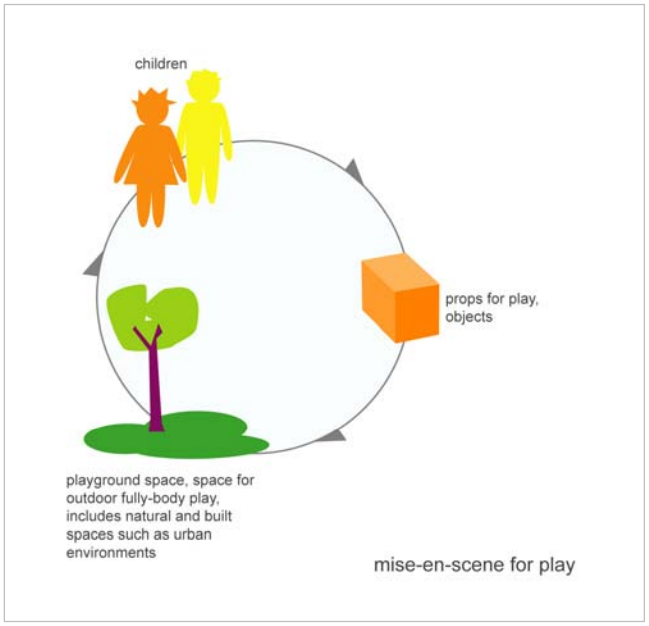

Figure 1. Cycle of outdoor play interactions involving children, objects, and spaces, referred to here as the mise-en-scene for play.

Engaging objects is one of the outwardly visible signs that play is necessarily a physical and tactile experience. Froebel developed a series of "gifts" which were designed as objects that young children could manipulate in order to learn. These "manipulatives" have evolved into a mainstay of the preschool environment [3]. In the playground, physical play and the manipulation of objects can be

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brought together in an especially engaging way through more full-body play patterns.

Different types of physical play dominate at various developmental stages, but they are all beneficial to children's general development according to Pellegrini and Smith who have extensively studied the benefits of physical play [14].

The benefits of play are related to the interconnected nature of different play styles. Large-motion physical play has a series of benefits that exceed physical health. There are social, cognitive and different aspects of physical skills which are supported and enhanced through self-directed, full-body physical play. Many children experience this type of play in the playground.

Over the short term and the long term, the relationship between children and their surroundings changes and so does their ability to interact with objects inside their environment. Hutt asks two questions which are constantly being (unconsciously) asked in play "what does this object do" and "what can I do with this object" [10]. The environment's role also changes over time as it is a "living, changing system" (Greenman, [4]) which allows children to grow.

EXPANDING THE SCOPE OF PLAY THROUGH DIGITAL TECHNOLOGIES

For today's children, so-called "millennials", digital devices and computation-based toys are taken for granted. Very little interaction with these objects takes place outdoors or involves full-body engagement. In fact, most digital devices such as computers, handhelds or robotic toys like Sony's Aibo or Robosapiens do not encourage full-body motion or open-ended play.

Many toys – whether digital or otherwise – also lack the open-ended nature which accommodates different styles of play. Resnick and Silverman call this characteristic "low floors and wide walls" meaning the child's ability to access the toy and reinvent new ways of using it [16].

There are successful approaches to designing digitally enhanced props for and with spaces in mind which expand the scope of play successfully [5]:

Providing Ambient Information

Ambient Wood, Equator Project

The Equator Project comprises many different research efforts, among them the Ambient Wood outdoor field trip for school children. In order to enhance the field trip, tools were built, which would provide digital information to the children while they were exploring the natural, outdoor environment. Rather than separating field research from other resources the goal was to enhance the experience through written and audio information or through tools for magnifying or framing certain elements in the forest. These devices function as digital props in the off-the-grid outdoor environment and become meaningful through the potential they have to unlock the secrets of those environments [17].

Enhancing Interactions

Water Games, Barcelona Forum of Culture

In Spain a group of researchers designed an interactive, outdoor water play installation for the "Universal Forum of Cultures" held in Barcelona, 2004. Users could activate the fountains by forming rings and spinning around them. Though facilitated by an artificial vision system the interaction was entirely natural and intuitive for the children (and grown-ups as well) [13].

Supporting Full-body Movement

Playware

A Danish group of computer scientists and roboticists developed Playware as a system of "intelligent hard- and software that aims at producing play and playful experiences among users." Inspired by hopscotch and other floor games this digital iteration opens many possibilities for reconfiguration [11].

Each approach expands the scope of outdoor interactions in a different way. In one case, an augmented object provides a window into other worlds. In the other example, the interaction symbolizing world peace drives the design. The final example illustrates a system which guides an immersive experience.

MISE-EN-SCENE OF PLAY

Each of these examples begins to address the continuum of meaning which is engendered by the triangle children ↔ objects ↔ play setting (see figure 1). I aim to think explicitly about these relationships as a whole in order to create new types of play props which will enrich children's discovery of the world.

Metaphorically and literally, the playground acts as a stage-setting for children's play (usually in an urban environment, though other outdoor play settings are equally relevant). In this context the connection between stage set, i.e. the sandbox, and props, i.e. the shovels and molds, lends meaning to the space which the children interpret and reinterpret throughout their play. Further, the spatial relationships among the objects and the children assume meaning based on the types of play patterns taking place.

These relationships resemble the technique with which filmmakers bestow meaning, the "mise-en-scène" (see figure 1). Modifying spaces by "putting things in the scene" provides the basis for the narrative or information interpreted by observers. Monaco in *Understanding Film* thereby differentiates film from other media because "it is not composed of units as such, but is rather a continuum of meaning" [12].

Objects further enhance the meaning of spaces through their appearance and position in relation to surrounding objects. And they contribute significantly to the continuum of meaning generated by a sequence of interactions in a space which echoes Greenman's understanding of "environment" as a system [4].

SPACE EXPLORATION

In trying to develop a prop from the suggested approach, a new category emerged called "space explorers" for preschool children, which derives from the pull-along toys many of us remember from our own childhood.

What are space explorers? *They are animated objects that reveal important information about outdoor play environments by adding another layer of interactions to the triangle of children ↔ objects ↔ play setting.*

In literal outer-space exploration, the spherical robot plays an important role. There are several examples of inflated or solid spherical robots which have been developed for understanding distant planets. Some attempts have been made to adapt these objects for children, but they are starting from a robotics framework [18].

Adapting rolling objects for children's play is nothing new – the ball is still one of the most common play objects. An initial prototype emerged starting from this universal spherical form and adding the idea of an exploration device. The basic scenario for such a roller would be:

Basic Scenario

Children encounter the roller – or another space explorer – in an outdoor play setting where it is activated by their presence. The types of ensuing behaviors include expected and unexpected outcomes, for example: the ball may initially roll down a hill as expected only to turn around and return towards the child.

Characteristics of a Space Explorer

Such a props success depends on at least four important aspects or characteristics:

1) Autonomy

First, the object is autonomous or moves of its own accord without needing a push from the outside. In other words, it is a "self-regulating device". Ackermann explains that these types of devices include "a mechanism able to read or *sense* certain features in its environment (such as light, sound, or obstacles), to measure or *evaluate* their value in relation to an internally fixed referent, and to *adjust its behavior* accordingly" [1,2]. As a result, children (and grown-ups) develop psychological and physical explanations for the object's behavior, which are continuously updated throughout the interaction with that object.

2) Animate/Inanimate

The second feature leads to another characteristic, a certain blurring between animate and inanimate which is fascinating for children whose understanding of what being "alive" means is still under construction. This became clear in a short exercise with a group of children at a preschool who were asked what crazy movements they could imagine for a ball. One child said that the ball should "roll it by itself." As Turkle's extension of Piaget's earlier studies shows, digital objects are especially interesting in this context because of their increased "holding power" [19].

3) Personality

Third, the roller has a personality which the child can give it based on how it moves through the play space. If it likes to hide in the corner the child might think it is shy. Granott and Resnick have explored how very simple behaviors in computational objects can be interpreted as complex character traits and feelings [8].

4) Personality and Interactivity: Same or different?

Fourth, the object can respond to specific actions of a child with specifically programmed reactions. At a certain distance, it can be a follower. At another it might ignore the child. The specific interactions must relate to particular play scenarios and serve to engage children in different activities over time as they explore their playground. The play scenarios will be drawn from a deep reflection as a designer and observer of children's play patterns. These play scenarios should create a reciprocal relationship between the child and the object. In other words, sometimes the child leads the exploration and sometimes the object does through its ability to traverse a space.

Early Prototype

An initial rolling wheel (16" diameter) demonstrates the first three characteristics described here (see figure 2). Though the prototype is not fully functional at this stage, it rolls autonomously. The pneumatic elements provide an interesting cue for notions of animacy. And finally, the treaded exterior leaves traces in the ground (especially the snow) which hints at a personality.

The three-dimensional context can provide an important cue for psychological and physical explanations for an autonomous object's movement. Leaving a trace on the ground provides a record for the child and encourages "drawing with the whole body". The tracks in the snow shown in figure 3 are an example of this manifestation which enriches the continuum of meaning of physically active, full-body play.

In a next step, the object should be enabled to respond to children's presence and engage them in reciprocal play, though the child is the driver of the interaction. Additional sensors on the object and in the hands of the children would be needed to enable certain responses. The implementation should be contingent on the interaction patterns for the most enriching outdoor explorations.

In exploring the interaction patterns with such an autonomous device, the stages of interaction should be considered in future implementations. While the child may be interested in the object as such in the beginning, questions of how the motion is generated and what experiments it might enable should arise. If the object is truly successful it should enable a rotation in play styles and explorations.

Figure 2. Initial wheel space explorer placed in the snow to illustrate the powerful relationship between object and ground. Children are connected to the space directly through their presence in it and the intangible links to the object.

CONCLUSION

An ecological approach to designing children's animated play props yields rich design directions. Building on previous attempts to develop innovative technologies for children's play, this method explicitly introduces the role of outdoor play environments in children's experiences of the world. Future work should address this aspect of children's play and develop more props that enrich the open-ended and full-body experience of playing outdoors.

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